AN INTERVENTIONAL STUDY ON ADHERENCE AND BLOOD PRESSURE CONTROL IN A TERTIARY HEALTH FACILITY IN NORTH-WEST NIGERIA

By

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DECLARATION

I declare that the work in this thesis entitled 'An Interventional Study on Adherence and Blood Pressure Control in a Tertiary Health Facility in North-West Nigeria' has been carried out by me in the Department of Clinical Pharmacy and Pharmacy Practice. The information derived from the literature has been duly acknowledged in the text and list of references provided. No part of this thesis was previously presented for another degree or diploma at this or any other institution.

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Name of Student	Signature	Date

CERTIFICATION

This thesis entitled "AN INTERVENTIONAL STUDY ON ADHERENCE AND BLOOD PRESSURE CONTROL IN A TERTIARY HEALTH FACILITY IN NORTH-WEST NIGERIA" by Kamilu Sarki LABARAN meets the regulations governing the award of Doctorate degree in Clinical Pharmacy of Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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ABSTRACT

The prevalence of hypertension in Sub-Saharan Africa has experienced a tremendous increase due to low awareness, treatment and control rates. Despite the scientific and medical advancements, many people are not aware that they have the disease, and fewer than half of those who are aware are adequately treated, thereby leading to increased morbidity and mortality due to complications such as stroke, ischaemic heart disease and renal failure. Non-adherence to antihypertensive medicines is the most important barrier to achieving target blood pressure control. However, in Africa, 63% of hypertensive patients on treatment were non-adherent even though successful treatment of hypertension reduces its burden and mortality. The aim of this research was to determine the impact of pharmacist intervention on adherence to antihypertensives and blood pressure control among patients attending a tertiary facility in North-west Nigeria. This was achieved through an interventional longitudinal study conducted between February, 2016 and February, 2017. The study examined the positive influence of pharmacist-delivered telephone voice call medication education and counselling on treatment adherence among hypertensive patients attending the Cardiac Clinic of the Medical Out-Patient Department of Ahmadu Bello University Teaching Hospital Zaria, North-west Nigeria. Ethical approval was obtained from the Hospital Research and Ethics Committee. The study was conducted on a sample of 130 hypertensive patients who were 18 years or older, had active telephone lines and consented to participate. At baseline and at six weeks, blood pressure values were examined and data on self-reported adherence and its patient-related determinants was collected with the aid of validated questionnaires. The pharmacist-delivered telephone-based education and counselling was provided weekly for a period of six weeks. Patients received six structured education and counselling sessions concerning hypertension, medication instructions, potential side

effects, adherence to healthy lifestyle, medication handling and the benefit of adherence. Statistical analyses were carried out with the IBM® SPSS for Windows statistical software package version 20 (Chicago, IL USA). Chi square tests were used to compare relationships between categorical variables. The *t*-tests or ANOVA were used to compare two or more groups of parametric data respectively, while multivariate logistic regression analysis was conducted to assess the association between determinants of adherence. Statistical significance was set at $p \leq .05$. Out of the 130 patients, fifty-one (39%) were males and 79 (61%) were females. The mean±SD age was 53.7±13.1 years. Majority (58%) of the patients' age was between 41 and 60 years. Majority (91%) of the patients were married and of the Islamic faith (83%). Most (38%) of the patients were house wives, and the majority (44%) had no formal education. Adherence and blood pressure control were found to be low before the pharmacist intervention, with fewer than half of the patients being adherent (38%) and controlled (47%). Patients' adherence rate and blood pressure control rate were increased to 66% and 70% respectively after the pharmacist intervention. Low level of education, old age and short hypertension duration were found to be associated with better adherence. A misconception about hypertension management, affordability of antihypertensives, and strong concerns about the cost and consequences of antihypertensives were found to be associated with low adherence and poor blood pressure control. The pharmacist intervention improved patients' adherence to antihypertensive medicines and blood pressure control. Patients' systolic and diastolic blood pressures were reduced by 10.6±3.1 mmHg and 2.3±1.9 mmHg respectively, with 70% of the patients achieving target blood pressure control at six weeks. Therefore, provision of a pharmacist-delivered telephone-based medication education and counselling service in health care facilities may go a long way in helping patients take their antihypertensive medicines appropriately as well as achieve target blood pressure control.

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ABBREVIATIONS

ABUTH	AHMADU BELLO UNIVERSITY TEACHING HOSPITAL
ACC	AMERICAN COLLEGE OF CARDIOLOGY
ACE	ANGIOTENSIN CONVERTING ENZYME
AHA	AMERICAN HEART ASSOCIATION
ANOVA	ANALYSIS OF VARIANCE
ANP	ATRIAL NATRIURETIC PEPTIDE
AT	ANGIOTENSIN
BMQ	BELIEFS ABOUT MEDICINES QUESTIONNAIRE
BP	BLOOD PRESSURE
CASI	COMPUTER ASSISTED SELF-INTERVIEW
CCB	CALCIUM CHANNEL BLOCKER
CVD	CARDIOVASCULAR DISEASE
DALY	DISABILITY ADJUSTED LIFE YEAR
DBP	DIASTOLIC BLOOD PRESSURE
ESH	EUROPEAN SOCIETY OF HYPERTENSION
FIP	INTERNATIONAL PHARMACEUTICAL FEDERATION
HEC	HYDROXYLETHYL CELLULOSE
HREC	HOSPITAL RESEARCH AND ETHICS COMMITTEE
IBM	INTERNATIONAL BUSINESS MACHINES
IPSF	INTERNATIONAL PHARMACEUTICAL STUDENT'S FEDERATION
ISH	INTERNATIONAL SOCIETY OF HYPERTENSION
JNC	JOINT NATIONAL COMMITTEE
KMO	KAISER MEYER OLKIN

LDL-C	LOW DENSITY LIPOPROTEIN CHOLESTEROL
LMIC	LOW-MIDDLE INCOME COUNTRIES
LR	LIKELYHOOD RATIO
MCBG	MEDICATION COUNSELLING BEHAVIOUR GUIDELINES
MEMS	MEDICATION EVENT MONITORING SYSTEM
MMAS	MORISKY MEDICATION ADHERENCE SCALE
MOPD	MEDICAL OUTPATIENT DEPARTMENT
NAFDAC	NATIONAL AGENCY FOR FOOD AND DRUGS ADMINISTRATION AND CONTROL
NCD	NON COMMUNICABLE DISEASE
NcD	NECESSITY-CONCERNS DIFFERENTIAL
NICE	NATIONAL INSTITUTE FOR HEALTH AND CARE EXCELLENCE
OR	ODDS RATIO
PCA	PRINCIPAL COMPONENT ANALYSIS
SAH	SYSTEMIC ARTERIAL HYPERTENSION
SBP	SYSTOLIC BLOOD PRESSURE
SD	STANDARD DEVIATION
SPSS	STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES
TFV	TENOFOVIR
UK	UNITED KINGDOM
USA	UNITED STATES OF AMERICA
USD	UNITED STATE DOLLAR
WHO	WORLD HEALTH ORGANIZATION

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Hypertension also known as high blood pressure (BP) or arterial hypertension, is a chronic medical condition in which the blood pressure in the arteries is persistently elevated (James *et al.,* 2014). Blood pressure is expressed by two measurements, the systolic and diastolic pressures, which are the maximum and minimum pressures respectively in the arterial system. Normal blood pressure at rest is within the range of 100–140 millimetres of mercury (mmHg) systolic and 60–90 mmHg diastolic. Hypertension is present if the blood pressure is persistently at or above 140/90 mmHg for most adults (James *et al.,* 2014). Despite decades of research and clinical practice, the pathogenesis of hypertension remains incompletely understood, and blood pressure is often suboptimally controlled (Currie and Delles, 2017).

Medicines play a crucial role in maintaining health, preventing illness, managing chronic conditions and curing disease, however, medicines use today is too often suboptimal (Royal Pharmaceutical Society, 2013). Suboptimal use of medicines is categorised in a number of different aspects affecting the medicines pathway. They include suboptimal prescribing and/or prescriptions errors, dispensing errors, administration errors, monitoring errors and adherence.

1.2 Adherence

As defined by the World Health Organization (WHO), adherence is the extent to which person's behaviour concerning medicines use, following a diet and/or executing lifestyle changes corresponds with agreed recommendations from a healthcare provider (Agbor *et al.*, 2018). Adherence is the most important hurdle for medicines optimisation and majority of studies conducted to address suboptimal use of medicines focused on adherence aspect, either in a disease area or specific conditions (Faria *et al*., 2014). Many studies on adherence to medication and the ways to improve it have been conducted and yet it has remained significantly low, especially among hypertensive blacks. Non-adherence is a potential obstacle to medicines accessibility and represents a missed opportunity for health gain and a waste of resources (Atkins and Fallowfield, 2006; Mattke *et al*., 2011).

Adherence to a treatment is linked to the knowledge about the disease condition being treated (Jankwoska-Polanska *et al*., 2016), attitudes towards the treatment (Tachfauti *et al.*, 2012), beliefs about the treatment (Horne and Weinman, 1999) and acceptability and satisfaction with that treatment (Henshaw *et al.*, 1993). The acceptability of any form of treatment will influence the degree to which it is used. Good acceptability will imply good adherence rate and minimal wastage (Hassali *et al.*, 2012).

There is a large body of evidence on the effectiveness of interventions to improve adherence to medication (Faria *et al*., 2014). Different types of interventions have been used to improve patients' adherence to antihypertensive agents. However, Schroeder *et al.* (2004) stated that simplified regimens appears to be the most promising intervention to increase adherence to blood pressure lowering medication. In the recent past, Agyemang *et al.* (2015) reported that improvements in blood pressure control was attributed, among other factors, to the increasing

use of multiple antihypertensive drugs. Pharmacist interventional role through the provision of pharmaceutical care has been shown to impact on patient health outcomes. These interventional roles may include pharmacist initiated changes to drug therapy or patient management or promotion of patient adherence to medications. Clifford *et al.* (2006) has confirmed the usefulness of pharmacist intervention in improving adherence to new medications for chronic conditions.

