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Antihypertensive Medication Adherence in the Twin Cities

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ANTIHYPERTENSIVE MEDICATION ADHERENCE IN THE TWIN CITIES

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Abstract

A retrospective study of antihypertensive medication adherence was conducted on patients' demographics data at Eastside Health Clinic in St. Paul, MN. The study sought to determine whether or not interventional means were needed to improve adherence to antihypertensive medication based on serial blood pressure measurements collected over the course of 6 clinic visits. The study found that patients were consistently more non-adherent than adherent in every category assessed, yet there was an overall decrease in mean systolic and diastolic blood pressure. Based upon these findings, it can be concluded that while individual adherence rates were imperfect for each demographic category analyzed, the patient population as a whole is considered well-controlled on their current medication regimens at Eastside Health Clinic in St. Paul, MN. This study lays the foundation for a multitude of further research possibilities and can be utilized as a resource should further studies be conducted.

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Chapter 1: Introduction

In the United States, an estimated 1 in every 3 adults, a total of 77.9 million people, have high blood pressure (Go, 2013). Of those adults, about 75% have been prescribed antihypertensive medication, but 48% do not have their blood pressure under control (Go, 2013). Non-adherence to prescribed medication stands out as one of the leading contributors to hypertension, with the average patient adhering to their entire prescription only 50% of the time (Gwadry-Sridhar, 2013). The estimated costs, both direct and indirect, of high blood pressure in the U.S. in 2009 were $51 billion (Ogden, Kaila and Neil, 2014).

Hypertension, otherwise known as high blood pressure, is defined as having a blood pressure above 140 mmHg systolic and/or above 90 mmHg diastolic ("Treatments", 2014). While generally an asymptomatic disease, if left untreated, hypertension eventually causes strain on both the heart and the arteries, leading to multiple potential medical complications ("Treatments", 2014). Hypertension increases the risk for heart failure, myocardial infarction, kidney failure, and stroke ("Treatments", 2014).

The goals of hypertensive treatment medications are to stabilize an individual's blood pressure in a particular range depending on the patient ("Treatments", 2014). For healthy adults older than 60 years of age, the goal is a blood pressure less than 150/90. For healthy adults younger than 60, the goal is 140/90. While the "ideal" blood pressure goal is 120/80, medications are generally not prescribed with that low of a goal in mind ("Treatments", 2014).

The types of hypertensive medications are numerous and include: thiazide diuretics, beta blockers, angiotensin-converting enzyme (ACE) inhibitors, angiotensin II receptor blockers (ARBs), calcium channel blockers, renin inhibitors, alpha blockers, alpha-beta blockers, central-acting agents, vasodilators, and aldosterone antagonists (Mann, 2014). Lifestyle changes can also be incorporated into a treatment regimen and may include a healthier diet with lower sodium intake, regular exercise, smoking cessation, and weight loss ("Lifestyle", 2014).

Healthcare is defined as "ensuring that all people have access to needed promotive, preventive, curative and rehabilitative health services, of sufficient quality to be effective, while also ensuring that people do not suffer financial hardship when paying for these services" (World Health Organization, 2014, p. 1). Adherence is defined as "patients possessing medication more than approximately 75% of the time" (Naderi, Bestwick, & Wald, 2012, p. 882). Adherence is also defined as the act of adhering; the act of doing what is required by a rule, belief, etc. ("Adherence", n.d.) In medical terms, adherence is defined as taking the number of pills prescribed by a provider in a given time period, greater than 80% of the time. Non-adherence is defined as taking the prescribed medication less than 80% of the time ("Adherence", n.d.).

Within healthcare, a great deal of importance is placed on a patient's accountability to take all of their medications as prescribed, but this is not always the case. Patients often cannot afford their medications, do not have the means to go and fill their prescriptions, or simply choose not to take their medications for various reasons (Vermeire, Hearnshaw, Van Royen, & Denekens, 2001). Many variables contribute to what is called medication adherence, and the lack of adherence can lead to many health

problems for the patient and financial problems for the national healthcare system (Vermeire et al, 2001).

Lifelong medications, like antihypertensives, typically have poor adherence due to the fact that the effects from not taking the medications are not seen immediately. More likely, patients will take their medications when the adverse effects of not taking those medications are felt instantly and cause disruption to daily life. Convincing patients that a medication is necessary when the effects are not directly felt, along with the many other variables that come with obtaining and taking a prescription, can cause complications within the healthcare system (Vermeire et al, 2001).

When people do not take the medication that they are prescribed, they are more likely to end up in the hospital due to complications from their medical condition (Conen, 2013). Being admitted to the hospital is expensive, and the increasing amounts of admissions to hospitals for preventable illness are causing the ever-rising national healthcare debt (Conen, 2013). According to the World Health Organization (WHO), "poor adherence leads to increased morbidity, mortality and is estimated to incur costs of nearly $100 billion per year" and that "of all medication-related hospitalizations that occur in the United States, between one-third and two-thirds are the result of poor medication adherence" (Brown & Bussell, 2011, p. 304-305).

Some sort of intervention needs to be put in place to ensure that medication prescriptions are being adhered to. Adherence will decrease hospital admissions by accruing fewer medical complications, and will decrease the national healthcare debt by reducing the numbers of preventable patient admissions.

One of the reasons why antihypertensive medication adherence is such a crucial topic is the fact that pharmaceutical companies have created drugs with proven effectiveness to reduce heart failure by 50% and stroke by 45%, deeming adherence imperative for good health outcomes (Wong, Tam, Cheung, Wang, Tong, Sek, & Griffiths, 2013). The problem does not lie in that there are no treatments available for diseases like Coronary Artery Disease (CAD) and hypertension; the problem is that healthcare money is being spent on treating diseases that people have the ability to prevent.

The World Health Organization (WHO) stated, "increasing adherence may have a greater effect on health than any improvement in specific medical treatments" (Brown & Bussell, 2011, p. 312). Non-adherence is an essential factor regarding the reasons patients do not completely improve and maintain their health. Surgeon General C. Everett Koop said it this way: "drugs don't work in patients who don't take them" (Brown & Bussell, 2011, p. 312).

Personal accountability by definition is "the quality or state of being accountable; an obligation or willingness to accept responsibility or to account for one's actions" ("Accountability", n.d.). The involvement of another person to help improve adherence rates comes from researching many different health care interventions, which remind patients to take their medications at a specific time. Numerous different types of automated reminders have been tested to alert patients to take their medications, but this non-personal approach has not produced the results desired by either party involved (Mcdonald, Garg, & Haynes, 2002).

One such study looked retrospectively at using telephone communication interventions to improve health care related behavior and health care delivery services in rural clinics. They looked at the way clinics used telephone contact as a form of "distance medicine" by counseling patients over the phone for behavioral change, and added in face-to-face counseling sessions to see if this would help improve adherence. The study found that telephone delivery interventions (TDI) that relied solely on telephone follow-up care had limited success because they found it was challenging to induce positive behavior changes in such a time-limited contact (McBride & Rimer, 1999).

Poor adherence is due to many factors and only a multilevel coordinated effort between patients, providers, and health care systems will fix the problem. Interventional means help patients achieve better medication adherence rates, thus lowering impending health risks and subsequent costs. Adherence can have enormous positive health care ramifications if improvement is achieved. Higher adherence rates significantly lower blood pressures and cardiovascular complications (Wong et al, 2013). As an added bonus, healthy patient outcomes reduce overall health care costs for hospitals and clinics (McBride & Rimer, 1999).

Purpose of the Study

The purpose of this study was to determine the relationship between antihypertensive prescription adherence and patient demographics within inner city St. Paul; determining this relationship provided information regarding the possibility for necessity of intervention. Due to limited research on patient antihypertensive prescription adherence in inner city St. Paul, Minnesota, a study on medication adherence was

performed to determine if interventional means were needed within this specific population in order to improve medication adherence rates.

Research Questions

The following research questions were addressed in this study:

1. What were the degrees of adherence that patients within inner city St. Paul, Minnesota had towards their antihypertensive medication prescription?
2. What role did patient demographics play in antihypertensive medication adherence rates?

Definitions

Hypertension - otherwise known as high blood pressure, is defined as having a blood pressure above 140 mmHg systolic and/or above 90 mmHg diastolic

Personal Accountability - the quality or state of being accountable; an obligation or willingness to accept responsibility or to account for one's actions.

Medical Adherence - defined as taking the number of pills prescribed by a provider in a given time period, greater than 80% of the time.

Non-adherence - defined as taking the prescribed medication less than 80% of the time

ACE Inhibitors – antihypertensive medication that works via vasodilation to decrease stress on the heart and increase cardiac output

Beta-Blockers – antihypertensive medication that inhibits effects of the sympathetic nervous system in order to reduce the rate and force at which the heart pumps blood

Calcium Channel Blockers – antihypertensive medication that causes muscle cells to

relax and blood vessels to dilate, reducing blood pressure as well as reducing the force and rate of the heartbeat.

