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Factors associated with primary medication non-adherence and its effect on health service utilization among Medicare beneficiaries with cardiovascular disease

Nilesh Gangan
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A Thesis

entitled

Factors associated with Primary Medication Non-adherence and its effect on Health
Service Utilization among Medicare Beneficiaries with Cardiovascular disease

by

Nilesh Gangan

Submitted to the Graduate Faculty as partial fulfillment of the requirements for the
Master of Science Degree in Pharmaceutical Science

Dr. Varun Vaidya, Committee Chair

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The University of Toledo

December 2013

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An Abstract of
Factors associated with Primary Medication Non-adherence and its effect on Health
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Medication non-adherence is commonly seen among patients with cardiovascular disease. However, failure to fill prescriptions, a type of medication non-adherence, is rarely studied among these patients. Failure to fill prescriptions, also known as primary medication non-adherence (PMN), can lead to progression of disease condition and adverse outcomes which can ultimately increase healthcare costs. Therefore, it is important for patients, especially who are newly diagnosed with cardiovascular disease to fill their prescriptions. The incidence of cardiovascular disease is higher in elderly population. Hence, elderly population is susceptible to PMN, but little is known about the extent of PMN for this population and its impact on health service utilization. Recent healthcare reform emphasizes on giving high quality care to elderly patients with chronic conditions such as cardiovascular disease. Since medication adherence is a quality measure for healthcare service received by this population, efforts should be made in identifying ways to improve PMN. Hence, the objective of this study is to measure the rate of PMN, assess reasons and factors that are associated with PMN and compare health service utilization behavior between adherent and non-adherent Medicare covered elderly population with newly diagnosed cardiovascular disease.

This was a cross-sectional cohort study of Medicare beneficiaries with newly diagnosed cardiovascular disease using Medicare Current beneficiaries Survey (MCBS) files from 2002 to 2006. Andersen's model of health service utilization was used as a theoretical framework to define factors that may be associated with PMN. Seven thousand five hundred and forty-two Medicare beneficiaries were newly diagnosed with cardiovascular disease from years 2002 to 2006. Out of these, 334 patients did not fill prescriptions which represented 4.43% of the cohort under study. Female gender (OR 0.682, 95% CI 0.522-0.890), lower patient satisfaction score on overall health service (OR 1.074, 95% CI 1.040-1.109), low Charlson comorbidity score (OR 1.074, 95% CI 1.000-1.155) and higher cardiovascular burden (OR 1.248, 95% CI 1.122-1.388) was significantly associated with PMN. The most common reasons given by the patient for PMN were related to enabling factors and personal perceptions. Non-adherent patients had lesser physician visits ($p < 0.0001$) and outpatient visits ($p < 0.0001$) but higher ER visits ($p < 0.0001$) and hospitalizations ($p < 0.0001$) than adherent patients.

Many patients failed to fill their prescriptions showing PMN among the study population. PMN was particularly significant in females, patients having low satisfaction with health service received, patients with low Charlson comorbidity score and patients with higher number of cardiovascular conditions. With the recent healthcare reform targeted at improving overall quality of care, findings from present study provide guidance towards identifying populations vulnerable to PMN. PMN is a much severe issue especially in case of chronic conditions such as cardiovascular diseases than the secondary adherence. A comprehensive approach involving physician-pharmacists collaborations could lead to develop interventions such as appropriate counseling designed to eliminate PMN. Future

research should focus on identifying more factors leading to causality of PMN and devise strategies to reduce prevalence of PMN.

I dedicate this thesis to...

Mom and Dad for their love and constant support,

Sister for providing motivation and encouragement to pursue my dreams,

Almighty God for giving me a blessed life.

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List of Abbreviations

CHD.....	Coronary Heart Disease
CI.....	Confidence Interval
CMS.....	Center for Medicare and Medicaid Services
ER.....	Emergency Room
IQR.....	Inpatient Quality Reporting
MCBS.....	Medicare Current Beneficiaries Survey
MPR.....	Medication Possession Ratio
OPD.....	Outpatient Department
OR.....	Odds Ratio
OQR.....	Outpatient Quality Reporting
PDC.....	Proportion of Days Covered
PMN.....	Primary Medication Non-adherence
PQRS.....	Physician Quality Reporting System
US.....	United States

Chapter 1

Introduction

1.1 Cardiovascular diseases

Chronic diseases, as defined by U.S. National Center for Health Statistics, are the ones that last for three or more months. The prevalence of chronic disease conditions such as heart diseases, cancer, diabetes, stroke and arthritis in the United States cannot be overlooked. In 2005, approximately 133 million Americans – almost 1 out of every 2 adults – had at least one chronic illness.¹ Chronic diseases are also the most common causes of deaths and disability, 7 out of 10 deaths among Americans each year occur as a result of chronic diseases.² Hence, chronic diseases present a great burden on the US healthcare system.

Cardiovascular diseases (CVDs) are the most common among the chronic diseases. Diseases like coronary heart disease, arteriosclerosis, high blood pressure, congestive heart failure and stroke have higher incidences than some of the other chronic diseases. More than 83 million i.e. 1 of 3 American adults suffer from some form of cardiovascular disease.³ CVDs are the leading cause of morbidity and mortality in the United States. They are responsible for causing one-third i.e. 33.6% of all deaths in the country.³ Heart disease and stroke also are among the leading causes of disability in the United States, with nearly 4 million people reporting disability from these causes.³

Given the prevalence and morbidity associated with CVDs, they lead to greater resource utilization and increase the burden of health care costs on policy makers, employers and patients. In 2008, 105 million visits to physician offices, hospital outpatient and emergency departments accounted through heart disease.^{4,5} In 2010, the estimated total costs of cardiovascular disease for US healthcare system were \$503.2 billion, out of which \$324.1 billion were direct costs which include the cost of physicians and other professionals, hospital and nursing home services, prescribed medications, home health care, and other medical durables.⁶ The indirect costs of cardiovascular disease were \$179.1 billion which include expenses due to lost productivity resulting from morbidity and mortality.⁶ If the break-up among the forms of cardiovascular disease are to be seen, the estimated direct and indirect costs in 2010 for Coronary Heart disease were \$108.9 billion, for Hypertensive disease were \$93.5 billion, for Stroke were \$53.9 billion and for Congestive Heart Failure were \$34.4 billion.⁷ Treatment of these diseases accounts for about \$1 of every \$6 spent on health care in the US.³ Therefore, researchers should strive to determine the possible reasons behind high healthcare utilization and costs among CVD patients.

1.2 Elderly population

Discovery of medicines for different conditions and availability of high quality care has contributed to increased longevity of the US population. Moreover, the Baby Boomer generation is aging and entering in the older age group. As a result, population among the older age group is bound to increase in coming years. The incidence and prevalence of cardiovascular disease has been seen to be more in elderly population. Out

of the 80 million Americans suffering from cardiovascular disease, 38 million are estimated to be 60 years or older.⁸ The incidence of a cardiovascular event in the age group of 65-74 years among men was found to be 34 per 1000 persons while among women; it was 20 per 1000 persons which was double the incidence rate found among men and women in the 45-64 years age group.⁸ Thus, this high risk population should have regular screenings for early diagnosis of cardiovascular disease. It is also important for those who are newly diagnosed with cardiovascular disease to utilize necessary health service, fill their prescriptions and initiate their treatment on time. Insurance coverage such as Medicare is available for this population in order to ease the cost burden related health service utilization. However, efforts should be made to ensure that these services are utilized by this population.

1.3 Medicare population

Populations aged 65 years and above are eligible for Medicare coverage in the US if they have worked for at least 10 years in Medicare-covered employment. Medicare covers hospital and related services that include inpatient care, skilled nursing facility care, hospice care, home health care and medical services such as doctor or other healthcare provider services, outpatient care, durable medical equipment and preventive services. This decreases the cost burden of the elderly population. With the introduction of Medicare part D in 2006, the insurance coverage was extended to include prescription drugs as well in order to motivate patients to take prescription medications as recommended. Thus, one might expect that this would motivate the Medicare population with chronic conditions such as cardiovascular disease to make appropriate use of this

insurance coverage. However, according to recent findings, a significant number of the elderly population suffer from cardiovascular disease even after Medicare coverage which suggests that there are factors other than cost of care that are preventing them from utilizing health services.

1.4 Medication adherence

Filling of prescription drugs is one way of utilizing healthcare service given by pharmacy. Improvement in patient outcomes among elderly population with cardiovascular disease can be achieved by filling the appropriate medications from the pharmacy and initiating them on time. Filling of prescriptions is the first step towards medication adherence. Medication adherence is defined by the World Health Organization as ‘the extent to which patients take their medications as prescribed by health care providers’.⁹ Medication adherence can improve patients’ condition and bring about favorable outcomes such as improvement in clinical endpoints, reduced unnecessary healthcare service utilization and costs. However, medication non-adherence is a significant health problem as many patients fail to adhere to their treatment.¹⁰ It can have serious consequences as it leads to worsening of disease condition.¹¹ The most common forms of medication non-adherence are failure to fill a prescription, taking incorrect doses, missing certain doses, taking medication at the wrong time and stopping the medication sooner than prescribed.¹² Medication non-adherence is of a concern particularly in the Medicare population because of beneficiaries’ relative high rates of chronic illness which involves heavy medication usage.¹³ Heavy medication usage makes them susceptible to non-adherence.

There are many ways to measure the rate of adherence to medication. The most commonly used measures for calculating the rate of medication adherence are through patient claims by Medication Possession Ratio (MPR) and Proportion of Days Covered (PDC).¹⁴ The rate of medication adherence is also measured through patients' responses to surveys. Rate of medication non-adherence in the elderly population is found to be in the range of 29-56% as calculated by MPR.¹⁵ A study has shown that medication non-adherence is responsible for 11% of all hospital admissions of the elderly population.¹⁶ Thus, medication non-adherence worsens patient outcomes and increases the cost burden on the patient and their employer. Also, it was found that medication non-adherence increases the risk of cardiovascular disease among elderly population.¹⁷ This suggests that medication non-adherence might be a major problem behind progression of cardiovascular disease in newly diagnosed elderly population and efforts needs to be made to further investigate this problem.

1.5 Primary medication non-adherence

Medication non-adherence can be classified into primary medication non-adherence and secondary medication non-adherence. Primary medication non-adherence (PMN) is a term given to a behavior where a patient absolutely fails to fill a prescription. Secondary medication non-adherence refers to not following recommendations after filling of prescriptions and includes non-persistence and non-conforming behavior. Non-persistence is when a patient stops taking a medication without being advised so by the healthcare professional. Non-conforming behavior is when a patient takes the medication irregularly, at incorrect times or skips doses. PMN is the first step that shows patients'

attitude towards taking prescribed medication and can lead to timely initiation of medications. PMN is measured by dividing the prescriptions that were never filled by the total prescriptions issued.¹⁸ PMN is important for treating chronic conditions as it ensures that patients have started the medications. Hence, PMN is the first marker that may decide patient outcomes, quality of life, health care utilization and health care costs in newly diagnosed patients as compared to other forms of medication non-adherence. PMN has been found to be 5-20% among all primary care prescriptions.¹⁹⁻²³ Studies have also shown that for chronic conditions, the rate of PMN is in the range of 13-22%.²⁴⁻²⁶ The rate of PMN is also high in the elderly population. An estimated 1.6 million Medicare beneficiaries failed to fill prescriptions in 2004. Out of these Medicare beneficiaries who failed to fill prescriptions, the majority were suffering from chronic conditions.²⁷ Among, the chronic conditions, Medicare beneficiaries with cardiovascular disease had high rates of failure to fill prescriptions.²⁷ This suggest that PMN is one of the major contributing factors to higher prevalence of CVD among elderly Medicare population and further research needs to be done in this area.