1.3 Determinants of Adherence

1.3.1 Knowledge about disease/treatment

Knowledge about disease and/or its complications, and knowledge about the medication used for the treatment of the disease have great impact on patient's adherence (Saleem *et al*., 2012). It has been established that the understanding of disease and drug therapy significantly influences patients' non-adherence. A well informed patient is more likely to accept treatment and comply with the physician's prescriptions, and be less likely to discontinue treatment prematurely (Okwuonu *et al.*, 2014). Poor awareness especially regarding symptoms and treatment outcomes and consequence have been reported to be associated with treatment non-completion (Tachfauti *et al.*, 2012). The higher the degree of patients' knowledge about the disease, the greater the self-care and the adherence to treatment (Barreto *et al.*, 2014).

1.3.2 Attitude towards medicines

Previous experience regarding disease condition and fear of its complications, acceptance of the disease and the adoption of the patient's role (where patients are not hesitant and positive to the idea of taking a medicine for their whole life) have been found to be important reasons for medication adherence. Also, the fear of adverse drug reactions, and avoidance of getting to

know the possible side-effects as well as the cost and particularly level of co-payment have been identified as important factors associated with adherence to pharmaceutical treatment (Tsiantou *et al.,* 2010). Co-payment level, independent of other determinants, was found to be a strong predictor of compliance with antihypertensive medications, with greater compliance seen among patients filing pharmacy claims for drugs that required lower co-payments (Taira *et al.,* 2006). Van der Laan *et al.* (2017) has shown that higher co-payment, side effects and a poor patient–provider relationship were the factors associated with antihypertensive medication non-adherence with consistent evidence because consistent significant relationships were found for these factors whenever studied.

1.3.3 Beliefs about medicines

Patients' beliefs are of importance particularly as alternative medicine is widely practiced. Low adherence may result from poor patient beliefs that there is no sound reason for them to permanently remain on medication based on the perceptions of their health status (Mpinda *et al.,* 2014). There is accumulating evidence that lack of motivation to take the treatment often arises from mistaken beliefs about the necessity of the treatment or from concerns about the potential adverse effects (Horne *et al.,* 2001). Although the perceptual and practical dimensions of adherence are influenced by the social, cultural, economic and healthcare system contexts, taking account of the patient's beliefs about the prescribed medication is fundamental to shared-decision making and supporting adherence (Horne *et al.,* 2013).

1.3.4 Acceptability of medicines

Acceptability has been conceptualised in several ways, including the hypothetical willingness to use a product, the choice of one product from among a number of other choices and continued

use of a product over time (Morrow *et al*., 2013). Acceptability of a medicinal product is likely to have a significant impact on the patient's adherence (Kozarewicz, 2014), and eventually prevent suboptimal use.

1.4 Statements of Research Problem

Hypertension is a silent, invisible killer that rarely causes symptoms and its complications account for about 10 million deaths worldwide every year. Households often spend a substantial share of their income on hospitalisation and care following complications of hypertension. Families face catastrophic health expenditure and spending on health care, which is often long term in the case of hypertension complications, pushing tens of millions of people into poverty (World Health Organization (WHO), 2013). High blood pressure is ranked the fifth leading risk factor for cardiovascular diseases (CVDs) in Sub-Saharan Africa (Mensah, 2013). Prevalence of hypertension and rate of use of antihypertensive medication have been shown to be higher in Black subjects (Agyemang *et al.,* 2003; 2005) and by the year 2025 about 75% of the world's hypertensive population will be in developing countries (Kearney, *et al.,* 2005). The overall prevalence of hypertension in Nigeria ranges from 8% to 46% and is increasing (Ogah, *et al.*, 2012). In the recent past, Akinlua *et al.* (2015) reported that the overall crude prevalence of hypertension in Nigerian adults ranged from 0.1% to 47.2% depending on the benchmark used for diagnosis of hypertension, the setting in which the study was conducted, sex and ethnic group. More recently, Ajayi *et al.* (2016) stated that according to the WHO, the prevalence of hypertension is highest in the African Region at 46% of adults aged 25 years and above. One of the critical factors and the cornerstone for achieving hypertension control is the patient's adherence to the prescribed regimen (Osterberg and Blaschke, 2005; Abegaz *et al.,* 2017) yet it remains unclear as to why patients fail to take their medicines. Medication non-adherence is a serious challenge to pharmacotherapy and is associated with adverse outcomes (Piercefield *et al.,* 2016). Maintaining medication adherence to multiple medications is a complex issue in patients with chronic diseases, particularly CVDs. The influence of non-adherence to antihypertensive medications is the most important cause of uncontrolled blood pressure.

Consequently, because of non-adherence, most (nearly 3-quarters) of the hypertensive patients do not achieve optimal blood pressure control (Abegaz *et al.,* 2017). Non-adherence to antihypertensive medication and effective blood pressure control is still below average in developing countries (Gwadry-Sridhar *et al.,* 2013; Lloyd-Sherlock *et al.,* 2014; Irazola *et al.,* 2016; Abegaz *et al.,* 2017; Agbor *et al.,* 2018). In Africa, 63% of hypertensive patients on treatment were non-adherent even though successful treatment of hypertension reduces its burden and mortality (Abegaz *et al.,* 2017; Agbor *et al.,* 2018; Oparil *et al.,* 2018). Hypertension if not properly managed can result in a wide range of complications like stroke, ischaemic heart disease and renal failure that have economic, clinical and humanistic outcome implications.

1.5 Justification

The need for research in hypertension cannot be overemphasised since the lifetime burden of hypertension remains substantial, despite modern therapy (Rapsomaniki, *et al.*, 2014). Essential hypertension is of public health importance because it has no identifiable cause and management is lifelong, meaning that appropriate intervention to help patient adhere to therapy would improve blood pressure control thereby preventing hypertension-related complications and mortality. Assessment of adherence is necessary firstly because it remains significantly poor among hypertensive patients; secondly, adherence is a dynamic process that needs to be followed up (WHO, 2003), and thirdly, non-adherence is the most important aspect of suboptimal medicines use. Further, continuing research in patients' knowledge about hypertension and attitude towards antihypertensives is necessary. This claim can be corroborated with the findings of Malik *et al.* (2014), which showed a significant association between patients' knowledge and blood pressure control status and drug adherence. Therefore, a research in patients' adherence may be incomplete without establishing patients' baseline knowledge and/or attitude in order to draw a meaningful conclusion. Moreover, the need for establishing patients' baseline beliefs about their medicines is paramount. This claim can be affirmed with the evidence by Horne *et al.* (2013) who postulated that adherence is influenced by implicit judgments of personal need for the treatment (necessity beliefs) and concerns about the potential adverse consequences of taking it. Research on the acceptability of the prescribed antihypertensives is important firstly because of its strong relationship with adherence as it has been shown by Kozarewicz (2014); Liu *et al*. (2014) and Morrow *et al*. (2013). They showed that patients' adherence to a medicinal product may be significantly influenced by the patients' acceptability for that medicinal product. This claim can be substantiated with Astin's (1998) survey, which showed that the majority of alternative medicine users appear to be doing so not

so much as a result of being dissatisfied with conventional medicine but largely because they find these health care alternatives to be more congruent with their own values, beliefs, and philosophical orientations toward health and life. Also, Eddouks *et al.* (2002) have shown that 80% of a patient sample in Ethiopia used phytotherapy because it was cheaper, more efficient and better than modern medicine. This study will be able to give insight into factors that contribute to non-adherence to antihypertensive medicines, with a view of promoting the safe and effective use of antihypertensives, and efficiency of health systems generally through appropriate intervention.

Pharmacist's intervention delivered alone or in collaboration with other health care professionals including education enhances blood pressure control and improves adherence to antihypertensive therapy (Omboni and Caserini, 2018). Also, Walsh *et al.* (2006) has reported that focus on hypertension by other health professionals in addition to the patient's physician was associated with substantial improvement of hypertension control. The strategies to improve hypertension control include, among other things, patient education, self-management, and patient reminders. Additionally, Munroe *et al.* (1997); Charbot *et al.* (2003); Machado *et al.* (2007) and Mogardo *et al.* (2011) have all reported that pharmacists' intervention improved adherence and reduce blood pressure levels in patients treated with antihypertensive agents.
There is strong desire for this research because no previous study unraveled the key factors that may positively influence adherence to antihypertensive medicines and blood pressure control in populations from this region of Nigeria.

1.6 Aim and Objectives

1.6.1 Aim

The main objective was to determine the impact of pharmacist's intervention on adherence to antihypertensives and blood pressure control among patients attending the Cardiac Clinic of ABUTH Zaria, Nigeria

1.6.2 Objectives

The specific objectives of this study were as follows:

1. To assess the impact of pharmacist's intervention on patients' adherence to antihypertensive medicines and blood pressure control.
2. To examine patients' knowledge about hypertension and lifestyle recommendations, and their relationships with adherence and blood pressure control.
3. To explore patients' attitude towards antihypertensives and its relationships with adherence and blood pressure control.
4. To investigate patients' beliefs about their antihypertensives and their relationships with adherence and blood pressure control.
5. To examine patients' acceptability for antihypertensives and its relationships with adherence and blood pressure control.

1.7 Research Hypothesis

Pharmacist intervention improves patients' adherence to antihypertensive medicines and blood pressure control.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Suboptimal Medicines Use

The concept of optimal medicines use is to promote safe, effective and economic use of medicines, healthy lifestyle and well-being, use of beneficial preventative medicine, strategic public health national campaigns and tackle waste. There is good evidence that people do not always take their medicines as intended, often due to poor communication and understanding of the need for medication (All Wales Medicines Strategy Group, 2008).

Medicines optimisation is clearly beneficial and uncontroversial but can be difficult to achieve. In practice, the optimal use of medicines involves getting all the steps right in the medicines pathway that comprise diagnosis, prescribing, dispensing, administration and monitoring. Adherence is an important part of the administration step in the medicines pathway, and is considered to be the most important hurdle for medicines optimisation (Faria *et al*., 2014) (Appendix 1).