Diuretics – antihypertensive medication that lowers blood pressure by causing the kidneys to excrete more sodium and water, which reduces fluid volume throughout the body and dilates blood vessels

Healthcare – ensuring that all people have access to needed promotive, preventive, curative and rehabilitative health services, of sufficient quality to be effective, while also ensuring that people do not suffer financial hardship when paying for these services

Limitations of the study

This study's results can only be able to be applied to individuals who live within the area defined by the study. Due to the nature of retroactively analyzing electronic medical records, there was a lack of patient input that would have be valuable toward their present adherence rates. Lastly, access to records was limited and did not include all information that could be pertinent to this study, however the appropriate steps with Eastside Health Clinic were taken to gather necessary data for the study.

Conclusion

In the United States, 1 in every 3 adults has a diagnosis of hypertension. Of these, about 75% have been prescribed antihypertensive medication, and of those, only 50% have their blood pressure under control. Due to the nature of hypertension being a largely controllable condition, one of the largest contributors to this lack of control is non-adherence to prescribed medications. This study served to analyze adherence rates of

patients at the Eastside Health Clinic in St. Paul, MN, and further, analyzed adherence based on patient demographics. The results both benefit the clinic by providing insight into their patient population, and serve as a resource for further research in this area.

Chapter 2: Literature Review

Introduction

A review of existing literature was performed to support the study undertaken in this thesis. Adherence rates have been shown to vary based on population sample demographics, which will be a facet of the literature review. The literature review also focuses specifically on the different types of patient, physician and health care system interventions that have been attempted and their subsequent success rates on increasing antihypertensive medication adherence. The researchers have not found any studies on interventions on this population in the inner city population of St. Paul, MN.

Survey of population sample characteristics and their effect on adherence

Medication adherence is an inconsistent entity that varies among demographics and people groups (Natarajan et al, 2008). The variable adherence rates across the board make it difficult to make connections and draw conclusions that are generalizable to any given population. Factors such as ethnicity, age, medication type, economic status, employment status, perceived health status, length of time on medication, among others, must all be taken into consideration.

A study entitled "Determinants of medication adherence to antihypertensive medications among a Chinese population using Morisky medication adherence scale" by Lee, Wang, Liu, Cheung, Morisky, and Wong in 2013 explores medication adherence trends among a Chinese population located in the New Territories Region of Hong Kong. In general, only one-third of the hypertensive population has their blood pressure medically under control. Of the two-thirds that do not have their blood pressure under control, the cause is due to poor drug adherence. This study was a cross-sectional study

conducted at an outpatient clinic via subjective patient survey. The self-administered questionnaire included basic socio-demographic profile, self-perceived health status, and self-reported medication adherence (Lee, Wang, Liu, Cheung, Morisky, & Wong, 2013).

The questionnaires were scored on the Morisky scale and further categorized qualitatively based on aforementioned numerical score. What the researchers found is that of the 1114 patients studied, 65.1% of them reported "good adherence" (a score of 6/8 or greater) to their prescribed medications. They also found that "younger age, shorter duration of antihypertensive agents used, job status being employed, and poor or very poor self-perceived health status were negatively associated with drug adherence" (Lee et al, 2013, p. 3). The conclusion from the study was that, as expected, a high percentage of the population showed poor prescription adherence. Therefore, patients that have the associated risk factors listed above should be monitored more closely in order to optimize their medication adherence (Lee et al, 2013).

This study, like many studies of its kind, imposes limitations. The population sample studied is specific to China and the particular demographics of the one clinic, so while the outcomes are important, they cannot be projected directly onto any other singular population group. Another limitation is the subjective nature of self-reporting – there will always be a degree of untruth in these types of responses, whether intended or not. Often, patients do not realize that what they are reporting is not entirely true.

Another study, entitled "Effect of treatment and adherence on ethnic differences in blood pressure control among adults with hypertension" by Natarajan, Santa Ana, Liao, Lipsitz, and McGee in 2008 looked at differences in ethnicity in hypertension control. Specifically, "this analysis provides a new understanding of hypertension

management by evaluating ethnic differences in hypertension treatment, adherence or control, and by analyzing whether differences in treatment or differences in adherence to treatment explain ethnic disparities in hypertension control" (Natarajan et al, 2008, p. 1). Non-white Hispanics were used as the comparison group with comparison between non-Hispanic blacks (NHB) and Mexican Americans (Natarajan et al, 2008).

Anti-hypertensive prescription, for the purpose of this study, included exercise, alcohol restriction, smoking cessation, tension reduction, diet modification, and medication. Adherence was defined as "the willingness and ability of the individual to follow the clinical prescription (pharmacological and non-pharmacological)" and was measured via subjective reporting by the participants. The research showed participants were more likely to adhere to lifestyle modification more so than medication prescription, but that uncontrolled hypertension was higher in both NHB and Mexican Americans despite medication adherence. Even after adjusting for adherence, substantial ethnic differences in hypertension control were still found (Natarajan et al, 2008).

One substantial benefit of this study is that the results were meant to be representative of the entire U.S. population, estimated by the researchers to be 45,511,379 (Natarajan et al, 2008). They found that medication adherence did not significantly vary among ethnicities, but that patients were given certain prescriptions based on their ethnicity (Natarajan et al, 2008). For example, NHB were more likely to be prescribed medications and to decrease their sodium intake than NHW were. Also, it was found that both NHB and Mexican Americans were at an increased likelihood of having uncontrolled hypertension despite taking their antihypertensive medications. All in all, this study is beneficial in showing significant differences between both hypertensive

causes and treatment between ethnicities. Therefore, ethnicity is an important factor to take into consideration when considering both prescription and causes for non-adherence (Natarajan et al, 2008).

An interesting study entitled "Disparities in antihypertensive medication adherence in adolescents" by Eakin, Brady, Kandasamy, Fivush, and Riekert in 2013 looked at antihypertensive medication adherence within an adolescent population. This differs from the standard when it comes to antihypertensive adherence studies because the majority of hypertension patients tend to be more elderly. This study looked specifically at 21 adolescents with essential hypertension recruited from a pediatric nephrology clinic. African American patients were compared with non-African American patients and trends were observed within and between the groups. Monitoring of adherence was done via objective methods by tracking pharmacy refill records using Medication Event Monitoring System (MEMS) (Eakin et al, 2013).

The researchers found that African American adolescents had lower rates of medication adherence than non-African American adolescents over the span of 12 months. Also of note, none of the participants showed high adherence with uncontrolled blood pressure. This suggests that the prescriptions given to the adolescents were appropriate and that adherence is a notable variable in hypertension control (Eakin et al, 2013).

Many advantages originate from this study, first and foremost being the fact that it looked at a population insofar studied very little. Hypertension in children and adolescents is on the rise and that approximately 5% of children and adolescents are currently affected. As this number is projected to keep rising, it is important to keep this

group in mind when looking at methods for improving medication adherence. Another forte of this study is its use of objective measurement. A narrower gap for variability is then based on subjective response and hypothetically provides a tighter data set (Eakin et al, 2013).

Effects of non-adherence on medical costs

The effects of non-adherence are multifactorial. Not only does poor medication adherence lead to poor health outcomes and possibly death, but it leads to increased healthcare service utilization including avoidable hospitalization charges, increased physician and clinic services, emergency room visits, urgent care visits, and treatment centers like nursing homes, hospice and/or dialysis centers (Luga & McGuire 2014).

The costs do not stop there either; the effects of non-adherence roll over into avoidable pharmacy costs and therapy charges for development of comorbid conditions and the diagnostic tests that those conditions require. This does not even account for other important factors such as missing time at work, reduced productivity, and increased disability charges for employers and society (Luga & McGuire 2014). One study looking at the impacts of non-adherence on health and business productivity found that, "…health-related productivity loss costs are 2.3 times higher than the direct health care costs." (Loeppke, Taitel, Haufle, Parry, Kessler, Jinnett, 2014). When the $100-300 billion annually that the U.S. already spends on its medication adherence problem is doubled to account for health-related productivity costs, the amount that medication non-adherence is costing the United States in a year is jarring.

Survey of antihypertensive medication adherence interventions

The measurement of medication adherence within patients is a difficult undertaking mainly because adherence is an individual patient behavior. To assess adherence one typically looks at three different areas: subjective measurements (such as self-report), objective measurements (pharmacy database records) and/or biochemical markers (serum or urine drug levels) (Lee et al, 2013). The strategies initiated by many third party researchers have largely focused on improving adherence through patient health care education, physician-patient teaching and reminder-based self-management interventions (Brown & Bussell, 2011).

One study by the Annals of Internal Medicine looked at provider education alone versus provider education and patient-specific hypertension computerized alert versus provider education, hypertension alert and patient education (Roumie, Elasy, Greevy, Griffin, Xulei, Stone, &…Speroff, 2006). This study showed that educating patients with a letter in the mail advocating medication adherence and lifestyle improvements achieved successful blood pressure (BP) control after six months (Roumie et al, 2006). Patient education positively influenced adherence rates, lowering the average BP to 138/75 mmHg versus provider education alone, which had average BPs of 146/76 mmHg, and compared to provider education and hypertensive alerts groups, which had average BPs of 145/78 mmHg (Roumie, 2006).