The importance of primary medication adherence among Medicare beneficiaries with cardiovascular diseases is eminent as it gives an assurance of medication initiation. Patient outcomes and disease progression largely depend on primary medication adherence. However, research lacks information on the prevalence of PMN among newly diagnosed Medicare beneficiaries with cardiovascular disease and its effect on health service utilization. Further research needs to be done on the rate of failure to fill prescriptions in Medicare beneficiaries with newly diagnosed cardiovascular disease. With the recent healthcare reform, healthcare providers in the future may be evaluated

based on quality measures for value based payments. Medication adherence is one of the aspects that define the quality provided by healthcare providers. Hence, it would also be beneficial to learn about factors other than costs that lead to PMN to help healthcare providers target specific population that are vulnerable to PMN. Other studies assessing the factors leading to PMN have shown that age, co-pays, number of medications, insurance status, income, co-morbidities, pharmacy location, clinical values, gender, perceived health status, patient knowledge of service benefits, patient satisfaction with health service and type of disease condition are associated with PMN.²⁴⁻³¹ However, factors predicting PMN in Medicare beneficiaries with newly diagnosed cardiovascular disease have not yet been studied.

The factors that may predict the behavior of PMN may best be studied by using the Andersen's model of health services utilization. Andersen's model provides the appropriate framework to explain the predisposing, enabling and need-based factors related to PMN and a predictive model can be built accordingly.^{32,33} This model has been used in past in many studies in order to learn about factors that lead to a health service utilization.³⁴⁻³⁶ Also, knowing the reasons behind not filling prescriptions will give a clear idea about why PMN is prevalent in newly diagnosed cardiovascular patients. Additionally, research is scarce on the immediate effect of PMN on health service utilization such as emergency room visits, hospitalizations, outpatient visits and physician visits. Hence, the overall objective of this study is to measure the rate of PMN, assess which of the factors identified through Andersen's model of health service utilization predict PMN in Medicare beneficiaries with newly diagnosed cardiovascular disease, to determine reasons behind PMN and compare the health service utilization pattern

between PMN and primary medication adherent patients. Through this study the following research questions will be answered:

- To what extent is PMN observed in Medicare beneficiaries with newly diagnosed cardiovascular disease?
- Which factors identified through Andersen's model of healthcare utilization are significant predictors of PMN?
- What are the reasons given by Medicare beneficiaries with cardiovascular disease for being non-adherent to filling prescriptions?
- Do Primary medication non-adherent and adherent Medicare beneficiaries differ in outpatient visits, hospitalizations, physician visits and ER visits?

1.6 Need for study

Most of the previous studies on medication non-adherence have been focused on evaluating adherence to dosage regimen in patients who have filled their first prescription (Secondary medication non-adherence). Only a handful of studies have concentrated on PMN and its impact on disease outcomes. Research on PMN is limited by difficulty in measuring the fill rates of initial prescriptions due to lack of prescription claims generated. One of the methods for measuring PMN involves the use of electronic prescribing systems which have not yet been adopted by most physicians. Moreover, prescription filling becomes difficult to track when patients do not fill their prescriptions. Despite these shortcomings, most of the studies have measured PMN by combining electronic prescriptions with pharmacy claims files.^{18,24-26,30,31,37} These studies on PMN using electronic prescriptions cover only few patients and hence cannot be generalized to

patients that were not prescribed medications through electronic prescribing. Only three studies have used comparatively uncomplicated and inexpensive patient reports via surveys for studying PMN which can capture the trends in general population.²⁷⁻²⁹ Surveys can also overcome the shortcomings associated with the use of electronic prescribing system for measuring PMN. Hence, there is a need to study PMN using survey methods that would give generalizable findings.

Primary Medication Non-adherence (PMN) is a risk factor that can lead to further worsening of cardiovascular disease in elderly population. Progression of cardiovascular disease may increase the healthcare service utilization for these patients which increases the cost burden on the US healthcare system. However, the extent of this problem in Medicare beneficiaries with cardiovascular disease is yet to be studied. Previous studies on this topic have shown that Medicare beneficiaries with cardiovascular disease are susceptible to PMN²⁷, however no study has evaluated the extent to which there is PMN. Through this study, researchers are hoping to determine the prevalence of PMN in Medicare beneficiaries with cardiovascular disease using previously administered survey data.

There is a need to identify factors that prevent Medicare beneficiaries to fill their first prescription to understand the behavior of PMN. Medication non-adherence including PMN is an important measure that defines the quality of care received by the patients. CMS evaluates healthcare providers based on quality measure and their performance. Therefore, it is important for the healthcare providers to know about the factors that lead to PMN to give appropriate interventions to vulnerable populations. Existing literature on PMN especially among Medicare patients is scarce. Few studies

have identified factors associated with PMN which are of particular importance for the healthcare providers, policy makers and employers as PMN can lead to undesirable outcomes. Moreover, as per researchers' knowledge, factors leading to PMN among Medicare beneficiaries with cardiovascular disease are not yet studied. The present study will identify the predictors of PMN among Medicare beneficiaries with cardiovascular disease by using variables that can be defined through Andersen's model of health service utilization.

The utilization behaviors of patients who do not fill their prescriptions have been rarely studied. Only one previous study has shown the effect of PMN on mortality.²⁴ The health service utilization behavior such as emergency room visits, hospitalizations, outpatient visits and physician visits among PMN patients has not been studied. The present study will compare the health service utilization between adherent and non-adherent patients.

1.7 Significance of the study

In this study, the extent of PMN in Medicare beneficiaries with newly diagnosed cardiovascular disease will be calculated. Additionally, the factors identified through Andersen's model of health service utilization that predict PMN will be determined. The determination of adherence rate and identifying factors will fill the gap in literature that currently exists in research related to PMN. It will add to the literature on PMN which altogether can inform the extent of this problem to physicians and help them understand the intricate causes of PMN. After referring to the studies on PMN, health care providers can design their interventions, targeting groups with specific characteristics in order to

reduce this problem. These interventions can include patient education, patient follow-up and motivating patients.

Research has shown that cost is an important factor that determines PMN which might have been partly addressed by the introduction of Medicare Part D. However PMN still exists, which indicates that there are factors other than cost that predict PMN. This study will help understand factors other than cost that are responsible for the behavior of PMN. Understanding of factors will give a head start to healthcare providers as to which factors to focus on to improve PMN and in turn the quality of care. Additionally, it will also help to understand whether patients that are non-adherent have more outpatient visits, hospitalizations, ER visits and physician visits as compared to adherent patients.

1.8 Goal

To assess the factors associated with primary medication non-adherence and determine the health service utilization behavior among Medicare beneficiaries with cardiovascular disease.

1.9 Specific Aims

- 1) To measure the extent of Primary medication non-adherence in Medicare beneficiaries with cardiovascular disease.
 - Hypothesis: Primary medication non-adherence is high in Medicare beneficiaries with cardiovascular disease.

- 2) To determine factors that predict primary medication non-adherence among Medicare beneficiaries with cardiovascular disease based on Anderson's model of healthcare utilization.
 - Hypothesis: Factors identified through Andersen's model of healthcare utilization are significant predictors of PMN.
- 3) To determine reasons behind PMN among Medicare beneficiaries with cardiovascular disease.
- 4) To compare ER visits, hospitalizations, outpatient visits and physician visits between primary medication non-adherent and adherent Medicare beneficiaries with cardiovascular disease.
 - Hypothesis: Primary medication non-adherent and adherent Medicare beneficiaries differ in their ER visits, hospitalizations, outpatient visits and physician visits.

Chapter 2

Literature review

This chapter gives a brief description of relevant topics related to the study and covers a review of literature. This chapter is composed of following subtopics:

- (1) Cardiovascular disease,
- (2) Elderly population with cardiovascular disease,
- (3) Medicare insurance,
- (4) Medication adherence,
- (5) Types of non-adherence and its measures,
- (6) Medication non-adherence in elderly,
- (7) Primary Medication non-adherence,
- (8) Reasons for primary medication non-adherence, and
- (9) Factors affecting primary medication adherence.

2.1 Cardiovascular disease

Cardiovascular diseases affect many people throughout the world. In United States, there are about 83 million people suffering from different forms of cardiovascular diseases.³ Cardiovascular diseases involve conditions of the heart and blood vessels. Coronary heart disease (CHD) which includes myocardial infarction and angina pectoris,

arteriosclerosis, high blood pressure, stroke, atrial fibrillation and congestive heart failure are the conditions that constitute the diseases of heart and blood vessels.⁸ CHD occurs when arteries carrying blood in the heart become partially blocked. CHD is the number one killer of both men and women in United States.³⁸ Angina pectoris and Myocardial infarction are forms of CHD. Angina pectoris is chest pain that occurs due to poor blood flow through the vessels of the heart. Myocardial infarction occurs when blood flowing to a part of the heart stops completely leading to damaged cells³⁸. Arteriosclerosis is a condition where the blood vessels in different body parts get partially blocked.³⁸ High blood pressure is a condition in which the force of the blood against the walls of the arteries is high. This high force is due to higher resistance of the walls of the arteries. High blood pressure is a risk factor that can lead to angina pectoris and myocardial infarction.³⁸ Congestive heart failure is a condition in which the heart cannot pump enough blood to the rest of the body. All these conditions can be controlled by initiating appropriate medications on time and continue taking them regularly.

Cardiovascular diseases are the leading cause of deaths and disabilities. Around 33.6% of all deaths in the country are due to cardiovascular disease.³ Heart disease and stroke also are among the leading causes of disability in the United States, with nearly 4 million people reporting disability from these causes.³ In 2010, the estimated total costs of cardiovascular disease were \$503.2 billion.⁶

2.2 Elderly population with cardiovascular disease

A large proportion of the older population in the United States suffers from cardiovascular disease. About 38 million Americans of age 60 and above are suffering

from cardiovascular disease.⁸ Hypertension and CHD is the most prevalent conditions among this population.³⁹ The incidence of a cardiovascular event in the age group of 65-74 among men was found to be 34 per 1000 persons while among women; it was 20 per 1000 persons.⁸ Moreover 85% of those who die of CHD are 65 years and older.⁴⁰ Since the mid-1980s, there has been a concern that increased longevity and the aging of the Baby Boom generation will result not only in a larger elderly population, but also in an increased prevalence of chronic condition in this population. Increased survival could mean more years of suffering and higher long term care and other medical costs. The elderly population can thus contribute greatly to health care utilization and cost.