2.2 Hypertension

2.2.1 Definitions

Hypertension/arterial hypertension also known as high blood pressure, is a chronic medical condition in which the blood pressure in the arteries is persistently elevated (James *et al.,* 2014). Blood pressure is expressed by two measurements, the systolic blood pressure (SBP) and diastolic blood pressures (DBP), which are the maximum and minimum pressures respectively in the arterial system. Hypertension is present if the BP is persistently at or above a predetermined level. Generally, hypertension can be defined as an elevated SBP, DBP, or both, and the sustained elevation at or above the predetermined level is the criterion that is used to characterise group of patients whose risk of hypertension-related CVD is high enough to merit medical attention (Alldredge *et al.,* 2013). Blood pressure is normally distributed in the population and there is no natural cut-off point above which 'hypertension' definitively exists and below which it does not, however, the risk for ischaemic and haemorrhagic stroke, myocardial infarction, heart failure, chronic kidney disease, cognitive decline and premature death increases with an increasing blood pressure (National Institute for Health and Care Excellence, 2017). Reports have shown that the main concern for doctors is the level of BP that needs drug treatment, and the pragmatic definition of hypertension is the level of blood pressure at which treatment is worthwhile. This level varies from patient to patient and there should be a balance between the risks of untreated hypertension in different types of patients, the known benefits of reducing blood pressure, and the disadvantages of taking drugs and the likelihood of side effects (Beevers *et al.,* 2007). Basically, the risk of both fatal and non-fatal cardiovascular disease in adults is lowest with SBP below 120 mmHg and DBP less than 80 mmHg; these risks increase progressively with higher SBP and DBP (Koda-Kimble *et al.,* 2009).

2.2.2 Epidemiology of hypertension

Hypertension is a silent, invisible killer that rarely causes symptoms and its complications account for about 10 million deaths worldwide every year (WHO, 2013). As a key non-communicable disease (NCD) risk factor, hypertension appears to be increasing in prevalence, possibly due to development, urbanisation and lifestyle changes (Lloyd-Sherlock *et al.*, 2014). Hypertension affects millions of people with approximately 970 million people affected worldwide in 2015. It is estimated that by 2025, 1.6 billion adults will be affected worldwide (Bell *et al.,* 2015).

Hypertension is the most important preventable risk factor for CVD, which is the leading cause of death worldwide. Hypertension prevalence increases with age, and is a readily treatable risk factor for the most common causes of morbidity and mortality in older age: stroke, ischaemic heart disease, renal insufficiency and dementia.

Hypertension and its complications have been shown to be associated with overweight/obesity, diabetes, hyperlipidemias, and more common in women, those in the lowest wealth quintile and in heavy alcohol consumers. However, hypertension cuts across every social class with both low-income group and high-income group being at an increased risk of developing the disease. (Lloyd-Sherlock *et al.,* 2014; Ajayi *et al.*, 2016).

The overall occurrence of hypertension is similar between both men and women, but differs with age. For those younger than 45 years old, high blood pressure is more common in men than women. For those 65 years old or older, high blood pressure affects women more than men. The lifetime risk of developing hypertension among those 55 years of age and older who currently have normal BP is 90% (Bell *et al.,* (2015).

Populations around the world are rapidly ageing, and low-middle income countries (LMICs) are experiencing some of the most dramatic increases and rapid population ageing. This demographic transition is closely linked to an epidemiological shift from communicable to NCD. Due to this epidemiological transition, risk factors for CVD, diabetes and other NCDs are increasing in most communities in Sub-Saharan Africa where communicable diseases and famine used to be the predominant causes of mortality and disability (Lloyd-Sherlock *et al.*, 2014).

Hypertension is associated with at least 7.6 million deaths per year worldwide (13.5% of all deaths). It causes significant morbidity, accounting for 7% of all global disability adjusted life years (DALYs) lost, mostly in the LMICs. It has been suggested that the burden of stroke, ischaemic heart disease and kidney failure may be several times higher in the LMICs than in their high-income counterparts. Nearly 80% of deaths due to CVD occur in the LMICs. They are the countries that can least afford the social and economic consequences of ill health. Thus, prevalence tend to be disproportionate with many people failing to seek treatment because it is prohibitively expensive, health systems are weak, the understanding of the prevalence and management is limited and eventually, the inaccessibility to treatment hinder a successful control over long term (WHO, 2013; Irazola *et al.*, 2016).

More so, the numbers of people with hypertension who are undiagnosed, untreated and uncontrolled are higher in these LMICs compared to high-income countries with the control rates of hypertension in patients presenting to primary care ranging from barely 6% in Pakistan to 65% in South Africa (Almas *et al.*, 2012).

According to a study on the prevalence of hypertension and associated factors conducted in Ibadan-North Local Government Area of Nigeria, the overall prevalence of hypertension was

reported at 33.1%, comprising those detected (28.0%) and those who were currently on medication (5.1%). When compared between men and women, the prevalence was 36.8% for males and 31.1% for females with the highest prevalence among adults aged 70 years and older. The prevalence was observed to increase with age with those 70 years and older having the highest prevalence (78.0%), while those below 20 years of age had the lowest prevalence (11.6%) (Ajayi *et al.,* 2016).

Worldwide, hypertension has been found to be the most prevalent health problem among adult patients in primary care, and its treatment has often been suboptimal. The management of suboptimal blood pressure represents about 10% of the world's overall healthcare expenditures, with more than 90% of the expenditures on antihypertensive treatment (Hassali, *et al.,* 2012; Irazola *et al.,* 2016).

2.2.3 Etiology of hypertension

In the majority of cases (95%) hypertension has no identifiable cause but may be the consequence of a complex interaction between environmental and genetic factors. Hypertension tends to cluster in families and may represents a collection of genetically based diseases or syndromes such as impaired sodium excretion or insulin resistance with several resultant inherited biochemical abnormalities. The resulting phenotypes can be modulated by various environmental factors such as stress, obesity and high salt intake (especially in salt-sensitive individuals), thereby altering the severity of blood pressure elevation and the timing of hypertension onset. Endothelial dysfunction, increased vascular reactivity, and vascular remodelling may be causes, rather than consequences, of blood pressure elevation and increased vascular stiffness contributes to isolated systolic hypertension (Oparil *et al.,* 2003).

Less commonly, and in 5% of cases, hypertension is caused by an underlying physiological condition like pregnancy, or alcoholism, drugs, coactation of the aorta, renal or adrenal diseases that may lead to sodium retention and/or vasoconstriction (Venkataraman *et al.*, 2013).

2.2.4 Types of hypertension

2.2.4.1 Primary or essential hypertension

This type of hypertension is more common, and by definition, has no identifiable cause. It occurs in 95% of hypertensive patients, and tends to be hereditary. Nevertheless, it is likely to be the consequence of a complex interaction between environmental and genetic factors. The presence of these factors, in addition to an inappropriate interplay of the various factors responsible for normal blood pressure regulation, leads to the manifestation of essential hypertension. A distinct factor such as a high salt intake in a salt-sensitive individual or metabolic risk factors like obesity, diabetes or raised blood lipids may play a dominant role in a given patient. Genetic defects may affect renal mechanisms, alterations of vascular smooth muscle cells, humoral factors or neural mechanisms. Genes that can influence any of these factors and thus increase the susceptibility for the development of hypertension, can be considered candidate genes for essential hypertension (Figure 2.1) (Distler and Sharma, 1996).

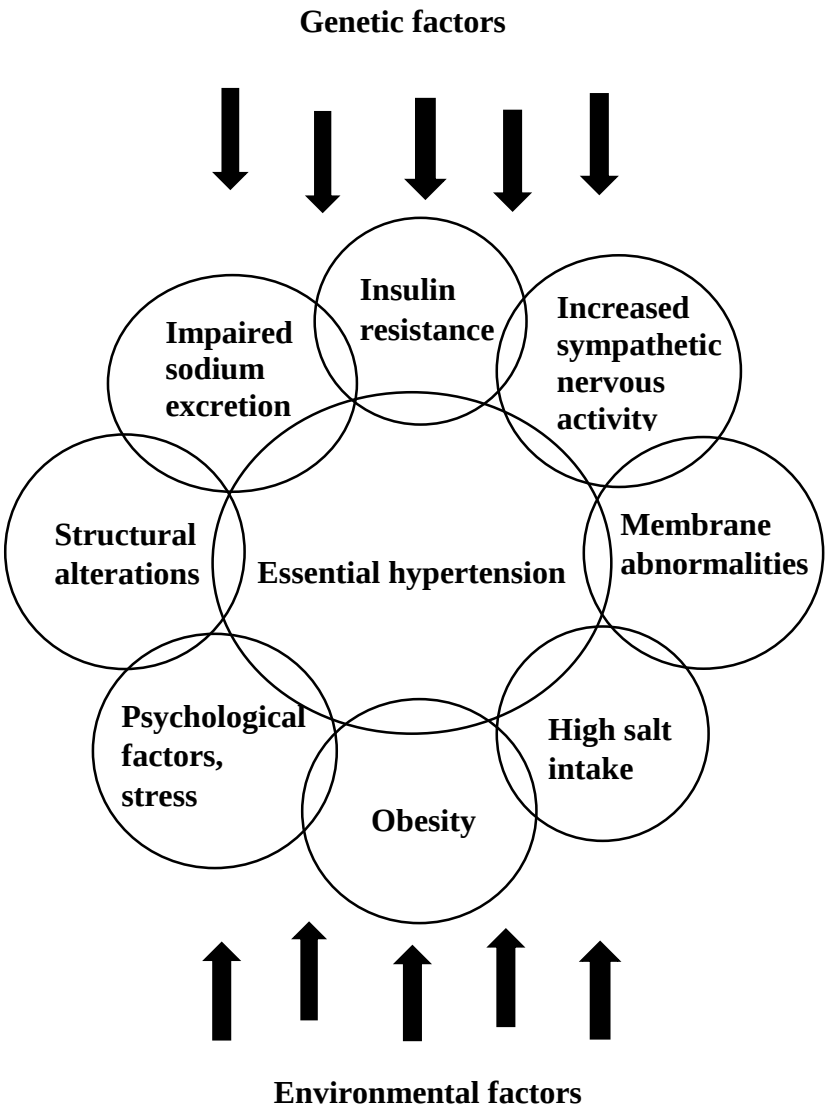

Figure 2.1: Genetic Influence and Environmental Factors in the Development of Essential Hypertension (Distler and Sharma, 1996)

2.2.4.2 Secondary hypertension

This is the type of hypertension which by definition is caused by an identifiable underlying condition. It occur in only 5% of hypertensive patients, with many different causes including endocrine diseases, kidney diseases, hyperaldosteronism, sleep apnea or pre-eclampsia. Also, it can be a side effect of many medications such as oral contraceptives, liquorice and indomethacin.