In addition to this study, the World Health Organization (WHO) recommends that all patients struggling to adhere to their medication regimen look up additional educational resources available online through websites like www.medlineplus.gov, consult with their local pharmacist and/or engaging in community health seminars

(Brown & Bussell, 2011). Each of these resources has helped patients become more informed about their disease and its potential complications (Brown & Bussell, 2011). The additional educational resources focus on the basic reasons why patients need to take their medication, how adherence will help achieve optimal health outcomes, and prevent future health complications. The whole purpose is to make patients feel more empowered through participation and thus help to motivate them to manage their conditions more diligently through close adherence (Brown & Bussell, 2011).

Another promising intervention conducted by the Cochrane Database Systematic Review board looked at the results of various adherence studies aimed at the self-management of long-term illnesses and their success rates (McBride & Rimer, 1999). The interventions utilized telephone delivery intervention (TDI) through mobile phone messaging and multimedia alerts to monitor their success in changing patient behavior (McBride & Rimer, 1999). The analysis showed that TDIs in the form of weekly telephone calls and text messages for 6 months to hypertensive patients older than 60 years of age significantly enhanced patient medication adherence compared to usual provider care (McBride & Rimer, 1999). This type of intervention illustrates that text messages and telephone calls do help remind patients to take their medications on time.

However in these studies, many researchers ran into several telephone based delivery problems include non-workable phone numbers, address changes and behavioral issues with patients (de Jongh, Gurol-Urganci, Vodopivec-Jamsek, Car, Atun, 2012). These problems caused significant increases in project time length and overall data analysis challenges because a handful of patients were unable to be followed up with for various economic reasons. Due to the factors of project time length and other challenges,

intentional TDIs have not been as effective with minority patient populations (de Jongh et al, 2012).

Nevertheless, a study conducted by the Contemporary Clinical Trials takes physician and patient adherence interventions and applies them to a randomized multi-site, multi-cultural economically disadvantaged population and observes the effectiveness of a stepped care type of intervention (Gerin, Tobin, Schwartz, Chaplin, Rieckmann, Davidson, Ogedegbe, 2007). In their study, they monitor behavior objectively using electronic pill bottles to assess the effectiveness of their interventions (Gerin et al, 2007).

The first step in the Contemporary Clinical Trials adherence intervention was to provide home-based patient self –blood pressure monitoring (SBPM) to everyone in the trial. After 3 months of monitoring, those whose BP had not improved were randomly assigned to either continue SBPM or continue SBPM and add on TDI nurse based management (Gerin et al, 2007). Their study design aimed to test the effectiveness of commercially available products in economically disadvantaged individuals in more than 230 community-based primary care clinical sites (Gerin et al, 2007). Preliminary results are currently underway. One limiting factor in the results thus far is the fact that more than 75% of the patients in the trial are women, which may not accurately reflect male adherence rates (Gerin et al, 2007).

Issues with Previous Attempted Interventions

Many studies have been conducted, as stated above, that have compared multiple avenues of interventional means toward medication adherence and their benefits. Yet, there are some issues that need to be addressed before determining whether intervention in a clinic is the right choice for those patients.

A plethora of possible issues occur when dealing with medication adherence interventions. These issues are not just about the patient, but about the provider, and the practice of medicine as well (Mendys, Zulling, Burkholder, Granger & Bosworth, 2014). Before even implementing an intervention on medication adherence, Mendys et al suggested thinking about three specific questions pertaining to the administrative side of implementation including, "Have you identified medication adherence as a priority within your practice or organization? How do you want to affect medication use in your patient (population)? What are the available resources in terms of people, process, and investments to achieve your medication adherence goals?" (Mendys et al, 2014, p. 1034).

First and foremost, a clinic or hospital must determine if medication adherence is really an issue and whether or not they want to improve it. Then, that clinic or hospital must agree on a goal to achieve with medication adherence, whether it is improving a number of patients or increasing adherence by a certain percentage. Finally, the clinic or hospital has to have the necessary resources including time, personnel, and money in order for an intervention to be successful (Mendys et al, 2014). If any of the questions are unable to be answered or do not have a solution, intervention will not be as successful and may even cost the clinic or hospital time and money in the future (Mcdonald, Garg, & Haynes, 2002).

Mcdonald, Garg, and Haynes did a study that reviewed different types of interventions for patient medication adherence and compared their benefits and complications (2002). The types of interventions they reviewed, alone or in combination, included oral and written material and programmed learning; compliance therapy; automated telephone, computer-assisted patient monitoring and counseling; manual

telephone follow-up; family intervention; provision at the worksite; simplified dosing; tailoring the regimen to daily habits; special reminder pill packaging; dose-dispensing units of medication and medication charts; appointment and prescription refill reminders; reduced frequency of visits and partial payment for blood pressure monitoring equipment (Mcdonald et al, 2002). Through their review of several studies, Mcdonald et al found that, "Almost all the interventions that were effective for long-term care were complex, including combinations of more convenient care, information, counseling, reminders, self-monitoring, reinforcement, family therapy, and other forms of additional supervision or attention" and that "even the most effective interventions only had modest effects" (Mcdonald et al, 2002, p. 2868). That being said, interventional means are difficult to predict whether or not they will effective and Mcdonald et al concluded that "current methods of improving adherence for chronic health problems are mostly complex, labor-intensive (and thus expensive), and not predictably effective" (Mcdonald et al, 2002, p. 2877).

Summary

As one can see, many different interventions are available to help improve medication adherence but, like the WHO points out, only a multilevel coordinated effort between patients, providers, and the health care system can successful adherence be achieved (Brown & Bussell, 2011). Based on the review of literature there has not been a study on the necessity of interventional needs for patient antihypertensive medication adherence within inner city St. Paul, MN at the Eastside Clinic. This study seeks to determine whether or not interventional means are needed to improve adherence to antihypertensive medication.

Chapter 3: Methodology

Overview

This chapter includes the following information: study design, study subject variables, population, validity and reliability, procedures, data analysis, and limitations.

Introduction

The purpose of this study was to determine whether or not interventional means were needed to improve adherence to antihypertensive medications in inner city St. Paul, MN. This study addressed and analyzed two questions regarding the research process.

1. What role do patient demographics play in antihypertensive medication adherence rates?
2. What were the degrees of adherence that patients within inner city St. Paul, Minnesota have towards their antihypertensive medication prescription?

Study Design

This research project was a descriptive, retrospective, quantitative research study regarding patients at the Eastside Health clinic in St. Paul, Minnesota. Data regarding medication adherence parameters was retroactively analyzed, keeping patient information anonymous, looking for patterns between patients that were adherent and patients that were not. Data analysis included sorting data into excel spread sheets based on blood pressure measurements, age, race, different types of anti-hypertensive medications and over time, looking for medication adherence based on subsequent blood pressure ranges. Adherence was analyzed using each patient's blood pressure measurements gathered from his or her six most recent clinic visits. Once the data was sorted, it was analyzed,

looking for correlations in patterns within adherence or non-adherence and therefore drawing conclusions regarding contributory factors to adherence rates.

Study Subject Variables

This study compiled information on how the dependent variable, blood pressure, was affected by the independent variable, their adherence to prescribed antihypertensive medication, which was hypothesized to depend on the patient's demographics.

Population

The sample population was made up of patients of variable demographics at the Eastside Health Clinic in St. Paul, MN. Patients must have had a hypertension diagnosis on record to be considered for this study, and antihypertensive medications prescribed needed to be an ACE inhibitor (ACEI), a beta-blocker (BB), a calcium channel blocker (CCB), diuretic or a combination of these. At the time the first clinical event was assessed a patient's blood pressure had to be optimized, meaning that the patient's previous diagnosis of hypertension was considered controlled on the initial prescribed regimen. From that point in time forward, adherence was objectively monitored by blood pressure measurements over the course of their six most recent clinic visits to see if that particular patient's blood pressure stayed within the accepted national standard (systolic pressure of 100-140 mmHg and a diastolic pressure of 60-90mmHg).

Utilizing blood pressure optimization ensured that non-adherence was due to a patient's choice, demographics, or another factor and not due to the initial problem of trying to get a patient's hypertension under control. Patients were selected at random for analysis, with a goal of at least 50 patients in each category (adherent and non adherent). The number 50 was chosen in order to strengthen the adherence analysis. No patient

identifiers were used, ensuring anonymity of the subjects. Eligible subjects were patients with the necessary criteria dating from March 2010 to November 2015.

Validity and Reliability

Reliability and validity was ensured based on the fact that all of the data came from the same clinic that adheres to nationally accepted blood pressure standards. Retroactive data collection excluded possible extraneous factors that could skew data. Data was quantitative only, not allowing for analysis of situational factors that could cause or explain outliers in the data set.

Procedures

The researchers of this study gathered pre-collected data via chart review from the Eastside Health Clinic under physician supervision. Data collected included blood pressure measurements, age, race, employment status, marital status, and different types of anti-hypertensive medications prescribed. The appropriate Internal Review Board measures were taken to gain permission from both the clinic and the providers of these patients. Patient data from the initial visit as well as the following 5 visits was collected regarding blood pressure medication adherence through objective blood pressure cuff readings.