2.3 Medicare insurance

The population group of 65 years and above is automatically eligible for Medicare insurance coverage if they have worked for at least 10 years in Medicare-covered employment. Medicare insurance helps cover a number of hospital or related services including inpatient care, skilled nursing facility care, hospice care and home health care. Medicare also covers medical related services such as doctor or other healthcare provider services, outpatient care, durable medical equipment and preventive services. This provides a great incentive for the elderly population to utilize the covered services. This is especially advantageous in case of patients with chronic conditions as these patients can sometimes require surgeries and prolonged hospital stays which can be very costly. Studies on satisfaction of Medicare coverage has shown favorable outcome. A study done by Davis *et al*¹⁰ showed that patients with Medicare coverage are more satisfied with their insurance than those with their employer coverage. The study also showed that 85%

of patients with Medicare insurance are satisfied with the coverage. Higher patient satisfaction will lead to optimal utilization of services and improve clinical outcomes.

2.4 Medication Adherence

One aspect that is of increasing concern among the elderly population is that of Medication Adherence. Medication adherence is defined by the World Health Organization as the extent to which a person's behavior i.e. taking medications corresponds with agreed recommendations from a health care provider.⁹ It is of utmost importance as it decides the clinical outcome of a prescribed drug regimen and costs of care. In a study by Munger *et al*¹⁷ on elderly patients with cardiovascular disease in Medicaid programs, only 20% of patients showed good adherence. Medication non-adherence is when patients do not take their medications as prescribed or discontinue taking medications. The most common forms of medication non-adherence are failure to fill a prescription, taking incorrect doses, missing certain doses, taking medication at the wrong time and stopping the medication sooner than prescribed.¹² Medication non-adherence is approximately 50%, on average, for common chronic conditions.^{41,42} Medication non-adherence is likely to grow as the US population ages and as patients take more medications to treat chronic conditions. Medication non-adherence is a growing concern to clinicians and healthcare systems because of its prevalent and associated with adverse outcomes and higher costs of care. According to a study, medication non-adherence is responsible for 11% of hospital admissions and 40% of nursing home admissions annually.¹⁶ The direct costs of medication non-adherence in the United States at a minimum of \$100 billion.⁴³

2.5 Types of non-adherence and its measures

Non-adherence can be classified into three types: primary non-adherence, non-persistence and non-conforming. Primary non-adherence is when a patient completely fails to fill a prescription. Non-persistence is when a patient fills the prescription but stops it after some time without being advised by a health professional to do so.⁴⁴ A patient is non-conforming when the medications are not taken as prescribed by skipping doses, taking medications at incorrect times or taking incorrect doses.⁴⁴ Medication non-adherence can be measured in many ways. The commonly used methods for measuring adherence are patient self-report, measuring physiological markers, pill count, use of electronic monitoring devices, prescription record review, and ascertaining rates of refilling prescription. Medication adherence is also measured through the use of administrative claims database.⁴⁵ In such studies, the rate of medication adherence is mostly calculated either by Medication possession ratio (MPR) or Proportion of Days Covered (PDC). MPR is calculated by dividing the number of days' supply during the observation period by the number of days in the observation period while PDC is calculated by dividing the number of days' supply by the total treatment duration.¹⁴

2.6 Medication non-adherence in elderly

The effects of medication non-adherence in the elderly population are profound. The estimated rate of adherence ranges from 26-59% in people aged greater than 60 years.¹⁵ Col *et al*⁴² interviewed 315 patients greater than equal to 65 years of age upon hospital admission. Out of them, 11% of admissions were as a result of non-adherence. One-third of these elder patients gave a self-admitted history of non-adherence.

Economic factors and adverse effects were the most commonly cited reasons for non-adherence leading to hospitalization. In a more recent study of elderly patients greater than 75 years of age, non-adherence, omission and cessation of drug therapy collectively accounted for 26% of hospital admissions.⁴⁶ An estimated 40-45% of elderly individuals are unable to take their medications as prescribed.⁴⁷ Low medication adherence is increasingly recognized as a dominant feature in elderly patients.

2.7 Primary Medication Non-adherence

Primary medication adherence is an important behavior as timely initiation of medications is necessary to treat any condition. Starting the treatment soon after doctor prescribes a medication, can suppress or eliminate the disease condition and contribute to the well-being of the patient. However, not starting the treatment on time will worsen the disease condition that can lead to avoidable consequences like high health care utilization and costs. Hence research on PMN has been of interest to providers and health policy makers in order to develop and implement interventions to decrease it.

Previous research has used electronic prescribing systems and surveys in order to measure the rate of PMN. Electronic prescribing system is a program that records a prescription given to the patient which is merged with claims data to measure PMN. In surveys, patients are asked to give an account of whether they have not filled any prescription and non-adherence is calculated accordingly. Most of the studies on PMN have used electronic prescribing system^{18,24-26,30,31,37} while only three studies have used surveys²⁷⁻²⁹.

In PMN studies that used surveys, the extent of PMN was calculated by dividing number of people being non-adherent by the total number of people to whom medication was prescribed. Esposito *et al*²⁸, carried out telephonic survey of military health system beneficiaries and found that 8% reported failure to claim prescription during the prior 12 months. Kennedy *et al*²⁷ carried out a secondary analysis of the 2004 Medicare Current Beneficiary Survey and found that an estimated 1.6 million beneficiaries failed to fill one or more prescriptions. Wroth *et al*²⁹ used telephone survey data from adults in rural counties of eight different states. Results showed 21.6% of respondents did not fill prescriptions over the accounted time period.

Other studies on PMN used electronic prescription systems to measure the rate of non-adherence. Here the rate of PMN is calculated by taking the percent of the number of prescriptions unclaimed divided by total number of prescriptions. The estimated rate of non-adherence in these studies ranged from 2.4-28%. Although the range is huge, this rate is still considered to be high.

2.8 Reasons for primary medication non-adherence

The reasons associated with PMN are dependent on patients and hence vary. The most common reasons for failure to fill prescriptions according to a study done on Medicare beneficiaries were high cost, patients did not think the medications were necessary, medications not covered by insurance and patients were afraid of drug reactions.²⁷ Another study done in Military health systems found the reasons for non-adherence as no perceived need for prescriptions, forgetfulness, and long wait time in pharmacy and prescription not in stock in pharmacy. Balkrishnan⁴⁸ classified these

reasons in five categories: medication, behavioral, economic, medical and demographic. The knowledge of reasons for primary medication non-adherence will help health care professionals to identify interventions to decrease the non-adherence problem.

2.9 Factors affecting primary medication adherence

This section gives a review of all the studies done on factors associated with PMN. In all, ten studies have looked at the factors that affect PMN. Fischer and colleagues¹⁸ studied the predictors of PMN by using e-prescribing data. Age, formulary status of medications and place of residence classified as per income were significantly associated with non-adherence.

Kennedy and colleagues²⁷ examined the characteristics of Medicare beneficiaries who failed to fill the prescriptions. Variables were obtained through secondary analysis of the 2004 Medicare Current Beneficiary Survey (MCBS). They found that rates of failure to fill were higher among Medicare beneficiaries aged 18 to 64 years eligible through Social Security Disability Insurance than among beneficiaries aged 65 years or older, were higher for women than for men, non-whites than whites, for dually eligible Medicaid beneficiaries than those who did not have Medicaid coverage and in patients with psychiatric conditions followed by cardiovascular disease.

Esposito and colleagues²⁸ examined the factors that contribute to unclaimed prescriptions in patients. A telephone survey was administered to Military Health system beneficiaries which covered background characteristics, medical conditions and unclaimed prescriptions. They found that younger age, active duty military status, lower

educational levels and the absence of certain chronic medical conditions were some of the factors associated with unclaimed prescriptions.

Lagu and colleagues³¹ assessed the association of co-morbidity type with filling an antihypertensive prescription. They found that 50 years or younger patients with five or more non-cardiovascular co-morbidities were likely to fill their prescriptions and presence of cardiovascular co-morbidities was not associated with filling of an antihypertensive prescription. In a study assessing factors associated with first-fill adherence rates for diabetic medications, Shah and colleagues²⁴ found out that co-pays less than \$10 and baseline A1c more than 9% were associated with improved first fill rates while age, sex and co-morbidity score had no association.

Fischer and colleagues²⁶ in an analysis of 195,930 Electronic prescriptions found that medication class was the strongest predictor of adherence. Medications for chronic conditions including hypertension, diabetes and hyperlipidemia were less likely to be filled for all prescriptions and especially when it is newly prescribed. Cooke and colleagues³⁰ carried out a retrospective study that reviewed claims from a Mid-Atlantic managed care organization. They found that new diagnosis of hypertension, new anti-hypertensive agent, higher co-payment and enrollment in a health maintenance organization or preferred provider organization were significant factors associated with first-fill failure.

In a study done on patients with hypertension, Shah and colleagues²⁵ found that sex, age, therapeutic class, number of other medications prescribed within 10 days of the antihypertensive prescription, number of refills, co-pay, co-morbidity score, baseline blood pressure and change in BP were significantly associated with first-fill rates.

Jackevicius and colleagues⁴⁹ found that younger age, low income, discharge medication counseling, in-hospital attending cardiologist and fewer medications before Acute Myocardial Infarction episode are factors that predict Primary Non-adherence after Acute Myocardial Infarction. In a study done by Wroth and colleagues²⁹ on adults in 150 rural counties, age, gender, race, income, health status, transportation and patient satisfaction were associated with PMN.

2.10 Summary

The prevalence and incidence of cardiovascular diseases are high in elderly population. Cardiovascular diseases are also the leading cause of death. Primary Medication Adherence is necessary for timely initiation of therapy to improve patients' health condition. Elderly patients with cardiovascular disease are especially susceptible to PMN. PMN can lead to further worsening of disease condition which may reduce patients' quality of life, increase health care utilization and health care costs. Thus, it is important to determine PMN in Medicare patients with cardiovascular disease and factors associated with it. Currently, no study has measured the extent of PMN in Medicare beneficiaries with cardiovascular disease and identified factors associated with PMN. This study will bridge this gap in the literature.

Chapter 3

Methods

This chapter gives a description of the methodology used in the study. The methodology is based on the goal of the study. This chapter covers the following topics:

- (1) Study design,
- (2) Data source,
- (3) Patient selection,
- (4) Exclusion criteria,
- (5) PMN,
- (6) Study variables and
- (7) Data analysis.

3.1 Study Design

This was a retrospective, cross-sectional study using a secondary database for obtaining information about study variables. Patient inclusion criteria were delineated to identify patients with newly diagnosed cardiovascular disease. Five years of data from 2002 to 2006 was used to identify patients from Medicare Current Beneficiaries Survey (MCBS) database, a secondary database that was used for the purpose of this study.

3.2 Data Source

The Medicare Current Beneficiaries Survey (MCBS) containing five years data from 2002 to 2006 was acquired by the researchers from the Center for Medicare and Medicaid services. The MCBS is a longitudinal panel survey of the Medicare patients. The survey is administered each year since its inception in 1991. The Center for Strategic Planning of the Centers for Medicare and Medicaid Services (CMS) is responsible for conducting the survey. The CMS spends \$14.8 million every year to administer the survey. The purpose of the survey is to determine healthcare use, costs and sources of payments for all services used by Medicare Beneficiaries which includes co-payments, deductibles, and non-covered services. It also helps to generate reliable and current information on the use and cost of services not covered by Medicare and monitors the financial effects of changes in the Medicare program. Additionally, it provides information on the characteristics of the Medicare population and their access to and satisfaction with Medicare services. The collected information can be used to inform, manage and evaluate health policies for the Medicare program and help formulate future changes.