2.2.5 Pathophysiology of hypertension

Many pathophysiologic factors have been implicated in the genesis of essential hypertension, however, the major pathophysiologic mechanisms include activation of the sympathetic nervous system and renin–angiotensin–aldosterone system. Increased sympathetic nervous system activity possibly due to increased exposure or response to psychosocial stress leads to increase in the release of noradrenalin from the sympathetic nerve endings and adrenalin from the adrenal medulla. This in turn leads to increase in cardiac output with no resultant appropriate decrease in total peripheral vascular resistance, and eventually causes the initial mild increase in blood pressure. Plasma noradrenaline concentrations have been found to be elevated in patients with essential hypertension by 25% on average, with considerable overlap of the values in hypertensives and normotensives. Such increases may also be found in patients with normal blood pressure, e.g. in patients with endogenous depression or with hypothyroidism. Therefore, an increased sympathetic tone can only be considered to be meaningful for blood pressure elevation if the pressor response to the sympathetic neurotransmitter, noradrenaline, is similarly increased (Distler and Sharma, 1996).

Overproduction of sodium-retaining hormones and vasoconstrictors; long-term high sodium intake especially in salt sensitive subjects; inadequate dietary intake of potassium and calcium, deficiencies of vasodilators such as prostacyclin, nitric oxide, and the natriuretic peptides; alterations in expression of the kallikrein–kinin system that affect vascular tone and renal salt handling; abnormalities of resistance vessels, including selective lesions in the renal microvasculature; diabetes mellitus; insulin resistance and obesity have been implicated (Oparil *et al*., 2003)

Angiotensin II increases blood pressure by various mechanisms, including constricting resistance vessels, stimulating aldosterone synthesis and release and renal tubular sodium reabsorption (directly and indirectly through aldosterone), stimulating thirst and release of antidiuretic hormone, and enhancing sympathetic outflow from the brain. Of importance, angiotensin II induces cardiac and vascular cell hypertrophy and hyperplasia directly by activating the angiotensin II type 1 (AT1) receptor and indirectly by stimulating release of several growth factors and cytokines. Activation of the AT1 receptor stimulates various tyrosine kinases, which in turn phosphorylate the tyrosine residues in several proteins, leading to vasoconstriction, cell growth, and cell proliferation. Activation of the AT2 receptor stimulates a phosphatase that inactivates mitogen-activated protein kinase a key enzyme involved in transducing signals from the AT1 receptor. Thus, activation of the AT2 receptor opposes the biological effects of AT1 receptor activation, leading to vasodilation, growth inhibition, and cell differentiation. The physiologic role of the AT2 receptor in adult organisms is unclear, but it is thought to function under stress conditions (such as vascular injury and ischemia reperfusion). When an angiotensin receptor blocker is administered, renin is released from the kidney because of removal of feedback inhibition by angiotensin II. This increases generation of angiotensin II, which is shunted to the AT2 receptor, favouring vasodilatation and attenuation

of unfavourable vascular remodelling. Local production of angiotensin II in various tissues, including the blood vessels, heart, adrenals, and brain, is controlled by angiotensin converting enzyme (ACE) and other enzymes (Oparil *et al.*, 2003).

In Nigeria, the plasma levels of sodium pump (Na^+–K^+ -ATPase) inhibitor were reported to be significantly higher in normotensives with and without a family history of hypertension, which correlated positively with the urinary sodium excretion of hypertensive individuals (Osotimehin *et al*., 1984). High levels of the Na^+–K^+ -ATPase inhibitor would cause decreased pump activity in the kidneys that would result in an increased tubular sodium reabsorption and, in a vascular smooth muscle cells, in an increased intracellular sodium concentration that eventually leads to salt-induced rise in blood pressure. Although hypertensive Nigerians were found to have low levels of plasma renin, ACE and atrial natriuretic peptide (ANP), another study has shown that the plasma noradrenaline level was higher compared to normotensive subjects (Adebiyi *et al*., 2011). This supports the claim that increased sympathetic nervous activity plays role in the development of hypertension among Nigerians.

2.2.6 Classification of hypertension

There has been no consensus in the literature concerning hypertension classification. While 140/90 mmHg remain prehypertension in the World Health Organization/International Society of Hypertension (WHO/ISH, 2003) classification (Table 2.1), the National Institute for Health and Care Excellence (NICE, 2017) classified 140/90 mmHg as stage 1 (Table 2.2), and more recently the American College of Cardiology/American Heart Association (ACC/AHA) lowered the hypertension threshold to 140/90 mmHg to reflect stage 2 (Whelton *et al.*, 2018) (Table 2.3).

Table 2.1: The World Health Organization and International Society of Hypertension (WHO/ISH) Blood Pressure Categories

Prehypertension	140 – 159/90 – 99 mmHg
Stage 1	160 – 179/100 – 109 mmHg
Stage 2	≥ 180/110 mmHg

Table 2.2: The National Institute for Health and Care Excellence (NICE) Blood Pressure Categories

Hypertension	
Stage 1	Clinic BP ≥ 140/90 mmHg and subsequent ABPM or HBPM average BP is ≥ 135/85 mmHg
Stage 2	Clinic BP ≥ 160/100 mmHg and subsequent ABPM or HBPM average BP is ≥ 150/95 mmHg
Stage 3	Clinic SBP is ≥ 180 mmHg or clinic DBP is ≥ 110 mmHg

BP = Blood Pressure; ABPM = Ambulatory Blood Pressure Measurement; HBPM = Home Blood Pressure Measurement; SBP = Systolic Blood Pressure; DBP = Diastolic Blood Pressure

Table 2.3: The American College of Cardiology and American Heart Association (ACC/AHA) Categories of Blood Pressure in Adults*

Normal	SBP < 120 and DBP < 80 mmHg
Elevated	SBP 120 – 129 and DBP < 80 mmHg
Hypertension	
Stage 1	SBP 130 – 139 or DBP 80 – 89 mmHg
Stage 2	SBP ≥ 140 or DBP ≥ 90 mmHg

*Individuals with SBP and DBP in 2 categories should be designated to the higher BP category; BP indicates blood pressure (based on an average of ≥2 careful readings obtained on ≥2 occasions); SBP = Systolic Blood Pressure; DBP = Diastolic Blood Pressure

Nonetheless, the 8th Joint National Committee on the Detection, Prevention, Evaluation and Treatment of Hypertension (JNC-8) calls for lowering BP to 150/90 mmHg in those age 60 years and older, and to 140/90 mmHg for adults less than 60 years. In the population age 18 years and older with diabetes, the guidelines recommends initiating drug treatment to a goal of systolic BP < 140 mmHg, and a diastolic goals of 90 mmHg. The same applies to patients with chronic kidney disease in the general non-black population, including those with diabetes.

2.2.7 Management of hypertension

Hypertension is managed with both lifestyle modification and pharmacotherapy. Different management guidelines exist including the ACC/AHA, European Society of Hypertension (ESH), WHO/ISH etc. The overall principles common to these guidelines are to implement lifestyle modifications in addition to pharmacotherapy to control BP in patients with hypertension. The presence of specific complications of hypertension or comorbidities (sometimes referred to as "compelling indications") in any given patient should be considered when selecting specific pharmacotherapy to treat hypertension.

2.2.7.1: Goals of therapy

The primary goal of therapy of hypertension should be effective control of BP in order to prevent, reverse or delay the progression of complications and thus reduce the overall risk of an individual without adversely affecting the quality of life. Hypertension complications are the primary causes of death in patients with hypertension. Patients should be explained that the lifestyle modifications and drug treatment are generally lifelong and regular drug compliance is important (Venkataraman *et al.,* 2013).

2.2.7.2: Lifestyle modifications

Lifestyle measures should be instituted in all patients including those who require immediate drug treatment. These include:

Weight reduction: Weight reduction of even as little as 4.5 kg has been found to reduce blood pressure in a large proportion of overweight persons with hypertension.

Physical activity: Regular aerobic physical activity can promote weight loss, increase functional status and decrease the risk of CVD and all cause of mortality.

A program of 30-45 minutes of brisk walking or swimming at least 3-4 times a week could lower SBP by 7-8 mm Hg.

Alcohol intake: Excess alcohol intake causes a rise in blood pressure, induces resistance to antihypertensive therapy and also increases the risk of stroke. Alcohol consumption should be limited to not more than 3 units per day for most men and no more than 2 units per day for women.

Salt intake: Epidemiological evidence suggests an association between dietary salt intake and elevated blood pressure. An intake of <100 mmol of sodium or 6 g of sodium chloride a day is recommended. Patients should be advised to avoid added salt, processed foods, and salt-containing foods.

Smoking: Smoking or consumption of tobacco in any form is the single most powerful modifiable lifestyle factor for prevention of major cardiovascular and non-cardiovascular disease in hypertensive patients. Cardiovascular benefits of smoking cessation can be seen within one year in all age groups.

Relief of Stress: The stress especially emotional stress triggers the nervous system to secrete hormone especially the adrenergic amines which will raise the body defense and resistance to stress.

Diet: A diet rich in fruits, vegetables and dairy products with reduced saturated and total fat can substantially lower BP (11/6 mmHg in hypertensive patients and 4/2 mmHg in patients with high normal BP). Intake of saturated fats is to be reduced since concomitant hyperlipidaemia is often present in hypertensives; regular fish consumption may enhance blood pressure reduction in obese hypertensives; adequate potassium intake from fresh fruits and vegetables may improve blood pressure control in hypertensives; caffeine intake increases blood pressure acutely but there is rapid development of tolerance to its pressor activity (Chobanian *et al*., 2003).

2.2.7.3 Pharmacotherapy of hypertension

As blood pressure increases, it is more difficult to control with lifestyle modifications alone and antihypertensive medication becomes necessary. The benefits of blood pressure lowering in patients with significantly elevated blood pressures are well established.

Diuretics: Low-dose diuretic therapy is effective and reduces the risk of stroke, coronary heart disease, congestive heart failure, and total mortality. While thiazides are most commonly used, loop diuretics are also used successfully and the association with a potassium sparing diuretic reduces the risk of both hypokalaemia and hypomagnesaemia. Even in small doses diuretics potentiate other antihypertensive drugs. Thiazide-like diuretics (metolazone, indapamide) are the mostly recently developed drugs with a similar mechanism of action.

Beta-blockers: High sympathetic tone, angina, and previous myocardial infarction are good reasons for using beta-blockers. As low dose minimizes the risk of fatigue (an unpleasant effect of beta-blockade). Addition of a diuretic or a calcium channel blocker is often beneficial. However, beta-blockade therapy is associated with symptoms of depression, fatigue, and sexual dysfunction. These side-effects have to be taken into consideration in the evaluation of the

benefits of treatment. Over the past few years beta-blockers have been used increasingly frequently in the management of heart failure, a known complication of arterial hypertension. They are effective but their introduction in the presence of heart failure has to be very cautious, starting with very low doses to avoid an initial worsening of heart failure.