Data Analysis

The data collected from the clinic was analyzed using the SPSS software. Analysis included correlational studies and trend analysis in order to compare patient demographics with adherence rates. The quantitative data was then compiled into graphs, tables, and charts to look for patterns within the group of patients that were adherent and within those that were not.

Patients were deemed fully adherent if all measurements of their blood pressure, both systolic and diastolic, stayed within the range of the national guidelines. Partial adherence was defined as any of the twelve measurements falling outside of the specified range, and non-compliance was defined by blood pressure that rose above the national guidelines on two or more of the twelve measurements. All data was collected and stored on a flash drive that remained at Bethel University.

Limitations

The following were limitations that the researchers believed to be inherent and potential weaknesses of this study. The following was out of the researchers' control:

1. Changes in prescription of antihypertensive medications during the data collection period
2. Not all data collected followed the same timing. For example, for one patient, six visits may span six months, while for another patient, six visits may span six years
3. Location was highly specific and therefore only representative of a small population, regardless of how diverse the sample population may be.

Delimitations of this study were the decisions to only include data from one clinic and to only include patients prescribed on ACEIs, beta blockers, calcium channel blockers and diuretics, excluding patients on all other forms of antihypertensive medications. The decisions to choose these specific parameters were based on previous antihypertensive research (Mann, 2014).

Conclusion

This study was performed as a retrospective analysis via chart review using anonymous patient data from the Eastside Health Clinic in St. Paul, MN. Adherence was

assessed over the course of 6 visits and was further broken down by patient demographics, looking for patterns and correlations between patients who were adherent and those who were not. The results were quantified and assessed utilizing trend analysis and correlational studies via SPSS.

Chapter 4: Results

Introduction

Data was collected on 123 patients at the Eastside Health Clinic (ESHC) that met the criteria to be included in the study. Their blood pressure had to be optimized (below 140/90) with 5 subsequent visits recorded in the electronic medical record (EMR). As the EMR system dates back only 6 years, all data collected falls within that time frame. Demographic categories assessed include antihypertensive medication type prescribed, gender, age, employment status, marital status, race, and comorbidities.

Results

The average systolic pressure of all participants prior to data collection was 133.3 mmHg and was reduced to 127.2 mmHg over the span of the subsequent 5 visits. Paired t-tests were done to compare changes in blood pressure measurement between subsequent measurements and protected dependent t-test post hawk analysis was conducted to evaluate the specific differences between visits as well as significance of these values.

Adherence was assessed as true adherence, partial adherence, or non-adherence. True adherence was defined systolic measurements between 100mmHg and 140 mmHg and all diastolic measurements remaining between 60 mmHg and 90 mmHg, per the AHA, over the course of 6 clinic visits. One of any of the measurements – either systolic or diastolic – outside the range of these values deemed the patient partially adherent. Two or more measurements outside of these values deemed non-adherence.

Of the 123 participants, 70 were male and 53 were female. Of the 70 male participants, 40 fell into the categories of either true or partial adherence, meaning that 30

or 42.8% were technically non-adherent. Of the 53 female participants, 28 were either truly or partially adherent, with 25 or 47.2% falling into the non-adherent category.

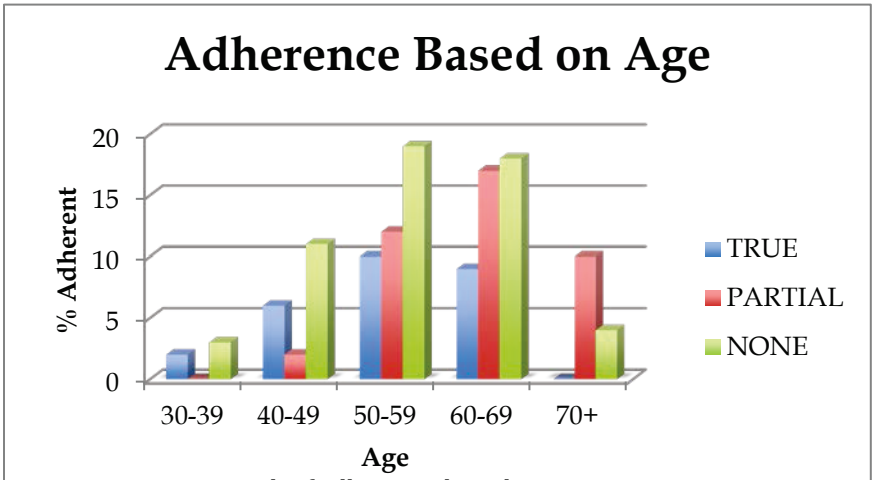

Figure 1. Bar graph of adherence based upon age.

5 of the 123 participants were between the ages of 30 and 39, 19 were age 40-49, 41 were age 50-59, 44 were age 60-69, and 14 were age 70+. The participants aged 30-39 showed 2 (40%) true or partial adherence with 3 (60%) non-adherence; 40-49 showed 8 (42.1%) with true or partial adherence and 11 (57.9%) with non-adherence; 50-59 showed 22 (53.7%) with true or partial adherence and 19 (46.3%) with non-adherence; 60-60 showed 26 (59.1%) with true or partial adherence and 18 (40.9%) with non-adherence; ages 70 and higher showed 10 (71.4%) with true or partial adherence and 4 (28.6%) with non-adherence *(see figure 1).*

There were 42 participants employed and 81 unemployed; it's pertinent to note that unemployed includes previously employed patients who may now be retired. 17 (41.5%) of the 42 employed participants showed true or partial adherence, with 25 (59.5%) being non-adherent. 51 (63.0%) of the 81 unemployed participants showed true or partial adherence with 30 (37.0%) non-adherent. When comparing mean optimized

measurements with mean post measurements regarding employment status, there is evidence of decrease in both categories *(see table 1)*.

Employment Status		Optimized Systolic	Post-Systolic	Optimized Diastolic	Post-Diastolic
Unemployed	**Mean**	**131.85**	**126.09**	**79.42**	**76.86**
	N	81	81	81	81
	Std. Deviation	24.42	16.87	11.59	10.66
Employed	**Mean**	**136.21**	**129.33**	**83.45**	**80.36**
	N	42	42	42	42
	Std. Deviation	18.14	20.76	13.05	11.59
Total	**Mean**	**133.34**	**127.20**	**80.79**	**78.06**
	N	123	123	123	123
	Std. Deviation	22.50	18.27	12.21	11.06

Table 1. Blood pressure measurements (mmHg) based upon employment status.

39 of participants were married and 84 were single, including widows/widowers and divorcees. 22 of 39 (56.4%) married participants were either truly or partially adherent, while 17 (43.6%) were non-adherent. 46 of the 84 single patients (54.8%) were truly/partially adherent and 38 (45.2%) were non-adherent. Comparing mean optimized measurements with mean post measurements, there is again evidence of decrease in both categories *(see table 2)*.

Marital Status		Optimized Systolic	Post-Systolic	Optimized Diastolic	Post-Diastolic
Single	**Mean**	**133.19**	**127.12**	**80.05**	**77.85**
	N	84	84	84	84
	Std. Deviation	20.56	18.25	12.27	11.12
Married	**Mean**	**133.67**	**127.36**	**82.41**	**78.51**
	N	39	39	39	39
	Std. Deviation	26.48	18.56	12.07	11.08
Total	**Mean**	**133.34**	**127.20**	**80.80**	**78.06**
	N	123	123	123	123
	Std. Deviation	22.50	18.27	12.21	11.06

Table 2. Blood pressure measurements (mmHg) based upon marital status.

Assessing the patient population based on race showed that there were 51 Caucasian, 37 African American, 21 Hispanic, and 14 of an ethnicity not otherwise listed among the 123 participants. Of the 51 Caucasians, 29 (56.9%) were truly or partially adherent and 22 (43.1%) were non-adherent. 18 of 37 (48.6%) African Americans were

truly or partially adherent and 19 (51.2%) were non-adherent. 15 of 21 (71.4%) Hispanic participants were truly or partially adherent and 6 (28.6%) were non-adherent. Of the ethnicities otherwise not specified, 6 of 14 (42.9%) were truly or partially adherent and 8 (57.1%) were non-adherent. When comparing mean BP measurements between optimized and post-BP values, there was decrease in every category except the diastolic measurements in the black population, which showed a very slight increase (while still remaining under the 90 mmHg required for adherence) *(see table 3).*

Race		Optimized Systolic	Post-Systolic	Optimized Diastolic	Post-Diastolic
White	**Mean**	**129.84**	**123.14**	**81.35**	**77.57**
	N	51	51	51	51
	Std. Deviation	19.68	20.53	13.42	9.46
Black	**Mean**	**138.27**	**132.16**	**81.57**	**82.00**
	N	37	37	37	37
	Std. Deviation	19.81	13.66	11.61	11.14
Hispanic	**Mean**	**128.86**	**128.38**	**75.62**	**74.76**
	N	21	21	21	21
	Std. Deviation	32.85	20.47	9.85	10.28
Other	**Mean**	**139.79**	**127.07**	**84.50**	**74.36**
	N	14	14	14	14
	Std. Deviation	17.85	14.62	11.07	14.86
Total	**Mean**	**133.34**	**127.20**	**80.80**	**78.06**
	N	123	123	123	123
	Std. Deviation	22.50	18.27	12.21	11.06

Table 3. Blood pressure measurements (mmHg) based upon race.