The Medicare beneficiaries are selected for the purpose of administering the survey through a three-stage process. The first stage is the selection of primary sampling units where certain metropolitan statistical areas, cluster of counties or major geographic areas that represent the nation are selected. In the second stage, zip code cluster within the primary sampling units are selected and in the third and final stage Medicare beneficiaries within the zip code areas are identified. MCBS uses a rotating panel sample design where the sampled Medicare beneficiaries are surveyed thrice annually in Fall, Winter and Summer for four years. Each year of MCBS data contains four overlapping

sample panels where a new panel is introduced in each Fall round of interviews and a panel that has been interviewed for four years retires in Summer round. For example, if we introduce a new panel in 2002, its first interview will be in Fall 2002. A total of 12 interviews will be conducted on this panel over a period of four years when ultimately in Summer 2006 the panel will give its final interview and retire. If we look at a particular year for example, say 2002, that year will have four overlapping panels which consist of a new panel, a panel in its second year of interview, a panel in its third year of interview and a last panel in its final year of interview. This design is diagrammatically shown in Table 1.

The survey administered in Fall, Spring and Summer session of interviews are different. The survey administered in Fall covers demographics, health status and functioning, insurance, access to care and satisfaction with care. The survey administered in winter asks about beneficiary knowledge. The survey administered in summer asks information on prescription drugs. The same strategy is followed each year for administration of survey.

Table 1: Rotating panel sample design

	2002			2003			2004			2005			2006			2007		
	W	Su	F															
Panel 1			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
Panel 2						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Panel 3									✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Panel 4													✓	✓	✓	✓	✓	✓

Key: W-Winter, Su-Summer, F-Fall

3.3 Patient selection

Patients that were included in the analysis were Medicare beneficiaries 65 years and older with a new diagnosis of cardiovascular diseases. The conditions that constituted cardiovascular diseases for this study were hypertension, arteriosclerosis, myocardial infarction, angina pectoris, congestive heart failure, arrhythmia and stroke. The conditions were selected according to the classification of cardiovascular disease given by the National Heart, Lung and Blood Institute. Since hypertension, arteriosclerosis, myocardial infarction, angina pectoris, congestive heart failure and stroke constitute the majority of cardiovascular diseases, all Medicare beneficiaries with these conditions were considered to have cardiovascular disease. Medicare beneficiaries with cardiovascular disease were identified by their response to following questions on the survey:

- Has a doctor told you that you had hardening of the arteries or arteriosclerosis?
- Has a doctor told you that you have hypertension, sometimes called high blood pressure?
- Has a doctor told you that you had a myocardial infarction or heart attack?
- Has a doctor told you that you had (a new episode of) angina pectoris or coronary heart disease?
- Has a doctor told you that you had congestive heart failure?
- Has a doctor told you that you had a stroke, a brain hemorrhage or a cerebrovascular accident?

The Medicare beneficiaries that responded 'YES' to the above questions were considered to have cardiovascular disease.

Out of the total cardiovascular patients, those having the condition since the previous year were identified by their response to the following questions on the survey:

- Since a year ago, did you have hypertension or high blood pressure?
- Since a year ago, did you have myocardial infarction or heart attack?
- Since a year ago, did you have angina pectoris or coronary heart disease?
- Since a year ago, did you have congestive heart failure?
- Since a year ago, did you have stroke?
- Since a year ago, did you have problems with heart rhythm?

If the beneficiaries responded ‘YES’, they were not considered as newly diagnosed cardiovascular patients. These patients having cardiovascular disease since the previous year were eliminated from the total sample of Medicare beneficiaries having cardiovascular disease to get a final sample of Medicare beneficiaries with newly diagnosed cardiovascular disease needed for the study.

3.4 Exclusion criteria

As the study focused on Medicare beneficiaries aged 65 years and above, other Medicare beneficiaries aged 18 to 64 years, eligible through Social Security Disability Insurance and dually eligible Medicaid and Medicare beneficiaries were excluded from the final sample. The sampled out Medicare beneficiaries should have responded to questions on the beneficiaries’ survey that are of interest for the study. Medicare beneficiaries that have not responded to any of the questions of interest were excluded for the purpose of analysis.

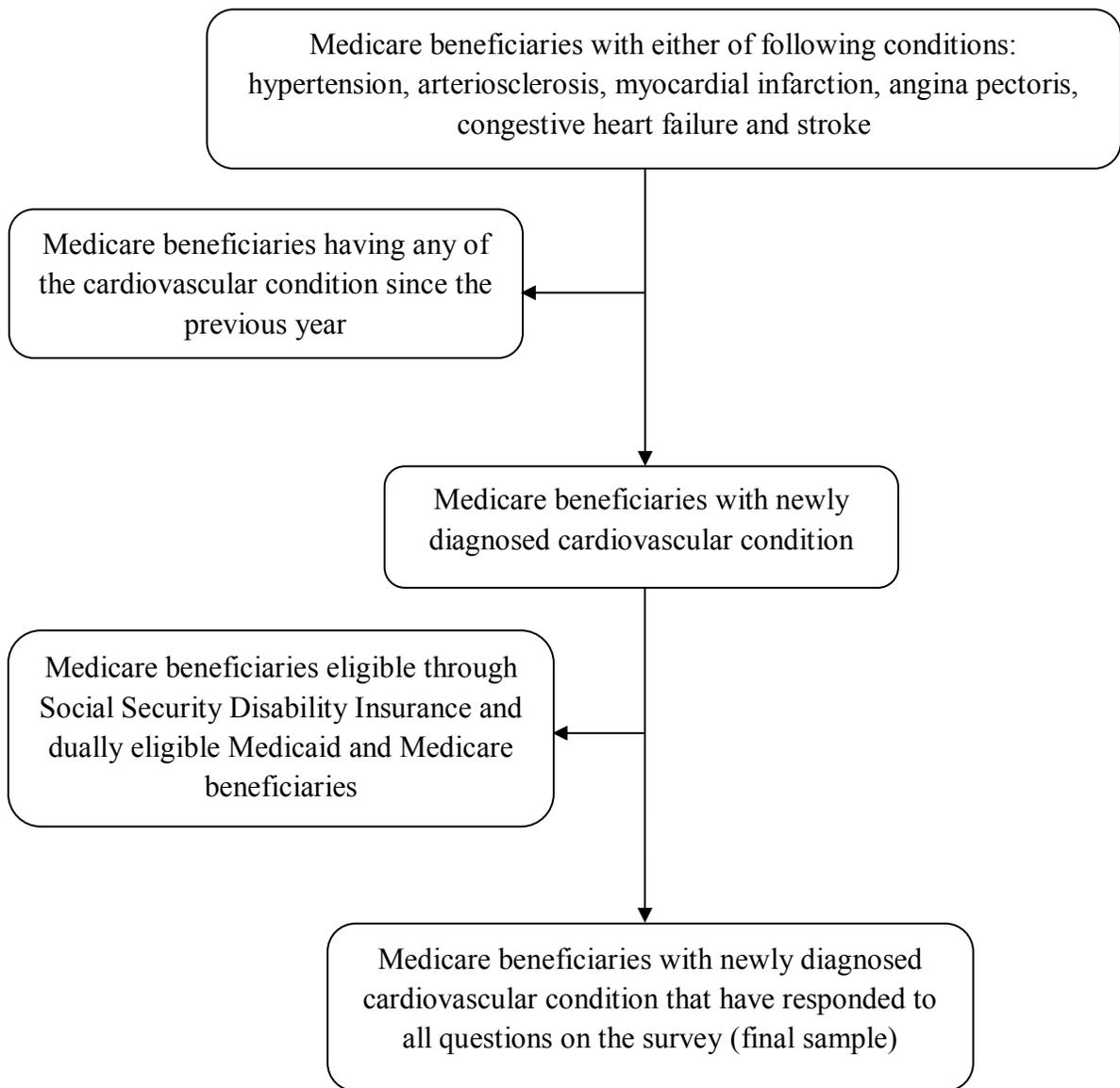


Figure 1: Patient selection

3.5 Primary Medication Non-adherence

Medicare beneficiaries with newly diagnosed cardiovascular disease who have not filled their first prescription were identified by their response to question ‘During the current year, were there any medicines prescribed for you that you did not get?’ Patients answering ‘Yes’ to this question were considered to be Primary medication non-adherent. Percentage of patients being primary medication non-adherent was calculated by dividing the total number of Medicare beneficiaries with cardiovascular disease being primary medication non-adherent to the total number of Medicare beneficiaries with newly diagnosed cardiovascular disease. A previous study also evaluated PMN by the same method.²⁷

3.6 Study variables

To explain the factors that may be associated with PMN, a theoretical framework was used. The most common theoretical framework used to study factors associated with healthcare utilization is the Andersen’s model for health services utilization.³³ This model was developed by Andersen and his colleagues in 1968 and has been used to evaluate various types of healthcare utilization in population with chronic conditions.^{34,35} According to Andersen’s model of health services utilization, there are predisposing factors, enabling factors and need based factors that determine patients’ utilization of the health service. Predisposing factors are the socio-cultural characteristics of the individuals which decide their proclivity to utilize health care services. According to Andersen, a patient is more or less likely to use health service based on age, gender, race/ethnicity, education and patient knowledge of health service benefits and satisfaction

with health service. Enabling factors are the resources found within the family and community which enable them to utilize the health service. Examples of enabling factors are income, geographic location, employment status, type of insurance plan and availability of inpatient, outpatient and emergency room services. Need based factors are those related to the perception of need for health services due to functional and health problems. Patient perceived health status and co-morbidities come under need based factors.

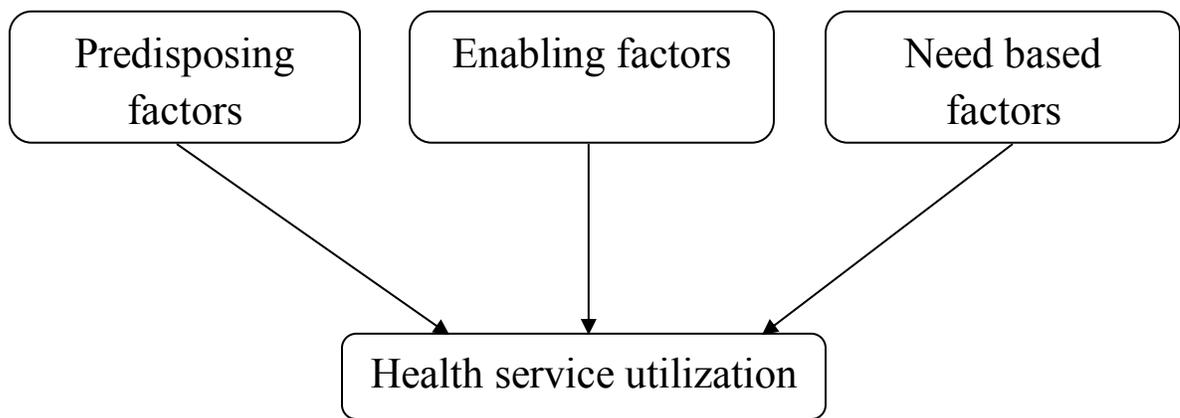


Figure 2: Andersen's model of health service utilization

Primary medication non-adherence is a behavior that can be assumed to be associated with predisposing, enabling and need based factors. Based on previous studies, it can be hypothesized that patients may differ in PMN behavior according to their age, gender, race, ethnicity and satisfaction with healthcare service. Similarly, patient characteristics such as income, educational level, employment status and type of insurance may enable patients to PMN behavior. Finally, patients may not perceive a need for medications unless their perceived health status is bad; have higher number of comorbidities and more than one cardiovascular condition. Variables that fit within the

three categories were included in the model only if MCBS had information on those variables. Hence, the Andersen's model was accordingly modified as shown in Figure 4. Age, gender, race, ethnicity, and patient satisfaction with health service fall under predisposing factors as they define the characteristics and beliefs of the patients. Household income, educational level, employment status and type of insurance fall under enabling factors. Lastly, perceived health status, co-morbidities and cardiovascular burden constitute the need based factors. The modified Andersen's model for this study is shown in the figure below.