Calcium channel blockers (CCB): Calcium channel blockers can be divided into dihydropyridines (e.g. nifedipine, nimodipine, amlodipine) and non-dihydropyridines (verapamil, diltiazem). Both groups decrease peripheral vascular resistance but verapamil and diltiazem have negative inotropic and chronotropic effects. Short acting dihydropyridines such as nifedipine cause reflex sympathetic activation and tachycardia, while long acting drugs such as amlodipine and slow-release preparations of nifedipine cause less sympathetic activation. Short-acting dihydropyridines appear to increase the risk of sudden death.

Angiotensin converting enzyme inhibitors: ACE inhibitors are increasingly being used as first line therapy. They have relatively few side-effects and contraindications except bilateral renal artery stenosis. Though ACE inhibitors are effective in unilateral renovascular hypertension, there is risk of ischaemic atrophy. Therefore, angioplasty or surgical renal artery reconstruction are preferable to long-term purely medical therapy. ACE inhibitors are first choice agents in diabetic hypertensive patients as they slow down the progression of renal dysfunction. In hypertension with heart failure, ACE inhibitors are also first choice.

Angiotensin II receptor blockers: As angiotensin II stimulates AT1-receptors that cause vasoconstriction, angiotensin AT1- receptor antagonists are effective antihypertensive drugs. Losartan, valsartan belong to angiotensin receptor blockers and are effective, and cause less coughing than ACE inhibitors. They block angiotensin-II-mediated vasoconstriction and

aldosterone release. Other medications used include; alpha blockers, centrally acting drugs, vasodilators and renin inhibitors.

Nevertheless, pharmacological approach to hypertension treatment is influenced by ethnical, age and comorbidity ties. The JNC-8 stated that initial antihypertensive treatment in the general black population including those with diabetes, should include a thiazide-type diuretic or CCB. Additionally, the NICE guideline recommend initiating treatment in black people of Africa or Caribbean family origin and whites who are over 55 years with CCB, while the thiazide-like diuretic preferably chlortalidone or indapamide should be offered if the CCB is not suitable.

2.3 Hypertension and Adherence

Adherence to medication is one of the critical factors that determine hypertension control, and it refers to the willingness and ability of an individual patient to follow health-related advice, take medication as prescribed, attend scheduled clinic appointments, and complete recommended tests and consultations (Osterberg and Blaschke, 2005). Although often used interchangeably with compliance, adherence is the extent to which patients follow through decisions about medicines taking (i.e., leaving open the question of who makes these decisions or how they are made) (Horne *et al.,* 2005). The importance of optimizing treatment adherence rises in proportion to the potential benefit from therapy, meaning that the higher the level of adherence, the higher the benefits gained from the therapy. As to whether patients achieved goal blood pressure despite not having fully complied with prescriptions, or failed to achieve goal blood pressure (in part) because of imperfect adherence, the first implication is that optimal compliance with prescribed antihypertensive medications should not be assumed, since it seems not to occur about half the time (Osterberg and Blaschke, 2005). Furthermore, it has been

reported that patients taking at least 80% of antihypertensive medication are more likely to achieve blood pressure control than patients taking less than 80% (Claxton, *et al., 2*001).

In Nigeria, different adherence rates for antihypertensive medicines and varying reasons for non-adherence have been reported. In a questionnaire-aided interview on self-reporting, good adherence rate has been shown in about 55% of hypertensive patients in one health facility in Kano state, Nigeria (Kabiru *et al.,* 2004). The reasons for the observed low adherence were absence of symptom, lack of funds to purchase drugs, and side effects of medication. Also, it was observed that once daily regimens had better adherence than three times ones. Akpa *et al.* (2008) observed antihypertensive medication adherence rate of about 60% among patients admitted to a Cardiac Clinic in Port Harcourt, Nigeria, through a questionnaire-aided interview on self-reporting. The result has shown that good adherence rate was associated with fewer daily doses and level of education of the participants. However, Okwuonu *et al.* (2014) assessed adherence to antihypertensive medication using the Morisky Medication Adherence Scale (MMAS) in 252 outpatients in a facility in Abia state, Nigeria, which have shown that 70% of the patients reported low adherence. Prominent reasons for low adherence included forgetfulness, lack of funds, high pill burden, feeling of well-being and cure, and side effects of medication. Also, premature discontinuation of treatment due to drug side effects and lack of money to buy drugs were observed to interrupt consistent use of antihypertensive medication.

2.3.1 Measurement of adherence

Although various methods are available for the measurement of medication adherence, there is still no gold standard (Saleem *et al.,* 2012). In the outpatient setting, four approaches are commonly reported for measuring medication adherence, and include the self-report, electronic monitoring, pill count, and pharmacy refill rates. Each of these approaches can lead to a

quantifiable measure of adherence and, with the exception of self-report, these approaches are objective. Recent attention has been given to electronic monitoring with systems such as medication event monitoring systems (MEMS). Provided they are used correctly, these systems capture data on daily intake and dosing over time, allowing analyses of long-term patterns and opportunities to identify "white-coat adherers." However, these devices are relatively expensive and somewhat cumbersome to carry, are subject to interference by the patient or other devices, can fail, and are able to capture large quantities of data points over time, posing challenges for data analysis. Research involving MEMS caps as a measure of adherence identified several problems with this approach, including not using the electronic monitoring device consistently (36%), taking out more than 1 dose at a time (41%), and reporting opening the electronic monitoring device but not taking the medication (26%). In addition, each medication that is being monitored for adherence requires its own device, and reasons for non-adherence are not captured by the electronic system (Morisky *et al.*, 2008).

Horne and Weinman (1999) have reported that, although patients' self-reported adherence is the most common method of assessment used in psychological research, it is subject to self-presentational and recall biases. Patients may overestimate the extent of their adherence in an attempt to "please the doctor," or if they believe that admitting to non-adherence may result in adverse judgments or penalties. Moreover, patients' recall may be inaccurate. Thus, because reports of non-adherence may be more accurate than reports of adherence, self-report tends to underestimate the true extent of non-adherence by approximately 20%. In contrast, self-report offers a convenient, "spot check" estimate of adherence behavior.

Horne *et al.* (2013) have shown that electronic monitoring of adherence and the use of prescription redemption data are the most objective over self-report. However, self-report measures are simple and economical to use and can provide real-time feedback regarding

adherence behavior and potential reasons for poor adherence including social, situational, and behavioral factors affecting adherence. Although self-report measures may be subject to recall bias, overestimation of adherence, and elicitation of socially acceptable responses, efforts aimed at increasing validity and reliability of self-report measures in different populations will facilitate the adoption and use of these tools in clinical practice. In a racially diverse sample of elderly patients with hypertension in a managed care setting, the MMAS-8 and antihypertensive medicine pharmacy fill rates were significantly correlated ($r = 0.46$; $P < .001$). The medication adherence scale (MMAS-8) presented in this research is relatively simple and practical to use in clinical settings. The instrument can be used initially to identify patients with adherence problems and can also be used to monitor adherence over the course of the treatment. The MMAS-8 has been adopted and validated in many languages and for a variety of chronic diseases that require customized assessment (Jankowska-Polanska *et al.,* 2016).

2.3.2 Determinants of adherence

Adherence is a multifactorial phenomenon and varies among the patients. There has been no consensus on the predominant factor determining adherence, and several factors tend to influence patients adherence to treatment with no predominant factor that is common in all patients. Many studies on adherence to antihypertensives conducted in Nigeria have found lack of funds to be a common important determinant of adherence, which could be as a result of low-socioeconomic status among many households. Other important determinants identified among Nigerian hypertensives were; forgetfulness, symptomlessness, pills burden and side-effects of medication (Kabiru *et al.,* 2004; Akpa *et al.,* 2008; Okwuonu *et al.,* 2014).

Nonetheless, factors determining adherence have been categorised into 3 or 5 dimensions that include therapy-related, health system-related and patient-related determinants. Another 2

dimensions that seem to overlap with the other three are the socio-economic and condition-related determinants.

2.3.2.1 Therapy-related determinants of adherence

These are sometimes called physician-related or condition-related and they include medication adverse effects, mistrust, complex drug regimen, duration of treatment period, taste of medication, and requirement for drug storage. Not only do health care providers often fail to recognize medication non-adherence in their patients, they may also contribute to it by prescribing complex drug regimens, failing to explain the benefits and adverse effects of a medication effectively, and inadequately considering the financial burden to the patient. Ineffective communication between the primary care physician and the patient with a chronic disease such as CVD further compromises the patient's understanding of their disease, its potential complications, and the importance of medication adherence. Patient's preference for alternative therapies may influence his or her decision on treatment. Additionally, health care provider's failure to elicit a history of alternative, herbal, or supplemental therapies from patients is another source of ineffective communication that can lead to non-adherence.

2.3.2.2 Health system-related determinants of adherence

These are also referred to as socio-economic factors such as the cost of therapy and income, transportation, waiting time, missed work and wages. Fragmented health care systems create barriers to medication adherence by limiting the health care coordination and the patient's access to care. Prohibitive drug costs or co-payments, lack of health insurance scheme and out-of-pocket payment also contribute to poor medication adherence. Health information technology is not widely available, preventing physicians from easily accessing information from different patient care–related venues, which in turn compromises patient care, timely

medication refills, and patient -physician communication. In an overtaxed health care system in which clinicians see a large volume of patients without resources to meet individual patient needs, the amount of time a clinician spends with patients may be insufficient to properly assess and understand their medication-taking behaviors. This lack of time may preclude engaging the patient in a discussion on the importance of medication adherence and strategies to achieve success.

2.3.2.3 Patient-related determinants of adherence

Patient-related factors include lack of knowledge, poor attitude and beliefs, forgetfulness, substance and alcohol use. Medication adherence is primarily in the domain of the patient. Because patients recall as little as 50% of what is discussed during the typical medical encounter, effective patient education must be multifactorial, individualized, and delivered in a variety of methods and settings outside of the examining room.

Knowledge: A key component of any adherence-improving plan is patient education. Formal health education programs have been shown to be effective; however, access to similar non–disease-specific programs is limited. In the absence of a formal program, physicians would do well to emphasize the availability of other educational resources, including but not limited to pharmacists (Brown and Bussell, 2011).