Assessment of patients with comorbidities included 18 with Diabetes Mellitus (DM), 2 with cancer, 27 with cardiovascular disease, 30 with conditions not otherwise specified, 28 with two or more comorbid conditions, and 18 with none. Adherence rates among comorbidities are as follows: 13 (72.2%) with DM truly/partially adherent, 5 (27.8%) non-adherent; 2 (100%) with cancer truly or partially adherent, 0 (0%) non-adherent; 14 (51.9%) with cardiovascular disease truly/partially adherent, 13 (48.1%) non-adherent; 19 (63.3%) with other conditions truly/partially adherent, 11 (36.7%) non-adherent; 13 (46.4%) of patients with two or more comorbid conditions truly/partially

adherent, 15 (53.6%) non-adherent; and 7 (38.9%) with no comorbid conditions truly/partially adherent, 11 (61.1%) non-adherent. Within these categories, there was an overall decrease of mean optimized measurements when compared to mean post-measurements, except in the sect of patients with diabetes mellitus, who showed a slight increase in diastolic measurement (while still remaining under the 90 mmHg required for adherence) (*see table 4).*

Comorbidities		Optimized Systolic	Post-Systolic	Optimized Diastolic	Post-Diastolic
DM and other	**Mean**	**125.94**	**124.56**	**78.56**	**79.56**
	N	18	18	18	18
	Std. Deviation	16.87	23.07	11.88	13.75
CA	**Mean**	**132.00**	**123.00**	**87.00**	**68.00**
	N	2	2	2	2
	Std. Deviation	.00	1.41	4.24	5.66
CV and other	**Mean**	**137.44**	**124.48**	**83.96**	**79.19**
	N	27	27	27	27
	Std. Deviation	22.48	13.31	12.49	8.60
Other	**Mean**	**131.07**	**125.10**	**81.97**	**78.57**
	N	30	30	30	30
	Std. Deviation	16.92	21.25	14.19	10.29
2 or more	**Mean**	**135.79**	**132.43**	**76.71**	**75.82**
	N	28	28	28	28
	Std. Deviation	31.67	16.74	9.27	12.66
None	**Mean**	**134.72**	**129.72**	**82.00**	**78.61**
	N	18	18	18	18
	Std. Deviation	19.69	17.22	12.29	10.70
Total	**Mean**	**133.34**	**127.20**	**80.80**	**78.06**
	N	123	123	123	123
	Std. Deviation	22.450	18.27	12.21	11.06

Table 4. Blood pressure measurements (mmHg) based upon comorbidities.

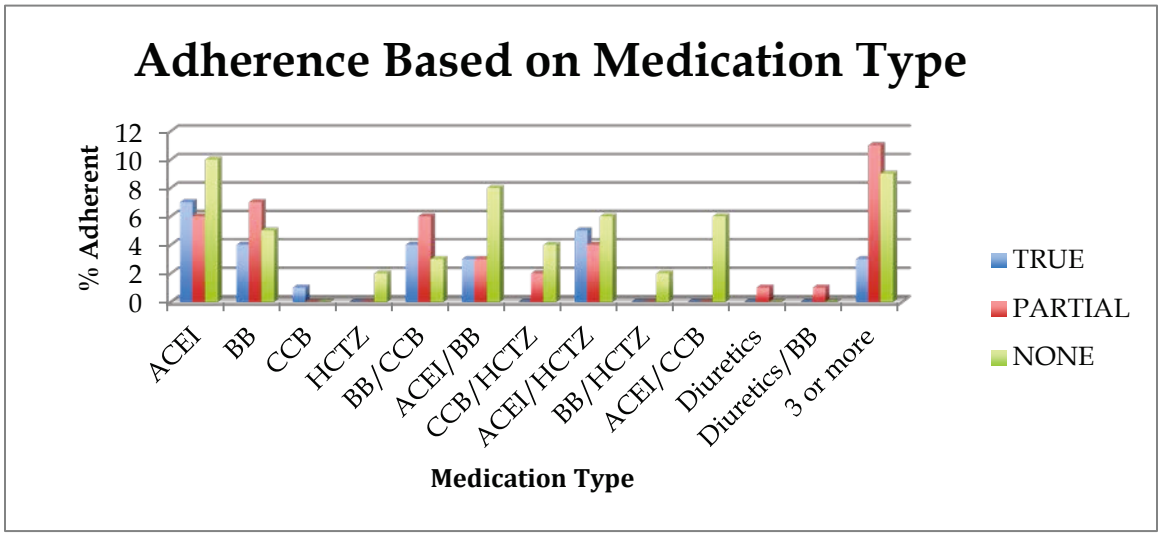

Figure 2. Bar graph of adherence based upon medication type.

Antihypertensive prescriptions included 23 ACEI, 16 BB, 1 CCB, 2 HCTZ, 13 BB/CCB, 14 ACEI/BB, 6 CCB/HCTZ, 15 ACEI/HCTZ, 2 BB/HCTZ, 10 ACEI/CCB, 1 diuretics, 1 diuretics/BB, and 23 on combinations of three or more. The adherence breakdown is as follows: 13 (56.5%) on ACEI truly/partially adherent with 10 (43.4%) non-adherent; 11 (68.8%) on BB truly/partially adherent with 5 (31.3%) non-adherent; 1 (100%) on CCB truly/partially adherent; 0 (0%) on HCTZ truly/partially adherent, 2 (100%) non-adherent; 10 (76.9%) on BB/CCB truly/partially adherent and 3 (23.1%) non-adherent; 6 (42.9%) on ACEI/BB truly/partially adherent with 8 (57.1%) non-adherent; 2 (33.3%) on CCB/HCTZ truly/partially adherent with 4 (66.6%) non-adherent; 9 (60%) on ACEI/HCTZ truly/partially adherent with 6 (40%) non-adherent; 0 on BB/HCTZ truly/partially adherent with 2 (100%) non-adherent; 0 on ACEI/CCB truly/partially adherent with 6 (100%) non-adherent; 1 (100%) on diuretics truly/partially adherent; 1 (100%) on diuretics/BB truly/partially adherent; and 14 (60.9%) on three or more truly/partially adherent with 9 (39.1%) non-adherent.

		Paired Differences		
		Mean	**Standard Deviation**	**Significance**
Pair 1	**Systolic 1- Systolic 2**	-.48	22.84	.828
Pair 2	**Systolic 2- Systolic 3**	1.08	22.83	.600
Pair 3	**Systolic 3- Systolic 4**	-2.27	21.28	.239
Pair 4	**Systolic 4- Systolic 5**	5.92	25.7	**.012**
Pair 5	**Systolic 5- Systolic 6**	1.86	25.2	.414

Table 5. Results from paired t-tests run between subsequent systolic measurements.

Paired t-tests were run on the entirety of the data comparing the mean systolic blood pressures from one visit to the next. As there were 6 visits evaluated, there were 5 significance values calculated (see table 5). Of the 5 values calculated, only the significance value of the 4th pair can be considered statistically significant, as it falls below the .05 required for significance. Overall significance values calculated between the initial (optimized) measurement and the final measurement were .623 and .540, respectively. Neither of these values is statistically significant.

All of the preceding data was collected by the researchers under direct physician observation and was subsequently analyzed using SPSS software to obtain the data shared. The following chapter will discuss these results.

Chapter 5: Discussion

Introduction

The purpose of this study was to determine overall adherence rates of a specific population within Eastside Health Clinic in inner city St. Paul, MN. Furthermore, analysis was done taking into account demographic differences within the population sample to determine the existence of patterns within subgroups.

Discussion of Findings

Overall, the data shows that adherence rates proved patients to be more compliant with their antihypertensive medications than predicted. In nearly every category assessed, mean systolic and diastolic blood pressures were lower at the 6th visit than they were at the beginning, despite the fact that their inclusion in the study necessitated previous optimization.

Based on the adherence results of the study, 27/123 patients were truly adherent to the AHA guidelines. This means that only 22% of the patients at ESHC were adherent compared with 50% nationally. However, when partial adherence and true adherence were combined, a total of 68 of the 123 patients (55%) were adherent, much closer to the national adherence expectation of approximately 50%. Based on these results, ESHC is doing comparably similar with national adherence rates.

National studies like the ones previously listed draw their conclusions based on an 80% adherence rate - the data collected in this study had even more stringent parameters, with just one missed blood pressure measurement out of the AHA standard deeming them partially adherent. Therefore it is more reasonable to compare this study's true and partial

adherence data together to gain a better picture of the actual representation of adherence rates within the inner city of St. Paul patient population.

In almost every category, non-adherence rates were larger than partial and true adherence, but when comparing these statistics with the mean overall change in blood pressure, one can see that the average systolic blood pressures for the clinic dropped by 6 mmHg. One potential reason for this finding could be the fact that the overall mean change in blood pressure factors in all the different aspects about a patient, for instance comorbidities, marriage, and employment status. It doesn't discriminate between categories and is able to better absorb the non-adherent patients to show that the clinic patients are getting objectively healthier based on their 6 most recent BP checks.