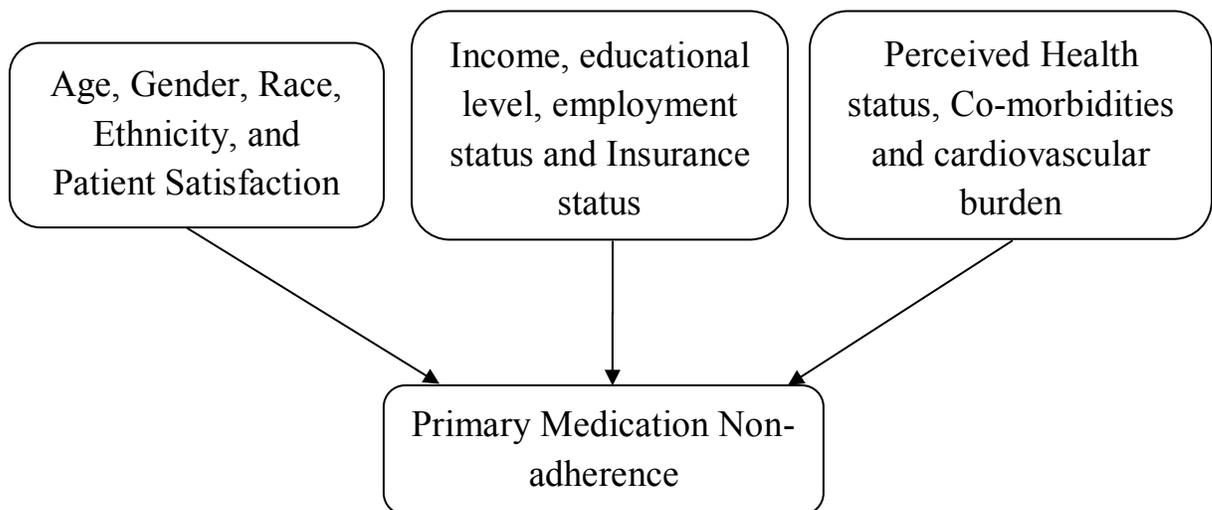


Figure 3: Modified Andersen's model of health service utilization

Additionally, a combination of factors may predict the behavior of PMN if they fail to do so individually, due to interplay of various factors that may lead to PMN. Hence, it was proposed, based on previous studies, that the interaction effect of race and income, age and income, insurance and income and educational level and insurance may be associated with PMN. It can be hypothesized that African American patients with low household income, or patients aged 75 years or more with low household income may be

more susceptible to PMN. Such interactions were studied to understand its effect on PMN.

Information on the selected factors was gathered by referring the following questions from the MCBS data:

For age - What is your Date of birth?

For gender - Select your Gender

For race - Please select an appropriate category that represents your Race

For ethnicity - Is SP of Hispanic or Latino origin?

For Patient Satisfaction – The following five questions were referred

1. Rate your satisfaction with quality of medical care received last year
2. Rate your satisfaction with availability of medical care at night & weekends
3. Rate your satisfaction with out-of-pocket costs for medical services
4. Rate your satisfaction with information about what was wrong with you
5. Rate your satisfaction with doctor's concern for overall health

The responses to these questions ranged from very satisfied to no experience and were scored as follows:

- 1 - Very satisfied
- 2 - Satisfied
- 3 - Dissatisfied
- 4 - Very dissatisfied
- 5 - No experience

For the purpose of analysis, the scores on each of the questions were added for every individual patient and the aggregate score was taken as a representation of the satisfaction level.

For income - What is the income range of patient?

For educational level - What is the highest grade patient has completed?

For employment status - Is patient now working at job or business?

For perceived health status - The following two questions were referred

1. Rate your general health compared to others of same age
2. Rate your health compared to one year ago

The responses to these questions ranged from excellent to poor and were scored as follows:

- 1 - Excellent
- 2 - Very good
- 3 - Good
- 4 - Fair
- 5 - Poor

For the purpose of analysis, the scores on each of the questions were added for every individual patient and the aggregate score was taken as a representation of their perceived health status.

For co-morbidities – Patients with newly diagnosed cardiovascular disease were reviewed in order to identify if they suffered from co-morbidities such as skin cancer, cancer, diabetes, rheumatoid arthritis, non-rheumatoid arthritis, Alzheimer’s disease, psychiatric disorder, osteoporosis, Parkinson’s disease, asthma, emphysema, chronic obstructive pulmonary disease or paralysis by referring to the questions on specific disease conditions. These comorbid conditions were classified using calculated Charlson co-morbidity index score. Charlson comorbidity index is a method for assigning weights to co-morbidities based on their risk of 1 year mortality to provide an indicator of disease

burden.⁵⁰ Specific points are assigned depending on the type of co-morbidity (eg. 1 point for diabetes, 2 points for cancer, etc.) and these are added to points assigned for age group (age 51-60 years – 2 points, age 61-70 years – 3 points, etc.) to give a Charlson co-morbidity score. These Charlson co-morbidity scores were calculated for each patient having a co-morbid condition.

For cardiovascular burden – The number of cardiovascular conditions that the patients were suffering from were identified by multiple ‘YES’ response to the following questions:

1. Has a doctor told you that you had hardening of the arteries or arteriosclerosis?
2. Has a doctor told you that you have hypertension, sometimes called high blood pressure?
3. Has a doctor told you that you had a myocardial infarction or heart attack?
4. Has a doctor told you that you had (a new episode of) angina pectoris or coronary heart disease?
5. Has a doctor told you that you had congestive heart failure?
6. Has a doctor told you that you had a stroke, a brain hemorrhage or a cerebrovascular accident?

3.7 Reasons for PMN

For each of the Medicare beneficiary with cardiovascular disease who was Primary Medication Non-adherent, the reasons for non-adherence were explored. The survey allows the respondents to select the reasons for being primary medication non-adherent and to choose the main reason among them for not filling the prescription. The survey questions related to reasons that were asked to Medicare beneficiaries can be

found in Appendix. These reasons were categorized according to the ones that are influenced by predisposing, enabling or need-based factors. The number of patients giving reasons related to predisposing, enabling and need-based factors was then found out.

3.8 Health service utilization of PMN patients

The health service utilization behavior was also investigated among adherent and non-adherent patients to see whether PMN patients had more physician visits, emergency room (ER) visits, hospitalizations or outpatient visits than filling the prescription on time. Patients who visited physician, emergency room, hospital or outpatient department (OPD) were identified using following questions:

1. Since reference date did patient go to ER for care?
2. Was patient admitted to hospital from ER?
3. Since reference date did patient go to OPD?
4. Since reference date has patient seen a physician?

The numbers of patients having physician visits, emergency room visits, hospitalizations or outpatient visits were compared between each adherence group.

3.9 Data analysis

Statistical analysis was conducted using SAS software (version 9.3 SAS Institute Inc., Cary, NC, USA). Patients were majorly analyzed for being primary medication adherent or non-adherent. Percentage of patients being primary medication non-adherent

was calculated by dividing the total number of Medicare beneficiaries with newly diagnosed cardiovascular disease being primary medication non-adherent to the total number of Medicare beneficiaries with newly diagnosed cardiovascular disease to answer the first aim. Descriptive statistics was used to describe the population according to socio-demographic characteristics. The characteristics of patients being primary medication non-adherent and adherent were analyzed for difference using t-tests for continuous variables and chi-square tests for categorical variables. The difference in number of patients with outpatient visits, physician visits, ER visits and hospitalizations between primary medication non-adherent and adherent was studied using chi-square test. All statistical values were considered significant at $p \leq 0.05$.

Logistic regression was carried out to determine the effect of independent variables on PMN among Medicare beneficiaries with cardiovascular disease. For the purpose of regression, PMN was used as a dichotomous variable. Patients who were non-adherent were coded as 1 and patients who were adherent were coded as 0. Age, gender, race, ethnicity, educational level, employment status, insurance status and income were the categorical variables while patient satisfaction with health service, perceived health status, Charlson comorbidity score and cardiovascular burden were continuous variables. The interaction effects of proposed independent variables on PMN were also studied. These interacting variables were decided by looking at previous studies and their significance in logistic regression analysis. The complex survey design of MCBS was incorporated by using sample weights for stratum, cluster, and individual persons to obtain unbiased national estimates. Nonresponse bias was also adjusted using the sampling weights.

Chapter 4

Results

This chapter gives a description of the patient population under study, the statistical analysis carried out on the data and the results obtained on each of the specific aims proposed for the study. It is divided into following sections:

- (1) Study population,
- (2) Characteristics of newly diagnosed cardiovascular patients,
- (3) Predictors of primary medication non-adherence,
- (4) Reasons for PMN, and
- (5) Health service utilization of the study population.

The differences in population characteristics between primary medication adherent and primary medication non-adherent population will be presented in this chapter. The reasons given by patients for PMN will be shown and the association between independent variables and PMN will be reported.

4.1 Patient Population for study

A total of 7,542 newly diagnosed cardiovascular patients out of 13,174 patients met the study criteria and were included in the primary data analysis. The selection of patient population for the study is described in Figure 4.