It has been established that understanding of disease and drug therapy significantly influences patients' non-adherence. A well informed patient is more likely to accept treatment and comply with the physician's prescriptions, and be less likely to discontinue treatment prematurely. Patient education can improve blood pressure control therefore, before treatment is started, the hypertensive patient needs medical information on the meaning of hypertension, its causes, the

duration of treatment, and the need for adherence to medication, lifestyle modification, and regular follow-up visits (Okwuonu *et al.*, 2014).

Barreto *et al.* (2014) confirmed that the reported relationship between the non-adherence to the systemic arterial hypertension (SAH) treatment and the patient's knowledge about the disease and therapeutic regimen requires further evidence. The objective of the study was to identify the degree of knowledge of people with hypertension concerning the disease and to verify the factors associated with the non-adherence to antihypertensive drug therapy. It was a cross sectional, descriptive study, involving people with SAH, undergoing outpatient care treatment at the primary healthcare service in a city located in the South region of Brazil. The result of the study showed about 65% of the studied people had low level of education and about 45% were considered to be non-adherent to the antihypertensive drug therapy. The implication of this study was that, the higher the degree of patients' knowledge about the disease, the greater the self-care and the adherence to treatment.

Further, the study by Almas *et al.* (2012) has found a relationship between good knowledge and better control of hypertension. It was a cross-sectional study conducted at three tertiary care hospitals in Karachi, Pakistan. The primary outcome was knowledge score based on 15 questions regarding knowledge, which were asked and marked on a scale of 1 to 5. Each correct response was given a score of 1, and incorrect response given score of 0, where there were multiple correct responses for one item question, score of 1 was given for each correct response. Sum of scores of each item question was given total score of 38. Linear regression analyses were used to determine association between knowledge and candidate variables. The total mean score for the knowledge compared between controlled and uncontrolled hypertensive patients was statistically significant ((controlled hypertension N=323; total percent mean score 57.5%)

uncontrolled hypertension N=124; total percent mean score 49.1%)), and there was significant association between knowledge and high blood pressure. The questions were focused not only on risk factors, but also on target blood pressure values, target organ damage, factors related to control of hypertension. They inference was that knowledge about hypertension in hypertensive patients was not adequate and was alarmingly poor in patients with uncontrolled hypertension.

The result of a study on hypertension-related knowledge, practice and drug adherence among inpatients of a hospital in Samark and, Uzbekistan has shown that patients' knowledge levels were significantly associated with BP control and adherence. When compared to those with an inadequate knowledge level, the odds ratio (OR) of controlled hypertension was 2.9 (95% CI 1.3–6.5) for the adequate level and 5.4 (95% CI 1.7–16.2) for a good knowledge level. The OR of drug adherence was 2.1 (95% CI 1.1–4.1) and 3.8 (95% CI 1.4–10.8), respectively. The study showed that knowledge about normal BP was higher in the BP controlled group compared to the uncontrolled group, and more than half of the patients knew the importance of a regular BP check-up and lifestyle change for better hypertension control (Malik *et al.,* 2014).

The most common discouraging factors cited in the literature such as forgetfulness, side-effects, cost of medication and lack of access to medication did not show statistically significant associations with non-adherence. The factors showing significant associations with adherence were age, number of drugs prescribed and patients' knowledge of the disease and treatment, including their beliefs and practices (Hashmi *et al.*, 2007).

Saleem *et al.* (2012) reported that, when patients were asked regarding their willingness to earn knowledge about hypertension, its management and medications, their responses were very positive. They stated that it will help them to control their condition. Some of the patients even

added that awareness programs shall be implemented at the community level so that the majority of the general population can get benefits from them.

Attitude: Initially, most patients are resistant to antihypertensives but attitudes change if they are well informed and if they have confidence in the health care system (Hultgren *et al.,* 2014). A qualitative research on patients' perception and experiences about hypertension treatment conducted in Pakistan has observed five major issues concerning patients' attitudes towards hypertension management. These include concerns about the unwanted effects of the medicines, poor relations and communication with health care providers, strong desire to complementary and alternative medicines, feeling hassled about sticking to treatment, lifelong management and lack of hypertension cure (Saleem *et al.,* 2012). Similarly, a study conducted in Sweden has shown that patients' attitudes towards antihypertensives undergo several phases. The process beginning with resistance to drug treatment caused by side effects, lack of control, and unwanted awareness of impaired health. These negative attitudes eventually change into a positive desire for lifestyle changes caused by a fear of cardiovascular disease, which in turn change the attitude towards drugs into seeing them as a rescue remedy and eventually something normal (Hultgren *et al.,* 2014).

In a cross-sectional descriptive comparative study, Sharaideh *et al.* (2013) has shown the benefits of knowledge, practice, and attitude towards the appropriate use of medications among different primary school children at age group (7–9) years in Amman/Jordan. The study was conducted using a structured interviewing technique that looked at Knowledge, Attitude and Practice (KAP) of children toward medications. Attitude questions like 'do you think that medications have benefit?', 'Do you think that medicines could be harmful?' and the attitude was categorized into positive or negative attitudes toward medications.

Children's knowledge about medication was considered by the research team as satisfactory (i.e. any knowledge score above 65%). For example, the majority of participating children answered correctly when they were asked about the meaning of a ''medical prescription'', which is a ''document written by a physician'', and most of the children answered that a vaccine is used to ''improve immunity against certain diseases'' (the correct answer). The limitation of this study was that it did not provide the details of the scoring procedure for the knowledge assessment. Result for knowledge was presented as minimum, maximum and mean scores and the percentage of score was presented as either satisfactory or poor.

Overall, knowledge and attitude have been shown to improve through patient's behavioral and informational education about hypertension and its treatment by the help of pharmacists and doctors.

Beliefs: The most prevalent factor determining adherence has been shown to be patients' beliefs about medication and disease (Saleem *et al.*, 2012). Medication beliefs have been shown to be stronger predictors of reported adherence than clinical and socio-demographic factors. Significant proportion of the variance in reported adherence is explained by patients' beliefs about their medicines; their type of illness; and their age (Horne and Weinman, 1999). Perceived barrier has been shown to be an important predictor to antihypertensive drugs adherence. Positive beliefs regarding medications are crucial for shaping adherence behaviour of elderly hypertensive individuals. Threatening views of illness and stronger beliefs of the necessity of medications contribute substantially to positive medication adherence (Kamran *et al.*, 2014). Cultural values can impact on the way in which individuals interact with the health care system and it has been shown that many patients harbour significant, unresolved doubts and concerns about prescribed treatment suggesting a fault-line between patients' and

prescribers' cultural perceptions of the treatment (Horne *et al.*, 2013). This area of research has shown different levels of adherence rate and the prominent reasons for non-adherence but in this community, no evidence of research on patients' beliefs about their medicines.

Variations in treatment necessity and concerns and association between these beliefs and adherence were noted across different countries, languages and cultures. It was observed that studies outside the United Kingdom (UK), where the Belief about Medicines Questionnaire (BMQ) and its disease-specific modifications have been predominantly developed, found reduced associations between necessity and concerns beliefs and adherence. Further work is needed to investigate potential cultural variations in medication beliefs. The findings suggested that novel interventions to support informed choice and optimal adherence to appropriately prescribed medicines are likely to be more effective if they take account of patients' beliefs about the treatment and how they judge their personal need for the prescription relative to concerns about potential adverse consequences of taking it. Necessity beliefs and Concerns may trigger intentional non-adherence, for example, if patients decide not to take their medication due to concerns regarding potential or actual adverse consequences, and unintentional non-adherence, (e.g. if patients who believe a medicine is not important for their health forget to take it). Beliefs can have counter-balancing effects on adherence, such as when patients continue to take a medication they believe is essential for their health despite concerns regarding adverse effects. The challenge now is to develop effective interventions to address patients' doubts about the necessity for treatment and concerns about adverse consequences in order to enhance adherence. The challenge goes beyond 'getting patients to take more medicines' (Horne and Weimann, 1999; Horne *et al.*, 2013).

Acceptability: Acceptability has previously been defined as ‘‘an overall ability of the patient and caregiver (defined as ‘user’) to use a medicinal product as intended (or authorised)’’ (Liu *et al*., 2014). Adherence rates have been used as a surrogate for acceptability. If adherence was high, acceptability was also deemed to be high: likewise, if adherence was low, acceptability was assumed to be low (Morrow *et al*., 2013). Acceptability is driven by the characteristics of the user (age, ability, disease type and state) and by the characteristics of a medicinal product such as: palatability, swallowability (size and shape, integrity of dosage form, e.g. film-coating), appearance (e.g. colour, shape, embossing, etc.), complexity of modification prior to administration (if required), required dose (e.g. the dosing volume, number of tablets, break marks, etc.), required dosing frequency and duration of treatment, selected administration device (if any), primary and secondary container closure system, actual mode of administration (Kozarewicz, 2014). Research also suggests that, while some aspects of acceptability may be common across different populations, other aspects are context-specific. In other words, product acceptability is a multi-factorial construct. Over the years, the conversation about what constitutes acceptability and how it is measured has enjoyed lively debate. Initially, adherence (i.e. correct and consistent use) was endowed with surrogacy status for acceptability. While this may be true, it is only part of the concept. As is true with drugs associated with myriad diseases, such as chemotherapy, there can be intense and even painful side effects, yet they still enjoy high adherence rates. Similarly, antibiotic courses are often not completed (consistent and correct use) even when there is little evidence for a lack of acceptability. Thus adherence and acceptability need to be extricated from each other conceptually to some extent. In fact, the critical factors impacting either acceptability or adherence remain poorly understood. If adherence is indeed inextricably linked to acceptability, as many have assumed, the relationship clearly needs to be understood better and efforts need to be increased to optimize both

acceptability and adherence (Morrow *et al*., 2013). The most important patient-related factors that affect oral medication acceptability in children and older adults are: Patient Characteristics; Drug Therapy-Associated Factors: the duration of treatment and the required number of medicines potentially increase the complexity of acceptance to medicines in older adults. Many older adults are on multiple medications to treat their multi-morbidities. The dose regimen further complicates adherence and acceptance of medicines. In this respect, multi-compartment adherence aids are promising in terms of helping patients to remember to take their medicines at the right time: Socio-cultural Factors: In both populations the involvement of a caregiver is common; therefore, there is a need for the directions on usage of a medicine to be clear both to the patient and the caregiver. Older adults living in their own home may be the sole person responsible for their medicine management, whereas seniors living in nursing homes are often helped by formal carers or by nurses at hospitals. As such, the ability and willingness of the carer to administer a medicine to these patients as intended could determine the acceptability of the medicine and outcome of the treatment. The acceptability of medicines may be influenced by the setting in which the administration of the medicine takes place. However, the ability to swallow determines the acceptability of conventional medication forms such as tablets and capsules.