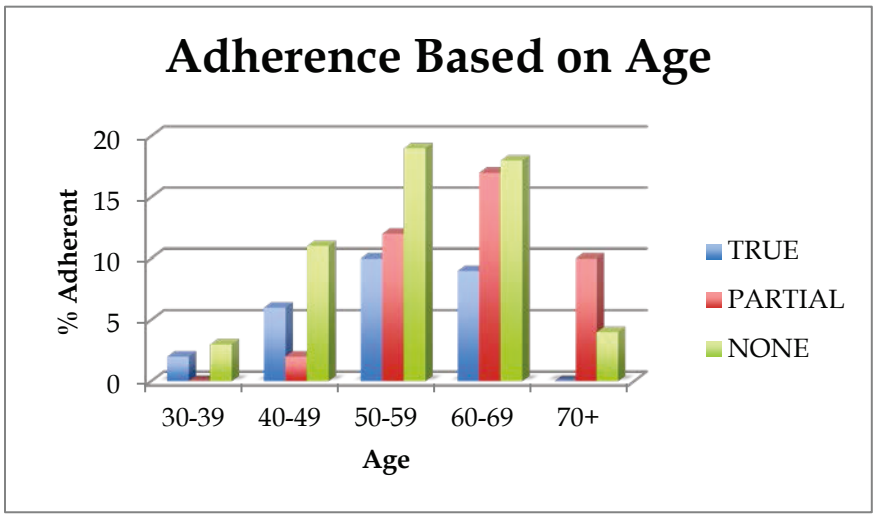

Figure 1. Bar graph of adherence based upon age.

The data shows that demographics play an inconsistent role in adherence. There are very few discernible patterns within the distributions of each category. The exception here is age – the majority of the people included in this study were between the ages of 50-69. The data shows that as a person ages, distribution of adherence rates follow a bell-shaped curve (see figure 1).

On the other hand, looking at adherence rates based on medication type for example, the distribution is much less consistent. It would be reasonable to assume that the more medications a person is taking, the less adherent they may be. However, the data does not support this, as non-adherent patients outnumber true and partial adherent patients in many categories, not including those patients on more than three medications. Looking at adherence based on comorbidities, non-adherent patients outnumbered both true and partially adherent patients in all categories except for Diabetes Mellitus and cancer. This suggests that comorbidities that are more cardiovascular in nature may be associated with lower levels of control over blood pressure.

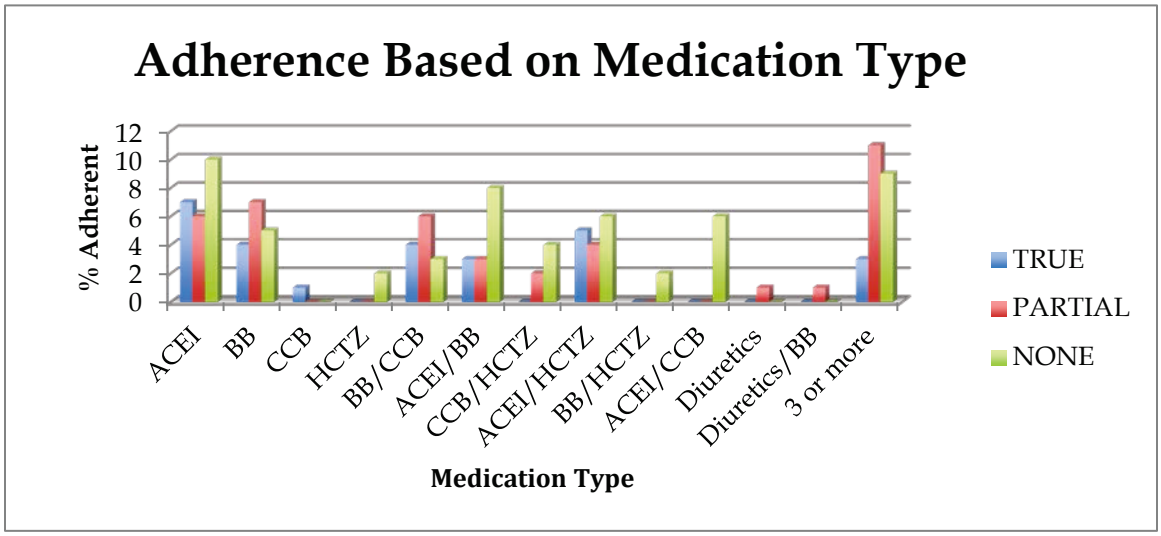

Figure 2. Bar graph of adherence based upon medication type.

Based on the data analysis, patients were clearly not 100% adherent based on the adherence standards utilized by this study. However, the conclusion can be drawn that, despite the lack of adherence, these patients were considered by AHA standards to be well controlled on their specific medication regimens. In nearly every category, as stated previously, mean systolic pressures and diastolic pressures either decreased or remained

largely the same. Even in the few categories in which mean pressure increased slightly, it was still lower than the 140/90 mmHg that the AHA requires. The overall change in systolic blood pressure for the entire sample population, despite imperfect adherence rates, was a decrease from 133.3 mmHg to 127.2 mmHg. The overall change in diastolic pressure was 80.8 mmHg to 78.1 mmHg.

The paired t-tests that were run on the data showed significance values regarding changes between two subsequent visits and therefore blood pressure measurements. The significance values of these t-tests were largely non-significant. The exception was the 4th pair that compared visits 4 and 5, with a significance value of .012. The significance value based on comparison between groups for the initial (optimized) blood pressure measurements was .623; the significance value for comparison between groups for the final blood pressure measurements was .540. When the optimized were compared to the final, the significance value was .218 and therefore not statistically significant. Therefore, while conclusions can be drawn based on the results of this study, there can be no statistical significance claimed.

Further Study

Based on the findings that more patients were partially/truly adherent vs. non-adherent at ESHC, it would be pertinent to do a follow up study asking patients at this clinic to complete a survey. This would serve to show whether patients actually took their medications as prescribed, how often they took them, if they regularly checked their blood pressures at home, what factors affected their adherence, and how seriously they take their health concerns. Ultimately, this would provide more insight into the wide

array of possibilities as to why patients are not fully adherent with their medication regimens in inner city St. Paul, Minnesota.

This study lays the foundation for a multitude of further research possibilities. Further research into this particular population group should include methods of determining the presence of interventional methods that may already be present. Further research separate from this study could proceed in several different directions. Looking further into efficacy of existing interventional methods as well as potential new interventional methods that could be used would be pertinent. Keeping in mind, of course, that the patient population these methods would be geared towards may not have access to or the ability to utilize electronic communication.

Limitations

When collecting the data for patient's blood pressures, limitations of the study design became apparent. The researchers were unable to gather data on whether or not a patient's blood pressure prescription was changed or which medication was started initially. Therefore, it is impossible to know when a particular medication was added to their current treatment plan. Because treatment plans were initiated based on AHA guidelines, it is possible to infer which type of antihypertensive was initially prescribed, but that does not take into consideration the wide range of possibilities as to why the provider may have started with a different medication or changed the prescription at some point.

Another limitation of this study is that many of these patients did not fit easily into one category. For example, a person may have worked their entire life and retired by the time of data collection, placing them in the category of "unemployed". This limitation

applies to nearly every category, with the exception of permanent traits such as gender. Therefore, it must be kept in mind that the data was collected based on the categorical status at the present moment in the chart.

Another limitation was that the method of data collection did not inform the researchers of whether or not interventional methods were already in place for this patient. Interventional methods, as mentioned before, included techniques such as telephone calls, text alerts, emails, and 7-day pill organizers. It's also possible that among the patients whose data was utilized were patients who lived in coordinated care, and therefore had medications administered by a healthcare professional. This includes but is not limited to rehabilitation institutions, drug and alcohol rehabilitation, post-operative nursing home stays, transitional care units, and assisted living.

Conclusion

Based upon the data that has been collected and analyzed, it may be concluded that interventional means are not needed within the patient population at Eastside Health Clinic in St. Paul, MN. While a significant change was not observed statistically and overall adherence rates were imperfect, patients may still be considered well controlled on their current medication regimens. This study lays the foundation for a multitude of further research possibilities and may be utilized as a resource should further studies be conducted.

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Appendix A: IRB Approval

Request for Approval of Research with Human Participants In Social and Behavioral Research

Institutional Review Board for Research with Humans
Bethel University
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St. Paul, MN 55112

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Research Advisor- Dr. Mary Michener, Human Services, P.O. 2354 Bethel University Office Center 1306 W County Road F, St. Paul MN 55112, x: 8001, mary-michener@bethel.edu

Research Title: Antihypertensive Medication Adherence
Keywords: medication, adherence, hypertension

A. OVERVIEW

Introduction: In the United States, an estimated 1 in every 3 adults, a total of 77.9 million people, have high blood pressure. Of those adults, about 75% have been prescribed antihypertensive medication, but 48% do not have their blood pressure under control. Non-adherence to prescribed medication stands out as one of the leading contributors to hypertension, with the average patient adhering to their entire prescription only 50% of the time.