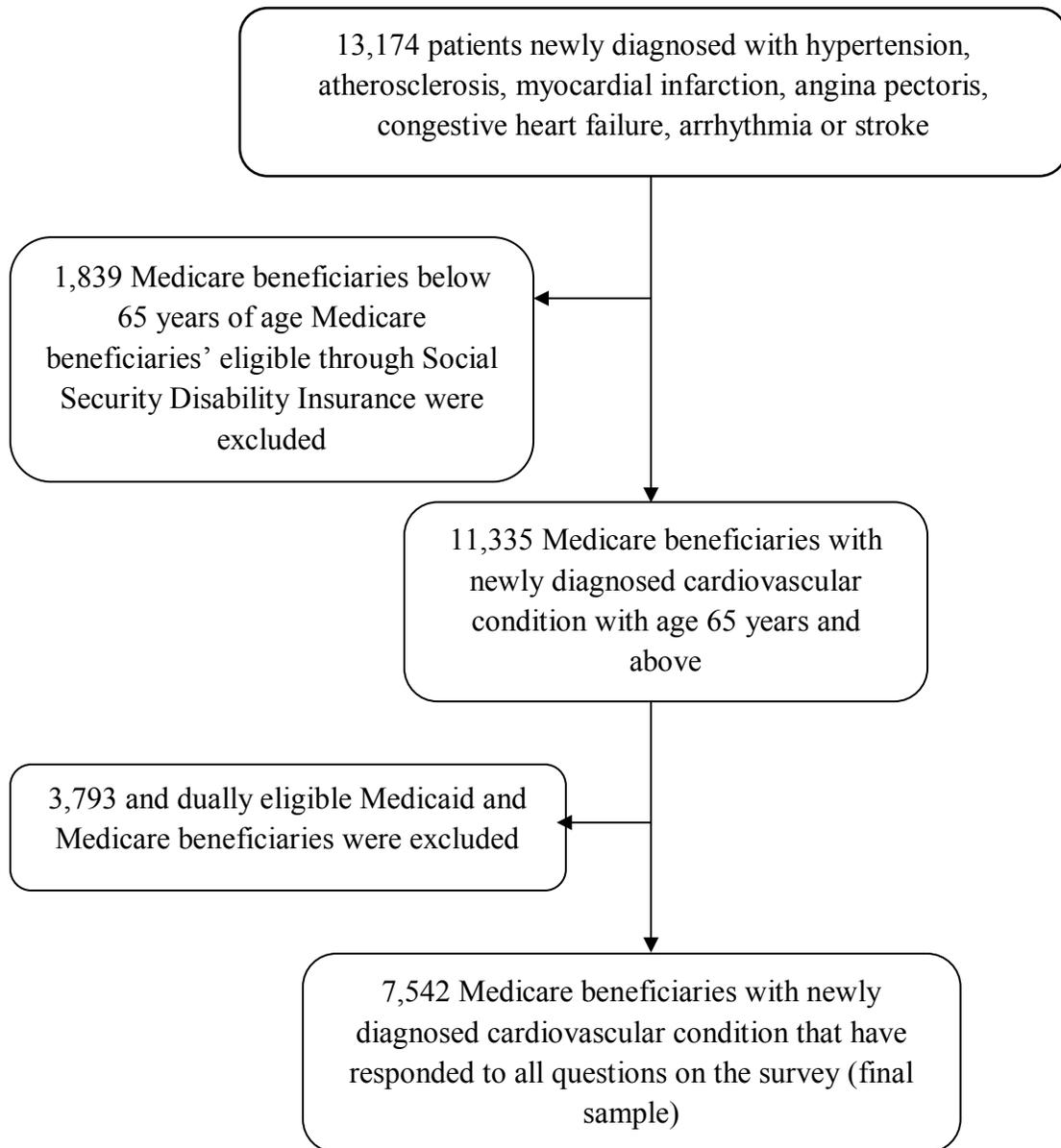


Figure 4: Patient inclusion based on criteria

There were 13,174 patients with newly diagnosed cardiovascular disease which included the ones with hypertension, atherosclerosis, myocardial infarction, angina pectoris, congestive heart failure, arrhythmia or stroke identified from the years 2002 to 2006. Out of these, 1,839 patients below the age of 65 years eligible through Social Security Disability Insurance were excluded. As a result, there were 11,335 patients with age 65 years and above. From these, 3,793 patients that were dually eligible Medicaid and Medicare beneficiaries were additionally excluded to maintain the homogeneity of the study population. This gave a final sample of 7,542 Medicare beneficiaries, 65 years and above, who were newly diagnosed with cardiovascular disease.

Table 2: Characteristics of the study population.

Characteristics	N(%) (Weighted %) /Mean±S.D.
Gender	
Males	3604 (48.07)(48.61)
Females	3938 (51.93)(51.39)
Age	
65-75	3042 (40.12)(48.64)
75-85	3347 (44.46)(39.99)
85 above	1153 (15.41)(11.36)
Income	
Less than 25000	3927 (52.01)(48.95)
More than 25000	3615 (47.99)(51.04)
Race	
White	6936 (92.06)(91.64)
African American	365 (4.86)(4.99)
Other	233 (3.08)(3.36)
Ethnicity	
Hispanic	242 (3.19)(3.17)
Non-Hispanic	7291 (96.81)(96.82)
Insurance	
Medicare only	358 (4.68)(4.63)
Private	7184 (95.32)(95.37)
Patient satisfaction	10.6±2.83
Health Status	5.88±1.53

Education level	
Less than High School	745 (9.93)(8.81)
High School	5172 (68.84)(69.1)
More than high school	1561 (20.73)(21.62)
No school	38 (0.5)(0.45)
Employment Status	
Working	741 (9.77)(11.83)
Non-working	6801 (90.23)(88.17)
Charlson comorbidity index	6.03±1.8
Cardiovascular burden	2±1.12

4.2 Characteristics of newly diagnosed Medicare beneficiaries with cardiovascular disease

As shown in the Table 2, more number of females (51.39%) were newly diagnosed with cardiovascular disease in the 5 year period. Most of the patients fell within the age category of 65 to 85 years (48.64%). The study population was predominantly white (91.64%) and non-Hispanic (96.82%). The number of patients with income less than \$25,000 and more than \$25,000 did not differ much among the newly diagnosed cardiovascular patients. Most of the patients had private insurance in addition to Medicare coverage. 88.17 percent were non-working and 69.1 percent had at least a high school degree.

As shown in table 2, the mean patient satisfaction score was 10.6. The mean perceived health status score was 5.88. The mean Charlson comorbidity score was 6 while mean number of cardiovascular disease per patient was 2.

A total of 334 patients were found to show PMN, out of a total of 7,542 newly diagnosed Medicare beneficiaries with cardiovascular disease. Assigning the weights, gave a number of 842,158 which represented national cohort of newly diagnosed Medicare

beneficiaries with cardiovascular disease who showed PMN. This corresponded to 4.43% of PMN in this population. This completes the first objective of the study.

Table 3: Patient characteristics stratified by adherence status.

Variables	Primary medication adherence	Primary medication non-adherence	significance
Gender			0.0128
Males	3465 (48.07)(48.61)	139 (41.62) (40.47)	
Females	3743 (51.93)(51.39)	195 (58.38)(59.52)	
Age			0.4070
65-75	2892 (40.12)(48.64)	150 (44.91)(51.8)	
75-85	3205 (44.46)(39.99)	142 (42.51)(38.8)	
85 above	1111 (15.41)(11.36)	42 (12.57)(9.39)	
Income			0.7219
Less than 25000	3749 (52.01)(48.95)	178 (53.29)(49.96)	
More than 25000	3459 (47.99)(51.04)	156 (46.71)(50.04)	
Race			0.7682
White	6629 (92.06)(91.64)	307 (92.19)(92.57)	
African American	350 (4.86)(4.99)	15 (4.5)(4.11)	
Other	222 (3.08)(3.36)	11 (3.3)(3.3)	
Ethnicity			0.8057
Hispanic	230 (3.19)(3.17)	12 (3.59)(3.44)	
Non-Hispanic	6969 (96.81)(96.82)	322 (96.41)(96.55)	
Insurance			0.2313
Medicare only	337 (4.68)(4.63)	21 (6.29)(6.13)	
Private	6871 (95.32)(95.37)	313 (93.71)(93.86)	
Patient satisfaction	10.6±2.83	11.27±2.95	<.0001
Health Status	5.88±1.53	5.99±1.54	0.1762
Education level			0.9981
Less than High School	713 (9.93)(8.81)	32 (9.61)(8.53)	
High School	4945 (68.84)(69.1)	227 (68.17)(69.21)	
More than high school	1489 (20.73)(21.62)	72 (21.62)(21.77)	
No school	36 (0.5)(0.45)	2 (0.6)(0.48)	
Employment Status			0.9707
Working	704 (9.77)(11.83)	37 (11.08)(11.74)	
Non-working	6504 (90.23)(88.17)	297 (88.92)(88.26)	
Charlson comorbidity index	6.02±1.79	6.32±1.99	0.0073
Cardiovascular burden	2±1.11	2.33±1.22	<.0001

Results from chi-square tests showed that a statistically significant number of females were primary medication non-adherent than males. Within the age category, more patients in the age group of 65-75 years were non-adherent than patients in the age group of 75-85 years and 85 years and above. Whites were more non-adherent compared to blacks and others while non-Hispanics were more non-adherent than Hispanics. More patients with additional private insurance were non-adherent compared to patients having only Medicare insurance while non-working patients who were non-adherent were more than patients who were still working. When compared according to educational level, more patients with high school education were non-adherent compared to patients with more than high school education and less than high school education or no schooling. However, these results were not statistically significant. Patients with income less than \$25,000 were fairly equal with patients having income more than \$25,000 in terms of non-adherent behavior. Results from t-tests showed that those patients who were adherent had on average 0.1 points lower score on perceived health status than non-adherent patients. This difference was not statistically significant. Patients who were non-adherent had a higher statistically significant score on the questionnaire for patient satisfaction with overall service than patients who were adherent. On average, patients who were non-adherent had statistically significant Charlson comorbidity score compared to adherent patients. The number of cardiovascular diseases per patient was also statistically significantly different among adherent and non-adherent patients.

4.3 Predictors of Primary Medication Non-adherence

This section presents the result of the logistic regression to determine the predictors of primary medication non-adherence.

Table 4: Logistic regression results

Category	Reference	Odds Ratio	Confidence Interval
Age			
75-85	65-75	0.844	0.642-1.109
85 above		0.678	0.470-0.978
Gender			
Male	Female	0.682	0.522-0.890
Race			
White	African American	1.063	0.474-2.385
Other		1.240	0.724-2.125
Ethnicity			
Non-Hispanic	Hispanic	0.882	0.452-1.721
Education level			
More than High school	Less than high school	1.090	0.669-1.775
High school		1.024	0.659-1.592
No school		1.283	0.277-5.937
Income			
More than 25000	Less than 25000	1.088	0.883-1.340
Employment status			
Working	Non-working	1.143	0.720-1.816
Patient Satisfaction		1.074	1.040-1.109
Health Status		0.994	0.912-1.084
Insurance status			
Public	Private	1.307	0.802-2.129
Charlson comorbidity score		1.074	0.999-1.155
Cardiovascular burden		1.248	1.122-1.388

Table 4 shows the results of the logistic regression. Primary medication adherence behavior was used as a categorical dependent variable for this regression analysis with patient filling the prescription being primary medication adherent and those patients not filling the prescriptions being primary medication non-adherent. The chi-square likelihood ratio for the model was 69.55 ($p < 0.0001$). This ratio indicates that the model was significant.

Gender, patient satisfaction with health service received, Charlson comorbidity score and cardiovascular burden were significant predictors of primary medication non-adherence. Patients in the age category of 75-85 years had 16% lesser odds to show PMN than patients in the age category of 65-75 years while patients in the age category of 85 years and above had significantly lesser odds to show non-adherence than patients in the age category of 65-75 years. Males had 32% lesser odds to show PMN than women and this association was statistically significant. Whites were more likely to show PMN than African Americans.

The odds ratio for non-Hispanics to show PMN was 0.882 (95% CI, 0.452-1.721) as compared to Hispanics which means that non-Hispanics had lower tendency to show PMN. Patients with high school or more than high school education had higher odds of showing PMN than patients with less than high school education. Patients with household income level of more than \$25,000 had higher odds of showing PMN than patients with household income of less than \$25,000. Working patients had 14% higher odds of showing PMN than patients who were not working. Patients with only Medicare insurance were 30% more likely to show PMN than patients having private insurance coverage in addition to Medicare. All these associations were not statistically significant.