The evaluation of acceptability, safety and adherence of a new reduced glycerin formulation of tenofovir (TFV) 1% gel to be used as rectal microbicides has been reported. The acceptability and adherence were determined by computer-administered questionnaires and interactive telephone response, respectively. Overall product like (or dislike) and likelihood of gel use in the future were assessed using an internet based computer assisted self-interview (CASI). This study assessed the acceptability of a new product (tenofovir gel) which was compared with Hydroxyethyl cellulose (HEC) placebo. Product acceptability was determined through a CASI

interview and was operationalised as intentionality of product use with participant having a rating in the upper one third of a 10-point Likert scale (values of 7–10). Among 46 participants who were assigned to use the gel and completed the acceptability questions, reported likelihood of future product use (acceptability) was 93% (HEC), 87% (TFV, Fisher exact test p-value = 1.0 when compared to the HEC group), and 63% (N-9, Fisher exact test p-value = 0.08 when compared to the HEC group) (Mcgowan *et al*., 2013).

Doherty *et al.* (2011) reported the acceptability of Brinzolamide-timolol suspension (Azarga™) The study was conducted at the Glaucoma Unit in the Sunderland Eye Infirmary, Sunderland, UK. A questionnaire was prepared, consisting of five questions pertaining to the use of brinzolamide-timolol suspension from the patient's perspective. Each question was assigned a numerical scale from 1 to 9, with a verbal option at the minimum and maximum of the scale. The questionnaires were distributed by one investigator to 76 consecutive patients using topical brinzolamide-timolol suspension. Each patient was handed a questionnaire prior to entering the consulting room and given adequate time to complete their responses. Seventy-six consecutive patients completed the questionnaire, ie, 58 females and 18 males, aged 68–95 years. The treatment duration range was 3–7 months. The questions used were: 1. What effect does your taking Azarga have on your daily life? (Minimal answer "no effect"; maximal answer "completely dominates life"). 2. To what extent does Azarga cause blurring of your vision? (Minimal answer "no effect"; maximal answer "dreadful"). 3. How much stinging does Azarga cause? (Minimal answer "none"; maximal answer "dreadful"). 4. How much irritation does Azarga cause? (Minimal answer "none"; maximal answer "very severe"). 5. Compared with previous drops how does Azarga compare? (Minimal answer "better"; maximal answer "worse").

2.3.3 Adherence interventions

Different types of interventions have been shown to improve patients' adherence to antihypertensive agent. Though different types of interventions have been used to improve patients adherence to antihypertensive agents, review by Schroeder *et al.* (2004) concluded that simplified regimens appears to be the most promising intervention to increase adherence to BP lowering medication. But a study by Sani *et al.* (2008) described the outcome of a study on hypertensive patients, which showed that blood pressure control was associated with taking more than one antihypertensive medication. Recent evidence from the United States of America (USA) indicates that BP control has improved significantly in all ethnic groups, despite persistent ethnic inequalities. In the 2009 to 2010 time period, 64% of White-American, 53% of African-American and 48% of Hispanic-American treated hypertensive patients had adequate BP control as compared with control rates of 46% in White-Americans, 39% in African-Americans and 46% in Hispanic-American in 2001–2002. These improvements in blood pressure control have been attributed, among other factors, to the increasing use of multiple antihypertensive drugs (Agyemang *et al*., 2015). Therefore, simplified regimens interventions may only improve adherence to fewer pills without ultimately improving BP control. Additionally, fixed dose combinations tend to be more expensive compared to the free combination agents.

Walsh *et al.* (2006) found quality improvement strategies are associated with improved hypertension control, and focus on hypertension by other health professional in addition to the patient's physician was associated with substantial improvement. The strategies were provider education, provider reminders, facilitated relay of clinical information, patient education, self-management, patient reminders, audit and feedback, team change, or financial incentives. Thus,

it is evident that educational intervention strategies on hypertension administered by other health professionals improve hypertension control.

Vermeire *et al.* (2001) has shown that many studies led to partial and conflicting conclusions. A meta-analysis of adherence-aiding strategies concluded that combinations of strategies led to improved compliance. Educational strategies such as good verbal communication or one-to-one counselling have a positive effect, whereas written information increases knowledge and decreases medication utilization errors but has no effect on compliance. On the other hand, written information with verbal reinforcement enhances compliance more than written information alone. This leads to the conclusion that educational strategies alone may not significantly improve patient compliance. Combinations of educational and behavioural strategies have a better effect.

In addition, Clifford *et al.* (2006) has shown the usefulness of pharmacist intervention in improving adherence to new medications for chronic conditions. The study was prompted because non-adherence to new medicines for chronic conditions develops rapidly, so they developed a service in which Pharmacist telephoned patients two weeks after they had started a new medicine for chronic condition. The pharmacist listened to patients problems and gave advice or information if needed. The intervention phone call was based on a semi structured interview schedule developed previously. The pharmacist started by asking patients ‘How are you getting on with your medicines?’ then went on to enquire about their medicine-related problems, adherence to new medicines and whether they require any further information. At four weeks follow-up, non-adherence was significantly lower in the intervention group compared to control (9% vs. 16%, $P = .032$). Adherence level increased by 7% in the intervention group.The phone calls took a median of 12 minutes each. Patients were recruited

using convenience sample of 40 Moss community pharmacies across England. Patients were recruited opportunistically when they presented a prescription in one of the pharmacies. This type of intervention is convenient for the provider because the pharmacist will only call from his own location. But it may be feasible only where the service network for the call is good and all the participants have access to telephones.

The study by Lindenmeyer *et al.* (2006) have reported the review of the literature on the role of pharmacist interventions to improve adherence to medication in people with type 2 diabetes mellitus. Studies were identified through a search of the databases and Google search engines on the Internet. Studies in primary care, outpatient, community settings and hospital settings were all included. This review has found evidence of the role of the pharmacist in improving diabetes care by addressing the important issue of adherence to medication, although this was not explicitly measured in three of the studies. The first role is in providing improved management for patients with diabetes by operating a reminder system, fine tuning medication, collecting and acting on adherence and self-monitoring data. The second role is in providing better care by supplying patient education and facilitating communication between patients and health care professionals. The review further highlighted that the difficulty of evaluating interventions aimed at enhancing adherence to medication lies in actually measuring adherence. Adherence is complex, can vary over time and is bound up with the need for integration with social life as well as health beliefs. They suggested that, although the studies reviewed were of limited quality, the potential benefit of pharmacist interventions to improve medication adherence in diabetes, especially in the context of patient education was obvious.

Clearly, more studies of pharmacist interventions that specifically address adherence to medication are needed.

Lee *et al.* (2006) has shown the effect of a Pharmacy Care Program on medication adherence and persistence. It was a multiphase, prospective study with an observational phase and a randomized controlled trial conducted at the Walter Reed Army Medical Center of 200 community-based patients aged 65 years or older taking at least four chronic medications. This trial was a single-center study of the efficacy of a comprehensive pharmacy care program, which included patient education and an adherence aid (medications custom-packaged in blister packs) to improve medication adherence among military health care beneficiaries. Eligible patients were recruited from the outpatient general medicine service and the Armed Forces Retirement Home, an affiliated retirement home of approximately 900 independently living military health care beneficiaries located in Washington, DC, and were elderly men and women (≥ 65 years) taking four or more chronic medications daily, a population selected as being at increased risk for medication non-adherence. Study patients were observed at the pharmacy clinics at both the Walter Reed Army Medical Center and Armed Forces Retirement Home. Study enrollment began on June 30, 2004, and was completed on July 6, 2005. The last follow-up visit occurred on August 30, 2006. The comprehensive pharmacy care program consisted of 3 elements, including individualized medication education (using standardized scripts), medications dispensed using an adherence aid (blister packs), and regular follow-up with clinical pharmacists every two months. Individualized educational interventions were performed to teach participants their drug names, indications, strengths, adverse effects, and usage instructions during each visit. The initial visit was scheduled for one hour. Subsequent visits (including adherence assessments, education as needed, and prescription refills) were scheduled for 30 minutes. Improved adherence was associated with improvements in both secondary end point. Among patients with drug-treated hypertension (n = 184), mean (SD) systolic BP was reduced from 133.2 (14.9) mm Hg to 129.9 (16.0) mm Hg (P = .02). Diastolic BP was not

significantly reduced. This area of study has shown the extent of non-adherence and reasons for it, as well as the different types of interventions and the role of pharmacist in improving adherence.

Nevertheless, strategies to improve medication adherence are typically highly focused on modifying patients' beliefs, feelings and understanding about their medications and health conditions. Therefore, improving patients' attitudes, beliefs and understanding regarding their treatment regimens would have beneficial effects on medication adherence. Furthermore, pharmacist's intervention has been shown to improve adherence and reduce blood pressure levels in patients treated with antihypertensive agents (Omboni and Caserini, 2018; Santschi *et al.*, 2014; Mogardo *et al.*, 2011; Machado *et al.*, 2007; Charbot *et al.*, 2003, Munroe *et al.*, 1997).

2.3.3.1 Background to the conceptual models

Patient education and counselling on medications, diseases and appropriate lifestyle recommendations are traditional pharmacist's activities. Pharmacist's intervention, including education and blood pressure measurement enhances blood pressure control and improves adherence to antihypertensive therapy (Omboni and Caserini, 2018). A meta-analysis of ramdomised controlled trials on pharmacist intervention to improve blood pressure by Santschi *et al.* (2014) has shown that pharmacist interventions delivered alone or in collaboration with other healthcare professionals averagely reduced systolic blood pressure by 7.6 mmHg and diastolic blood pressure by 3.9 mmHg. The pharmacist interventions mainly included patient education, feedback to physician, and medication management. Bosworth *et al.* (2005) has shown that telephone-based interventions are quite effective in changing behaviour, relatively easy to implement and gives the intervener an opportunity to follow a much larger patient panel

than would occur with an in-person intervention. Generally, patients appreciate being reminded by a healthcare provider, and such reminder systems may actually improve the patient–provider relationships.