Purpose Statement: The purpose of this study is to determine the relationship between antihypertensive prescription adherence and patient demographics within inner city St. Paul; determining this relationship will provide information regarding the necessity of intervention

Research Questions:

1. What are the degrees of adherence that patients within inner city St. Paul, Minnesota have towards their antihypertensive medication prescription?

2. What role do patient demographics play in antihypertensive medication adherence rates?

B. PARTICIPANTS

All participants will be adults with normal cognitive function and are established patients at the Eastside Health Clinic in St. Paul, Minnesota. Data from approximately 100 patients will be utilized in the study. Patients must have a hypertension diagnosis on record to be considered for this study, and antihypertensive medications prescribed must be an ACE inhibitor (ACEI), a beta-blocker (BB), a calcium-channel blocker (CCB), diuretic, or a combination of these. Blood pressure must be optimized, meaning it is within national guidelines and considered controlled (a systolic pressure of 100-140 mmHg and a diastolic pressure of 60-90mmHg) at the time the first clinical event is assessed. No patient identifiers will be used, ensuring anonymity of the subjects. Eligible subjects will be patients with the necessary criteria dating from the present back to 3-2010. Patients will not be contacted, as anonymity will be maintained throughout the study.

Inclusion Criteria: Patients must have an established diagnosis of hypertension, have a current prescription for either an ACE inhibitor, beta-blocker, a calcium-channel blocker (CCB), diuretic, or a combination of these, have an optimized blood pressure, and have 6 sequential clinic visits since 3-2010.

Exclusion Criteria: Patients with a non-optimized blood pressure or fewer than 6 visits to the clinic since 3-2010.

C. INFORMED CONSENT

Not applicable

D. ABSTRACT AND PROTOCOL

Research Design: This research project will be a descriptive, retrospective, quantitative research study regarding patients at the Eastside Health clinic in St. Paul, Minnesota. Data regarding medication adherence parameters will be retroactively analyzed, keeping patient information anonymous, looking for patterns between patients that are adherent and patients that are not. Data will first be sorted based on blood pressure, age, race, employment status, marital status, comorbidities, and type of medication. Over time, adherence will be monitored based on blood pressure ranges.

Protocol: Pre-collected data will be gathered via chart review from the Eastside Health Clinic under physician supervision. The appropriate measures will be taken regarding permission from both the clinic and the providers of these patients. (See attached form for Bethel - Eastside Health Clinic agreement). Patient data from the initial visit as well as the following 5 visits will be collected regarding blood pressure medication adherence through objective blood pressure cuff readings. The data collected from the clinic will be analyzed using the SPSS software. Analysis will include correlational studies and trend

analysis in order to compare patient demographics with adherence rates. The quantitative data will then be compiled into graphs, tables, and/or charts to look for patterns between patients that are adherent and those that are not.

E. RISKS

This study will pose no risk to the patients involved.

F. CONFIDENTIALITY

Only the researchers listed above will have access to the collected information, and all information will be stored on a secure flash drive. The information will be kept securely in the office of Wallace Boeve, director of Bethel University's PA Program.

Appendix B: Tables and Figures

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	70	56.9	56.9	56.9
	Female	53	43.1	43.1	100.0
	Total	123	100.0	100.0	

Table 6. Frequency based on gender.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	81	65.9	65.9	65.9
	Yes	42	34.1	34.1	100.0
	Total	123	100.0	100.0	

Table 7. Frequency based on employment status.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	84	68.3	68.3	68.3
	Yes	39	31.7	31.7	100.0
	Total	123	100.0	100.0	

Table 8. Frequency based on marital status.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	White	51	41.5	41.5	41.5
	Black	37	30.1	30.1	71.5
	Hispanic	21	17.1	17.1	88.6
	Other	14	11.4	11.4	100.0
	Total	123	100.0	100.0	

Table 9. Frequency based on race.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ACEI	23	18.7	18.7	18.7
	BB	16	13.0	13.0	31.7
	CCB	1	.8	.8	32.5
	HCTZ	2	1.6	1.6	34.1
	BB/CCB	13	10.6	10.6	44.7
	ACEI/BB	14	11.4	11.4	56.1
	CCB/HCTZ	6	4.9	4.9	61.0
	ACEI/HCTZ	15	12.2	12.2	73.2
	BB/HCTZ	2	1.6	1.6	74.8
	ACEI/CCB	6	4.9	4.9	79.7
	Diuretics	1	.8	.8	80.5
	Diuretics/BB	1	.8	.8	81.3
	3 or more	23	18.7	18.7	100.0
	Total	123	100.0	100.0	

Table 10. Frequency based on medication.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DM and other	18	14.6	14.6	14.6
	CA	2	1.6	1.6	16.3
	CV and other	27	22.0	22.0	38.2
	Other	30	24.4	24.4	62.6
	2 or more	28	22.8	22.8	85.4
	None	18	14.6	14.6	100.0
	Total	123	100.0	100.0	

Table 11. Frequency based on comorbidities.

		Paired Differences			
					95% Confidence Interval of the Difference
		Mean	Std. Deviation	Std. Error Mean	Lower
Pair 1	Systolic 1 – Systolic 2	-.44715	22.83986	2.05940	-4.52394
Pair 2	Systolic 2 – Systolic 3	1.08130	22.82636	2.05818	-2.99308
Pair 3	Systolic 3 – Systolic 4	-2.26829	21.27997	1.91875	-6.06665
Pair 4	Systolic 4 – Systolic 5	5.91870	25.69416	2.31676	1.33243
Pair 5	Systolic 5 – Systolic 6	1.86179	25.21297	2.27338	-2.63859

Table 12. Results from paired t-tests run between subsequent systolic measurements

		Paired Differences			
		95% Confidence Interval of the Difference			
		Upper	t	df	Sig. (2-tailed)
Pair 1	Systolic 1 – Systolic 2	3.62963	-.217	122	.828
Pair 2	Systolic 2 – Systolic 3	5.15568	.525	122	.600
Pair 3	Systolic 3 – Systolic 4	1.53007	-1.182	122	.239
Pair 4	Systolic 4 – Systolic 5	10.50497	2.555	122	.012
Pair 5	Systolic 5 – Systolic 6	6.36217	.819	122	.414

Table 13. Results from paired t-tests run between subsequent systolic measurements

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1799.855	5	359.971	.703	.623
Within Groups	59951.803	117	512.409		
Total	61751.659	122			

Table 14. ANOVA results for optimized systolic (systolic 1) measurements.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1372.964	5	274.593	.816	.540
Within Groups	39354.353	117	336.362		
Total	40727.317	122			

Table 15. ANOVA results for end-systolic (systolic 6) measurements.

Race		Systolic 1	Systolic 2	Systolic 3	Systolic 4	Systolic 5	Systolic 6
White	Mean	129.8431	130.2941	133.9804	132.3725	124.4314	123.1373
	N	51	51	51	51	51	51
	Std. Deviation	19.68489	24.07596	23.18835	21.25461	26.60170	20.53000
Black	Mean	138.2703	132.8378	133.2162	135.9189	132.7027	132.1622
	N	37	37	37	37	37	37
	Std. Deviation	19.81392	19.53986	19.55780	21.07971	14.17718	13.65754
Hispanic	Mean	128.8571	137.2381	128.0952	136.8571	127.0476	128.3810
	N	21	21	21	21	21	21
	Std. Deviation	32.84553	21.99069	15.45932	20.39433	14.45156	20.46577
Other	Mean	139.7857	143.8571	133.6429	139.1429	139.2857	127.0714
	N	14	14	14	14	14	14
	Std. Deviation	17.84626	19.20279	19.05703	22.48369	20.49176	14.62066
Total	Mean	133.3415	133.7886	132.7073	134.9756	129.0569	127.1951
	N	123	123	123	123	123	123
	Std. Deviation	22.49803	22.08748	20.38713	21.07188	21.30701	18.27103

Table 16. Systolic measurements (mmHg) and analysis characterized by race.

Race		Diastolic 1	Diastolic 2	Diastolic 3	Diastolic 4	Diastolic 5	Diastolic 6
White	Mean	81.3529	79.7255	81.2353	79.0196	79.3529	77.5686
	N	51	51	51	51	51	51
	Std. Deviation	13.41614	13.66028	12.77277	15.81580	10.78114	9.46204
Black	Mean	81.5676	79.8649	80.5946	82.4054	81.1081	82.0000
	N	37	37	37	37	37	37
	Std. Deviation	11.60589	9.61816	11.41018	11.71528	13.26395	11.14301
Hispanic	Mean	75.6190	78.2857	74.0476	77.3810	74.3333	74.7619
	N	21	21	21	21	21	21
	Std. Deviation	9.84620	9.70125	9.97736	14.27752	10.60817	10.27572
Other	Mean	84.5000	82.0714	83.0000	78.7857	81.3571	74.3571
	N	14	14	14	14	14	14
	Std. Deviation	11.07145	13.95853	10.45871	15.97680	12.62846	14.86145
Total	Mean	80.7967	79.7886	80.0163	79.7317	79.2520	78.0569
	N	123	123	123	123	123	123
	Std. Deviation	12.20519	11.87245	11.87985	14.38981	11.86232	11.06486

Table 17. Diastolic measurements (mmHg) and analysis characterized by race.