Patient satisfaction with overall health service was positively associated with PMN. The odds ratio with each one point increase in patient satisfaction score was 1.074 (95% CI, 1.040-1.109) which means that for every one point increase in patient satisfaction with overall service score, the odds of being non-adherent increased by 7.4%, holding all the variables constant. The result of the effect of patient satisfaction was statistically significant. Each 1 point increase in perceived health status score decreased the odds of being non-adherent by 0.6%. Each one point increase in Charlson comorbidity score increased the odds of being non-adherent by 7.4%. The odds of PMN increased by 24.8% with the addition of one more disease to cardiovascular burden. The result of the effect of Charlson comorbidity score and cardiovascular burden was statistically significant.

Since age, race, ethnicity, insurance, income and educational level did not predict PMN, the effect of plausible interaction of two variables on PMN was studied. The six interactions tried were between race and income, age and income, insurance and income, education level and insurance, ethnicity and income. The purpose for interaction was to see what effect does patient of a particular race and having high income has on PMN. Similar rationale was followed for other interactions as well. The results of the regression analysis are shown in Table 5. The logistic regression results showed that none of the interactions were significant predictors of PMN as shown in table though they showed some association with PMN.

Table 5: Logistic regression results with interaction effects

Category	Reference	Odds Ratio	Confidence Interval
Age			
75-85	65-75	0.844	0.642-1.109
85 above		0.678	0.470-0.978
Gender			
Male	Female	0.682	0.522-0.890
Race			
White	African American	1.063	0.474-2.385
Other		1.240	0.724-2.125
Education level			
More than High school	Less than high school	1.090	0.669-1.775
High school		1.024	0.659-1.592
No school		1.283	0.277-5.937
Employment status			
Working	Non-working	1.143	0.720-1.816
Patient Satisfaction		1.074	1.040-1.109
Health Status		0.994	0.912-1.084
Insurance type			
Public	Private	1.307	0.802-2.129
Charlson comorbidity score		1.074	0.999-1.155
Cardiovascular burden		1.248	1.122-1.388
Ethnicity and Income		0.937	0.372-2.359
Race and Income		2.192	0.466-10.308
Age (75-85 years) and Income		0.780	0.550-1.107
Age (85 years and above) and Income		1.014	0.459-2.241

Insurance and Income		1.543	0.941-2.529
Education(less than high school) and Insurance type		7.823	0.464-131.933
Education(high school) and Insurance type		1.451	0.576-3.654
Education(more than high school) and Insurance type		1.389	0.766-2.518

4.4 Reasons for PMN

Patients gave multiple reasons for not filling up their prescriptions. An analysis of the reasons given by cardiovascular patients for being PMN showed that the most common reason given for not filling the prescriptions was ‘the medicines were too costly’ (n=140). Other reasons given by PMN patients were ‘fear of adverse reaction’ (n=67), ‘felt medicines were not required for condition’ (n=57), ‘insurance did not cover medicines’ (n=57), ‘felt better, did not need medicine’ (n=27), ‘felt medicine would not help condition’ (n=27) and ‘dislike taking medicines’ (n=21).

Table 6: Common reasons given by patients for being PMN

<u>Reasons</u>	
Medicines too costly	140
Feared Adverse reaction	67
Felt not required for condition	57
Insurance did not cover medicines	57
Got better, felt no need	27
Would not help condition	27
Dislike taking medicines	21
Did not get medicine soon enough	6
Had no way to get it	5
No time to fill	2
Others	32

Out of the total of 334 PMN patients, 122 patients said that the main reason for not filling prescription was ‘the medicines were too costly’, 55 patients said that they ‘feared adverse reaction’, 44 patients felt ‘medicine was not required for the condition’, 23 patients said ‘insurance did not cover medicines’, 20 patients said ‘felt better, did not need medicine’, 15 patients felt ‘medicine would not help condition’, 10 patients said

they ‘dislike taking medicines’, 6 patients said that they ‘did not get medicine soon enough’, 4 patients said they ‘had no way to get it’ and 2 patients said they ‘had no time to fill’.

Table 7: Main reasons given by patients for being PMN

<u>Main Reasons</u>	
Medicines too costly	122
Feared Adverse reaction	55
Felt not required for condition	44
Insurance did not cover medicines	23
Got better, felt no need	20
Would not help condition	15
Dislike taking medicines	10
Did not get medicine soon enough	6
Had no way to get it	4
No time to fill	2
Others	30

The reasons given by the patients can be presumed to be due to beliefs of the patient about medications, lack of available resources or their perception of need for medication. Hence these reasons can be associated with predisposing factors, enabling factors or need based factors of the patients. Patients who provided reasons such as ‘feared adverse reaction’, ‘medicine would not help condition’ and ‘dislike taking medicines’ did so because of their beliefs regarding medications hence it can be said they were predisposed to give such reasons. Similarly, patients gave reasons such as ‘the medicines were too costly’, ‘insurance did not cover medicines’, ‘did not get medicine soon enough’, ‘had no way to get it’ and ‘had no time to fill’ due to lack of resources which serve as an enabling factors to take medicines. Also, patients giving reasons such

as ‘felt better, did not need medicine’ and ‘medicine was not required for the condition’ had low perception of need for medication. As shown in Table 8, 157 patients gave reasons associated with lack of enabling factors, while 115 patients gave reasons associated with predisposing factors and 64 patients gave reasons associated with need based factors.

Table 8: Reasons stratified according to related factors

<u>Predisposing</u>	
Feared Adverse reaction	55
Would not help condition	15
Dislike taking medicines	10
Total	80
<u>Enabling</u>	
Medicines too costly	122
Insurance did not cover medicines	23
Did not get medicine soon enough	6
Had no way to get it	4
No time to fill	2
Total	157
<u>Need based factors</u>	
Felt not required for condition	44
Got better, felt no need	20
Total	64

4.5 Health service utilization of study population

In order to compare the health service utilization behavior such as emergency room visits, hospitalizations, physician visits and outpatient department visits between adherent and non-adherent patients, chi-square test was conducted. Table 9 shows that the

percentage of adherent patients visiting OPD and physicians were more than non-adherent patients. In contrast, the percentages of adherent patients visiting ER or getting hospitalized were less as compared to primary medication non-adherent patients. Results from chi-square test showed that both these findings were statistically significant.

Table 9: Comparison of health service utilization between adherent and non-adherent population

Health service type	Primary medication adherence (%)	Primary medication non-adherence (%)	P-value (Chi-Square)
Emergency room visits	12.29	13.97	<0.0001
Hospitalization	5.73	6.62	<0.0001
Physician visits	47.57	34.81	<0.0001
OPD visits	17.04	14.53	<0.0001

Chapter 5

Discussion

This chapter discusses the findings of this study, its implications, limitations, future research and conclusion. It is divided into the following sections:

- (1) Prevalence of PMN among Medicare beneficiaries with cardiovascular disease,
- (2) Factors leading to PMN,
- (3) Reasons for PMN,
- (4) Comparison of Utilization of Health Services between adherent and non-adherent patients,
- (5) Implications of study findings,
- (6) Study limitations,
- (7) Future research and
- (8) Conclusion.

5.1 Prevalence of PMN among Medicare Beneficiaries with Cardiovascular Disease

Primary medication non-adherence is common, but the true extent of this type of non-adherence has become apparent only recently, with more studies focusing on PMN.

Primary medication adherence is of prime importance as it ensures timely initiation of treatment which can alleviate patient illness and can lead to favorable outcomes.⁵¹ As a result, it reduces unnecessary health care utilization and costs.⁵² Primary medication adherence is especially important in elderly population, who may forget to fill their medication or rely on others to fill their medication⁵³, as chronic conditions are often more prevalent in this population. Often times, elderly patients with chronic conditions are prescribed multiple medications which can increase their possibility of failing to fill prescriptions due to economic concerns or behavioral reasons. This was reflected in the rate of PMN of 4.4% which was found in a study on elderly patients.²⁷ Our study adds to this finding documenting that there is considerable non-adherence among Medicare beneficiaries with newly diagnosed cardiovascular disease. Cardiovascular diseases are conditions that require early diagnosis and immediate initiation of treatment in order to reduce its progression and the risk of mortality. This nationally representative study underlines the prevalence of PMN among Medicare beneficiaries with newly diagnosed cardiovascular disease and confirms the need for targeted intervention for this population.

Findings of the present study show that there were 4.43% of Medicare beneficiaries with newly diagnosed cardiovascular disease who showed PMN. Even though the proportion may look small, it is part of a national database which represented an estimated 0.8 million Medicare beneficiaries showing PMN. The number with PMN is also significant considering the fact that the information was collected through survey where there is a possibility of social desirability bias. Hence the number found out through this study might be an underestimated number. However, this was comparable with other studies that calculated PMN using surveys where PMN was found to be in the

range of 4-8%.^{27,28} The rate of PMN estimated in this study was found to be low as compared to those found using electronic prescription claims. PMN calculated through electronic prescription claims ranged from 14-28%.^{18,24-26,30,37} However, the results obtained through analyzing electronic prescription systems cannot be generalized as can be done with surveys as they are adopted by only a few physicians due to their costs.

A significant number of Medicare beneficiaries with newly diagnosed cardiovascular disease showed PMN which indicates that this population may be at increased risk of worsening of their condition. This presents a significant risk of increased hospitalization, outpatient visits, emergency room visits and mortality among this population.⁵² This unnecessary healthcare utilization may lead to an increase in healthcare expenditures for the Medicare. Hence, primary adherence is important in order to reduce healthcare spending as was shown in a study by Lopert *et al*⁵⁴ where Medicare spending were low in Medicare beneficiaries with congestive heart failure who had high level of medication adherence. Additionally, unnecessary healthcare utilization may also increase the financial burden on the Medicare beneficiaries. Therefore, special attention is warranted to this population.

5.2 Factors leading to Primary Medication Non-adherence

Some potentially modifiable factors that could represent targets for interventions to improve primary adherence were found. Age group was found to be non-significantly negatively associated with PMN. Patients in the age categories of 75-85 years and 85 years and above were 16% and 32% less likely to show PMN respectively as compared to patients in the age category of 65-75 years after controlling for other factors. In contrast,

other studies have reported that elderly patients have a higher tendency to forgo their medications.⁵⁵ This may suggest that increasing age makes patients more concerned about their health and increase their tendency to follow doctor's recommendations. This finding was consistent with previous work done by Wroth *et al*²⁹ on patients in rural counties where it was found that tendency to fill medication was higher in elderly population than in younger population. Studies that have evaluated medication non-adherence showed that the tendency of being non-adherent increases with age.⁵⁶ The possible reason for this is that as age catches up, patient may forget to take medications. However, forgetfulness may not play an important role in PMN, as patients have to fill their medications as soon as they are prescribed.

According to the study results, race was not found to be associated with PMN. Whites and African Americans were comparable in their tendency to show PMN. On the other hand, Non-Hispanics had lesser tendency to show PMN than Hispanics. However, this association was not found to be significant. Other studies assessing PMN also did not find any association between race/ethnicity and PMN.^{24,25} The weak association found between ethnicity and PMN may be due to language barriers faced by Hispanic population.

Gender was found to be significantly associated with PMN. Females were significantly likely to show PMN than males. This adds to the findings of previous studies which also found that females were more likely to show PMN than males.^{25,26,29} Fischer *et al*²⁶, in an analysis of electronic prescriptions found that females were 30% less likely to fill prescriptions than males. Shah *et al*²⁵ reported that hypertensive females filled lesser prescriptions than hypertensive males. As stated by these studies, it was not

possible to explain the occurrence of this disparity. Hence, further research needs to be done to find reasons why females show more non-adherence than males in order to explain this disparity.