Comorbidities		Systolic 1	Systolic 2	Systolic 3	Systolic 4	Systolic 5	Systolic 6
DM and other	Mean	125.9444	130.2778	126.2222	125.1111	120.7778	124.5556
	N	18	18	18	18	18	18
	Std. Deviation	16.86093	18.60046	20.89907	25.69708	12.78122	23.06824
CA	Mean	132.0000	141.0000	129.0000	123.0000	126.0000	123.0000
	N	2	2	2	2	2	2
	Std. Deviation	.00000	41.01219	24.04163	24.04163	31.11270	1.41421
CV and other	Mean	137.4444	134.8519	131.5926	133.9259	123.5556	124.4815
	N	27	27	27	27	27	27
	Std. Deviation	22.48133	28.31241	27.22168	19.38264	26.70830	13.31387
Other	Mean	131.0667	132.6333	133.0333	130.8667	132.5000	125.1000
	N	30	30	30	30	30	30
	Std. Deviation	16.91955	20.63890	18.03729	17.70590	17.01267	21.24626
2 or more	Mean	135.7857	133.1071	136.7857	141.3571	131.2143	132.4286
	N	28	28	28	28	28	28
	Std. Deviation	31.67235	19.34547	18.87063	18.48766	17.48514	16.73858
None	Mean	134.7222	137.8889	134.3889	144.6667	136.8333	129.7222
	N	18	18	18	18	18	18
	Std. Deviation	19.69116	21.61668	13.39508	22.84732	27.44245	17.22107
Total	Mean	133.3415	133.7886	132.7073	134.9756	129.0569	127.1951
	N	123	123	123	123	123	123
	Std. Deviation	22.49803	22.08748	20.38713	21.07188	21.30701	18.27103

Table 18. Systolic measurements (mmHg) and analysis characterized by comorbidities.

Comorbidities		Diastolic 1	Diastolic 2	Diastolic 3	Diastolic 4	Diastolic 5	Diastolic 6
DM and other	Mean	78.5556	80.8333	76.4444	73.7222	73.9444	79.5556
	N	18	18	18	18	18	18
	Std. Deviation	11.87792	10.97189	11.28884	12.31358	9.97333	13.74654
CA	Mean	87.0000	74.0000	71.0000	71.0000	79.0000	68.0000
	N	2	2	2	2	2	2
	Std. Deviation	4.24264	5.65685	15.55635	1.41421	7.07107	5.65685
CV and other	Mean	83.9630	82.2593	82.8519	83.8148	81.5926	79.1852
	N	27	27	27	27	27	27
	Std. Deviation	12.49456	15.41127	16.76008	12.61878	9.22063	8.59354
Other	Mean	81.9667	78.3667	81.7667	75.3333	81.0333	78.5667
	N	30	30	30	30	30	30
	Std. Deviation	14.19442	10.99995	8.14389	16.88773	10.61061	10.28787
2 or more	Mean	76.7143	75.7857	77.6071	82.4643	74.6429	75.8214
	N	28	28	28	28	28	28
	Std. Deviation	9.26506	9.39408	9.63919	13.25947	14.44328	12.65805
None	Mean	82.0000	84.2778	81.1667	83.6667	85.2778	78.6111
	N	18	18	18	18	18	18
	Std. Deviation	12.28581	10.64842	11.34097	13.72846	11.68108	10.69986
Total	Mean	80.7967	79.7886	80.0163	79.7317	79.2520	78.0569
	N	123	123	123	123	123	123
	Std. Deviation	12.20519	11.87245	11.87985	14.38981	11.86232	11.06486

Table 19. Diastolic measurements (mmHg) and analysis characterized by comorbidities.

Marital Status		Systolic 1	Systolic 2	Systolic 3	Systolic 4	Systolic 5	Systolic 6
No	Mean	133.1905	133.1310	130.9048	134.3929	128.9405	127.1190
	N	84	84	84	84	84	84
	Std. Deviation	20.56461	22.83296	21.46817	21.72446	18.54357	18.24955
Yes	Mean	133.6667	135.2051	136.5897	136.2308	129.3077	127.3590
	N	39	39	39	39	39	39
	Std. Deviation	26.47972	20.60427	17.46684	19.80758	26.57774	18.55502
Total	Mean	133.3415	133.7886	132.7073	134.9756	129.0569	127.1951
	N	123	123	123	123	123	123
	Std. Deviation	22.49803	22.08748	20.38713	21.07188	21.30701	18.27103

Table 20. Systolic measurements (mmHg) and analysis characterized by marital status.

Marital Status		Diastolic 1	Diastolic 2	Diastolic 3	Diastolic 4	Diastolic 5	Diastolic 6
No	Mean	80.0476	78.3929	78.4286	78.3571	78.7500	77.8452
	N	84	84	84	84	84	84
	Std. Deviation	12.26603	11.86878	10.98771	14.97922	11.65971	11.11657
Yes	Mean	82.4103	82.7949	83.4359	82.6923	80.3333	78.5128
	N	39	39	39	39	39	39
	Std. Deviation	12.07154	11.45743	13.10844	12.70962	12.37215	11.08311
Total	Mean	80.7967	79.7886	80.0163	79.7317	79.2520	78.0569
	N	123	123	123	123	123	123
	Std. Deviation	12.20519	11.87245	11.87985	14.38981	11.86232	11.06486

Table 21. Diastolic measurements (mmHg) and analysis characterized by marital status.

Employment Status		Systolic 1	Systolic 2	Systolic 3	Systolic 4	Systolic 5	Systolic 6
No	Mean	131.8519	132.3827	130.2963	132.1358	124.9383	126.0864
	N	81	81	81	81	81	81
	Std. Deviation	24.42750	21.34863	20.52404	22.30625	20.51789	16.86950
Yes	Mean	136.2143	136.5000	137.3571	140.4524	137.0000	129.3333
	N	42	42	42	42	42	42
	Std. Deviation	18.13841	23.47209	19.52462	17.42748	20.76817	20.75956
Total	Mean	133.3415	133.7886	132.7073	134.9756	129.0569	127.1951
	N	123	123	123	123	123	123
	Std. Deviation	22.49803	22.08748	20.38713	21.07188	21.30701	18.27103

Table 22. Systolic measurements (mmHg) and analysis characterized by employment status.

Employment Status		Diastolic 1	Diastolic 2	Diastolic 3	Diastolic 4	Diastolic 5	Diastolic 6
No	Mean	79.4198	77.5185	78.5432	77.8272	77.5309	76.8642
	N	81	81	81	81	81	81
	Std. Deviation	11.58864	9.58399	10.98072	12.37113	11.34139	10.66039
Yes	Mean	83.4524	84.1667	82.8571	83.4048	82.5714	80.3571
	N	42	42	42	42	42	42
	Std. Deviation	13.04813	14.50470	13.11966	17.22032	12.27161	11.59020
Total	Mean	80.7967	79.7886	80.0163	79.7317	79.2520	78.0569
	N	123	123	123	123	123	123
	Std. Deviation	12.20519	11.87245	11.87985	14.38981	11.86232	11.06486

Table 23. Diastolic measurements (mmHg) and analysis characterized by employment status.

		True adherence			
		Partial	True	None	Total
Marital	No	29	17	38	84
	Yes	12	10	17	39
Total		41	27	55	123

Table 24. Adherence based on marital status.

		True adherence			
		Partial	True	None	Total
Gender	Male	22	18	30	70
	Female	19	9	25	53
Total		41	27	55	123

Table 25. Adherence based on gender.

		True adherence			
		Partial	True	None	Total
Employment	No	31	20	30	81
	Yes	10	7	25	42
Total		41	27	55	123

Table 26. Adherence based on employment status.

		True adherence			
		Partial	True	None	Total
Race	White	16	13	22	51
	Black	11	7	19	37
	Hispanic	11	4	6	21
	Other	3	3	8	14
Total		41	27	55	123

Table 27. Adherence based on race.

		True adherence			
		Partial	True	None	Total
Comorbidities	DM & Other	9	4	5	18
	CA	1	1	0	2
	CV and Other	6	8	13	27
	Other	11	8	11	30
	2 or more	9	4	15	28
	None	5	2	11	18
Total		41	27	55	123

Table 28. Adherence based on comorbidities.

		True adherence			
		Partial	True	None	Total
Medications	ACEI	6	7	10	23
	BB	7	4	5	16
	CCB	0	1	0	1
	HCTZ	0	0	2	2
	BB/CCB	6	4	3	13
	ACEI/BB	3	3	8	14
	CCB/HCTZ	2	0	4	6
	ACEI/HCTZ	4	5	6	15
	BB/HCTZ	0	0	2	2
	ACEI/CCB	0	0	6	6
	Diuretics	1	0	0	1
	Diuretics/BB	1	0	0	1
	3 or more	11	3	9	23
Total		41	27	55	123

Table 29. Adherence based on medication.

		True adherence			
		Partial	True	None	Total
Age	30-39	0	2	3	5
	40-49	2	6	11	19
	50-59	12	10	19	41
	60-69	17	9	18	44
	70+	10	0	4	14
Total		41	27	55	123

Table 30. Adherence based on age.