Several studies have established a link between patient satisfaction with care and medication adherence.^{57,58} It has been shown that higher satisfaction with overall care received leads to higher probability of adherence. The present study assessed the relationship between patient satisfaction score and PMN. This patient satisfaction score was a composite score covering five dimensions which included quality of medical care received, availability of medical care night and weekends, out-of-pocket costs for medical service, information about what was wrong (condition) and physician's concern for overall health. Patient satisfaction with health service was found to be significantly associated with PMN. Patients who had higher scores on patient satisfaction had a lesser possibility of showing PMN. This suggests that in order to reduce PMN, improvement in patient satisfaction on all five dimensions may be required. It has been shown that patient satisfaction is highly dependent on quality of physician counseling.⁵⁸ Therefore, intensifying physician counseling by providing all the information to the patient about their condition as well as showing concern with patient health may partly improve patient satisfaction in patients with newly diagnosed cardiovascular disease. Also, physicians may consider following a more patient-centered approach instead of being disease-specific for treating these patients. Physicians may also collaborate with pharmacists for providing non-dispensing services to improve quality of care and patient satisfaction. At places where there are no physician offices, non-dispensing services may be provided at

the nearest pharmacies that may be extended to weekends, thus improving he accessibility to care.

Authors of the study found no association between income and PMN. This was consistent with the findings of Jackevicius *et al*⁴⁹ among Myocardial Infarction patients showing no association between income and PMN. This may be due to narrow definition of high and low income used in the study. The association of educational level and employment status with PMN was also not significant. A previous study also found similar results in relation to educational level and employment status.²⁹ Insurance status was non-significantly associated with PMN. Patients who had only Medicare coverage were 30% more likely to show PMN than patients with additional private insurance coverage. However, this association was not assessed previously in relation to PMN. The difference in PMN behavior among patients with Medicare coverage and private insurance coverage may be attributed to additional prescription benefits provided by private insurers. However, implementation of Medicare Part D might have partly reduced the cost burden related to prescription drugs which could not be captured in this study.

According to the findings of the present study, there was a significant association between cardiovascular burden and PMN. As the number of cardiovascular condition increased, the patients were more likely to show PMN. As per the author's knowledge, this association was not assessed in any previous study. This significant association may be due to increased economic burden as a result of multiple chronic prescriptions. The effect of Charlson comorbidity score on PMN was significant as well. A study done on hypertensive patients found Charlson comorbidity score had significant effect on PMN.²⁵ This suggests that presence of comorbid conditions may increase the

economic burden on patients due to multiple prescriptions leading them to show PMN. Perceived health status did not have any association with PMN. Significant association between health status and PMN was not studied in any of the previous research.

Age and income were found to significantly predict PMN in previous studies^{25,26,29,31,49} but the present study failed to find this effect. This might be due to interplay of various factors that may lead to PMN. Hence, in this study, the effect of interaction of race and income, age and income, insurance and income and educational level and insurance on PMN was studied. However, none of the interacting factors were found to be associated with PMN. This discredits the assumption that an interaction between factors might have led to non-significance of certain factors.

5.3 Reasons for PMN

The three most commonly cited reasons for PMN were ‘Medicines too costly’, ‘feared adverse reaction’, and ‘felt medicine was not required for condition’ with majority of the patients providing ‘Medicines too costly’ as the main reason for PMN. Similar results were documented by Kennedy *et al*²⁷, where PMN was assessed in Medicare beneficiaries using 2004 MCBS data and by Craig *et al*⁵⁹, where PMN was assessed using 1996-1999 MCBS data. In another study on myocardial infarction patients, the common reasons reported were ‘medication is not needed’, ‘inability to afford medication’ and ‘complexity of the regimen’.⁴⁹ Thus the finding of the present study, along with other studies suggests that a significant number of patients intentionally did not fill prescriptions due to cost of medicines. However, this study was done before the introduction of Medicare Part D in 2006. Hence, the cost burden on patients might

have reduced partly since. The other main reasons given after ‘Medicines too costly’ were ‘Feared adverse reaction’ and ‘Felt medicine not required for condition’. These reasons given by the patients also suggest that they need appropriate counseling on the purpose of medication and its effect on the condition. Effective counseling may generate confidence about the recommended treatment which may enable them to fill prescriptions.

An analysis of the reasons given by the patients showed that most of the reasons were related to lack of resources to fill the prescriptions while others were related to perceptions and beliefs of the patients about their condition, medicines and the medical service they received. The Medicare part D was implemented in 2006 which might have partly decreased the cost burden on the beneficiaries in regards to claiming prescriptions. However, patients’ perception and beliefs require special attention as it may define their behavior of prescription filling and adherence. The more perceptions related reasons may be associated to the low satisfaction with care received. Hence, it is important for the healthcare providers to focus on patient satisfaction.

5.4 Comparison of Utilization of Health Services between adherent and non-adherent patients

Non-adherence has been found to be associated with adverse outcomes and unnecessary healthcare utilization.^{11,52,60} However, only one study has previously reported the adverse outcomes associated with PMN. It was found that the adjusted 1-year mortality rate was 80% higher for patients who did not fill any prescriptions versus patients who filled all prescriptions.⁴⁹ To the best of author’s knowledge none of the previous studies on PMN have reported the healthcare utilization behavior. In the present

study, it was found that a significant number of adherent patients visited the physician and OPD than non-adherent patients. This suggests that patients who fill their prescriptions were more likely to visit the physician or OPD. The reason behind this behavior may be that filling of prescription and regularly taking it may be increasing the patient tendency to keep a track of their health leading them to visit physician or outpatient department on a regular basis. Visiting the physician may also suggests that the satisfaction with service given by the physician for these patients might be high. However, it was also found that significantly higher proportions of non-adherent patients visited the ER or were hospitalized as compared to adherent patients. This suggests that failure to fill the prescriptions may worsen patient condition which might have led to hospitalizations or ER visits. The information regarding health service utilization was restricted to the year in which the patients were interviewed. It would be interesting to look at the health service utilization pattern in subsequent years after not filling the prescriptions. The analysis of subsequent year's data may reveal further increase in hospitalizations and ER visits among non-adherent patients. .

5.5 Implications of Study Findings

The objective of the present study was to determine the prevalence of PMN among Medicare beneficiaries with newly diagnosed cardiovascular disease, the factors predicting this behavior and the healthcare service utilization behavior among PMN patients. This study found that an estimated 0.8 million Medicare beneficiaries with newly diagnosed cardiovascular disease failed to fill any prescription. This presents a significant risk of increased morbidity due to progression of disease which can lead to

increased unnecessary health service utilization, healthcare costs and death. Hence the population under study needs special attention.

Gender, patient satisfaction with overall health service, comorbidities and cardiovascular burden were the major predictors of PMN. Hence, in order to reduce PMN, it is important to consider these predictive patient characteristics. Intensifying patient counseling by providing all the necessary information about the condition, medications that were prescribed and its adverse effects, showing concern with patient health may help improve patient satisfaction. However, physicians may not always have the time to provide all the necessary information. Therefore, in such situations, the physicians may refer the patient to a pharmacist. Pharmacists are at prime position to provide information on the medications, its dosage and the side-effects. Referring to a pharmacist will also ensure that the prescribed medication will be filled and taken as per suggested dosage. Pharmacists can also send reminders to the patients for filling their prescriptions. Hence, active collaboration between the physician and pharmacist may help reduce PMN.

The Centers for Medicare & Medicaid Services (CMS) implements quality initiatives to assure high quality healthcare for Medicare beneficiaries. They have developed certain quality measures to help measure or quantify healthcare processes, outcomes and patient perceptions that are associated with high-quality healthcare. One of the measures looks at adherence to chronic medications in order to evaluate healthcare quality. These measures are used by CMS in the pay-for-reporting programs such as the Hospital Inpatient and Outpatient Quality Reporting Programs (IQR and OQR), and the Physician Quality Reporting System (PQRS). Hence healthcare providers should pay

special attention to reduce PMN as it defines adherence to chronic medications and will in turn act as a marker for quality of healthcare received. By targeting populations that are vulnerable to PMN (females, low satisfaction patients, high cardiovascular burden patients), healthcare providers could help reduce PMN and maintain high quality care.

It was found that females were more likely to be PMN than males. The tendency of being PMN also increases with getting diagnosed with multiple cardiovascular conditions. Hence, physicians should show special attention towards this population and explain them the importance of PMN. Primary medication adherence will improve the health outcomes among these patients and will reduce patient morbidity and healthcare costs.

5.6 Study Limitations

PMN and utilization of healthcare services were self-reported variables. Hence patient recall bias and social desirability bias were a possible threat to validity of the responses. A review of patient self-report of prescription use has shown that patient recall declines over time, the perceived social acceptability of the condition being treated can affect recall, and patients fail to report medication use with the same amount of accuracy as other health care events such as ER visits and hospitalizations. This suggests that self-reports of medication non-adherence has the potential to be underestimated. Additionally, the self-reported non-adherence could not be linked to actual failure to fill prescription since there was no access to Medicare claims data in order to verify the respondents' self-report. Therefore, the prevalence of 4.43% found in this study might be an underestimated figure.

Data from 2002-2006 MCBS files was used for this study. Implementation of Medicare Part D in January 2006 may have had some effect on the prevalence of PMN which could not be captured in this study. However, this finding will provide a baseline for comparison to similar research using beneficiary survey in 2006 and thereafter. Some patients might have received samples from their physician and thus might have reported failure to claim prescriptions. However, the analysis of reasons given by the patients showed that this number was very small. In the logistic regression, all the possible covariates may not have been adjusted due to limited variables available in the data.

5.7 Future Research

Future research on the topic of PMN should consider evaluating non-adherence in other chronic conditions such as diabetes, asthma and arthritis. Future studies in cardiovascular patients should be focused on determining the long-term effect of not filling their prescriptions on health care costs. Studies should be designed to compare costs between cardiovascular patients who filled their prescriptions and cardiovascular patients who did not fill their prescriptions. Also, long-term effect of PMN on emergency room visits, hospitalizations and OPD visits can be studied in the same way.

Future research can also focus on the general population instead of focusing on the elderly population. Also, studies could evaluate PMN in subsequent years after 2006 which will provide a current update on this topic. Studies should also look at other possible factors that may affect may which could not be seen in this study due restriction on data.

5.8 Conclusion

The researchers concluded that a large number of Medicare beneficiaries with newly diagnosed cardiovascular condition were non-adherent to prescription filling. PMN was especially higher in females, patients with lower satisfaction with overall health service, patients having higher Charlson comorbidity score and patients with multiple cardiovascular conditions. The reasons given by the patients for being non-adherent were more economic and perception based. Also, more number of patients who filled their prescriptions had a tendency to visit the outpatient department and physicians.

Based on these findings, PMN is a concern among patients with newly diagnosed cardiovascular disease. Healthcare providers may play an important role in reducing the behavior of PMN by giving good quality service and intensifying patient counseling in population that are vulnerable to PMN. Interventions strategies could be planned by the healthcare providers depending on the population susceptible to PMN. Comprehensive approach involving physician-pharmacist collaboration can serve better to reduce PMN.

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