2.3.3.2 Conceptual models underlying intervention

The approach for the intervention in this study was based on the Medication Counselling Behaviour Guidelines (MCBG) developed by the International Pharmaceutical Federation (FIP) and the International Pharmaceutical Students' Federation (IPSF), which has been developed with the objective of offering guidance that assists in fulfilling needs for managing medical conditions and prescribed medication (Appendix 2). The MCBG focuses on enhancing the patient's problem solving skills and supporting their efforts to develop medication management skills. It involves providing information that is detailed and tailored to the needs of individual patient (Wuliji and Airaksinen, 2005).

According to Santschi *et al.* (2014), pharmacist-delivered interventions consist of:

1. Patient education and counselling about lifestyle, medication and medication adherence. 2. Feedback to healthcare professional (including drug-related problems identification; recommendation to physician for medication change; team meeting, development of treatment plan).

3. Medication management (including drug monitoring with adjustment or change in medication).

4. Measurement of blood pressure, hypertension staging and risk of stratification, and reviewing of home blood pressure measurements.

5. Reminder system (including telephone contact, web services, home visits, or drug adherence aid).

6. Healthcare professional education (including training program).

For this study, the intervention focused on education and counselling about disease, lifestyle, medication, and medication adherence delivered via telephone contact.

CHAPTER THREE

3.0 METHODS

3.1 Research Site

3.1.1 Zaria

Zaria is a major city in Kaduna state in Northern Nigeria. It is a very large, heterogeneous city whose 1,490,000 population comes from different parts of the world (Wikipedia, n.d.). It is second in size only to the State capital, Kaduna. Zaria is accessible from different parts of the country by air via Kaduna, Kano, and Abuja; and by rail and road via Kaduna, Jos, Kano and Sokoto. It is located on the high plains of Northern Nigeria, 652.6 metres above the sea level, some 950 km away from the coast (112^{o} 31'N 7^{o} 42'E). Islam is the predominant faith and Hausa is the major language of its residents. Agriculture is the main occupation of the residents, majority of whom could be said to be low-middle income earners. It used to be a major collecting point for cotton and tobacco and cotton ginning became its chief economic activity after the opening of the railway. Other significant industries include railway repairing and cigarette manufacturing. Zaria is the educational centre of the northern states. The Main Campus of Ahmadu Bello University is located in Samaru, a suburb of Zaria. Samaru is situated on latitude 112^{o} 12" N and longitude 7^{o} 37" E, at an altitude of 550-700 meters. It is about 13 km from Zaria-city on the Sokoto road and 8 km to Shika (Ahmadu Bello University Official Website, n.d.).

3.1.2 Ahmadu Bello University Teaching Hospital

The Ahmadu Bello University Teaching Hospital (ABUTH) has about 700 bed capacity and is located at Shika, eight kilometres away from the main campus. It provides various services

including pharmaceutical service, specialities and general clinics. It has twenty clinical departments, which include medicine, and community medicine. It provides 24 hour emergency medical care, specialist cancer and urological services, specialist medical care including stroke and heart conditions. Currently, it host the North-west centre for pharmaco-vigilance. ABUTH is one of the largest hospitals in Nigeria, and one of the largest referral centres in North-west Nigeria.

3.2 Research Population

This study was conducted at the Cardiac Clinic of the Medical Outpatient Department (MOPD) of ABUTH. The Cardiac Clinic was run every Monday and Friday between 7am and 3pm, with follow-up visits mainly conducted on Mondays, and new cases mainly seen on Fridays. The MOPD has eight pavilions with four consulting rooms in each pavilion. During the clinic days, two to three pavilions were mainly used for the Cardiac Clinic while the remaining pavilions were reserved for other clinics. On average, the MOPD attend to more than 10,000 hypertensive outpatients a year, and over 800 hypertensive outpatients attended every month comprising both the follow-up and new cases. Approximately, over 400 new hypertension cases were seen every year.

Hypertensive patients who were registered with and attend the Cardiac Clinic at the MOPD, ABUTH and met the following criteria were enrolled.

3.2.1 Inclusion criteria

Old cases of hypertensive patients who were ≥18 years.

Old cases of hypertensive outpatients who were taking antihypertensive medications.

Old cases of hypertensive patients who had active telephone line and consented to take part.

3.2.2 Exclusion criteria

Hypertensive outpatients who were critically ill.

Patients who lost interest and declined/withdrew consent.

Hypertensive patients who were involved in another similar research.

3.3 Sample Size

The sample size was calculated using a formula for sample size estimation, and the variables imputed in the formula were obtained from the literature. A systematic review on positive influence of short message service (SMS) and voice call interventions on adherence and health outcomes has shown a significantly high proportion (81%) of hypertension control among patients (Yasmin *et al.,* 2016). Similarly, several studies on adherence measure conducted in Nigeria have shown level of adherence to range from 33% to 70% (Kabiru *et al.,* 2004; Akpa *et al.,* 2008; Sani *et al.,* 2008; Adeyemo *et al.,* 2013).

Therefore, assuming 70% hypertension control, and using one-tailed prediction direction at alpha level of 5% (0.05), 95% confidence interval and 10% attrition, a maximum sample of 130 patients was used based on Suresh and Chandrashekara's formula for sample size estimation.

$N = Z\alpha^2 \times P\ (1\text{-}p) \times D/E^2$ _____Equation 1 (Suresh and Chandrashekara, 2012)

Where N = the total number of participants to be recruited

Z_α = is normal deviate for one-tailed alternative hypothesis at a level of significance; for example, for 5% level of significance, Z_α is 1.64,

P = is the assumed impact of event of interest for the study = 70% in this study,

D = is the design effect -reflects the sampling design used in the survey type of study. This is 1 for simple random sampling,

E = is the Precision (or margin of error) with which a researcher want to measure something. Generally, E will be 10% of P,

$N^1 = N/1-q$_____ Equation 2 (Suresh and Chandrashekara, 2012)

Where N^1 = total number of subjects which have to be recruited to ensure that the final sample size (N) is achieved after drop out before the study ends,

q = is the proportion of attrition/drop out and is generally 10%,

Therefore; $N = (1.64)^2 \times 0.7 \times (1- 0.7) \times 1/(0.1 \times 0.7)^2 = 115$,

Substituting this in equation 2, gives $N^1 = 115/(1-0.1) = 127$.

Directional hypothesis was used because of the difficulties associated with recruitment of participants, which include getting patients who possessed mobile phone, and retaining patients in the intervention when a mobile phone is lost/broken and/or the number changes (Yasmin *et al*., 2016).

3.4 Research Design

This was an interventional longitudinal study carried out between February, 2016 and February, 2017. The research examined the influence of pharmacist intervention on treatment adherence and blood pressure control among hypertensive patients attending the Cardiac Clinic of the MOPD of ABUTH Zaria, North-west Nigeria. At baseline and at six weeks, blood pressure values were examined and data on self-reported adherence to medication and the patient-related determinants of adherence (knowledge, attitudes, beliefs, acceptability and satisfaction) was collected with the aid of validated questionnaires.

A prospective research design was chosen so that the characteristics of the participants match with the target population intended for final implementation of the research findings in order to enhance generalisability. Also, because of the prospective approach, most data were highly

reliable and there was an increased opportunity and ability to capture most recent exposures and detection of unintended risks and benefits as well as hypotheses generation.

A baseline/post-intervention design was chosen because it relatively had more power to detect effects, since the type of factors that are held constant in this design are free to vary in the independent-measures design that may have bigger unsystematic variation (Field, 2009).

3.4.1 Instrument/Questionnaire development

Questionnaires designed to achieve the objectives of the study were used for both pre- and post-intervention evaluations. A questionnaire was designed to collect information on patients' socio-demographic and other medical characteristics. They include patients' age, gender, occupation, religion, marital status, ethnicity, educational status, comorbidities, hypertension duration, patients' telephone numbers and contact address (Appendix 3).

A data collection instrument was used to collect patients' socio-demographic information, prescribed medications, and blood pressure values. Patients' adherence was measured with the 8-item Morisky Medication Adherence Scale (MMAS-8) (Morisky *et al.,* 2008). Another self-reported information on patient-related determinants of adherence that included knowledge, attitude, beliefs, acceptability and satisfaction was obtained. Knowledge about hypertension was assessed with a knowledge questionnaire adopted from Barreto *et al.* (2014), while attitude was determined with the aid of a questionnaire comprising various items adapted from different authors, which included Odusola *et al.* (2014), Elliott (2009) and Hashmi *et al.* (2007). Beliefs about antihypertensive medicines were evaluated, using the 10-item Beliefs about Medicines Questionnaire adopted from Horne and Weinman (1999). Additionally, patients' acceptability and satisfaction with care were determined with the aid of a questionnaire comprising different

items adapted from Ughasoro *et al.* (2015), Liu *et al.* (2014), and Doherty *et al.* (2011) (Appendices 4, 6, 8, 9 and 11).

3.4.1.1 Questionnaire for the measurement of patients' self-reported adherence

Design: The Morisky Medication Adherence Scale (MMAS-8) (Appendix 4) is one of the most widely used tools in health and social research. Originally, it was developed by Morisky *et al*. (1986) as a 4-item scale, the scale was modified to 8 items in 2008. The new scale (8-item) was developed as the previous scale (4-item) was considered accusatory in nature, isolating and often evoked defensiveness from patients (Saleem *et al.,* 2012). The MMAS-8 is comprised of eight questions with dichotomous response of 'yes' or 'no'. Examples of scale questions include: "Do you sometimes forget to take your high blood pressure pills, yes or no?.

Reliability of scale score: The reliability of the scale was determined in SPSS version 20 (Appendix 5), where all the 8 items were entered in the reliability analyses to find the internal-consistency reliability coefficient (Cronbach's alpha) and the test-retest consistency reliability (intraclass correlation coefficient) over a six weeks interval.

Known-group validity: The *t*-test and chi square test were used to determine the relationship between the MMAS scores and systolic/diastolic blood pressure control. The odds ratios for having controlled systolic/diastolic blood pressure and the scales' sensitivity, specificity, positive and negative predictive values were calculated.

Construct validity: A principal component analysis (PCA) was conducted with oblique rotation (Direct Oblimin). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett's test of sphericity for the factor analysis were determined.

3.4.2 Instruments for assessing patient-related determinants of adherence

3.4.2.1 Questionnaire for assessment of knowledge

Design: The knowledge questionnaire was adopted from Barreto *et al.* (2014) (Appendix 6). It assessed patients' knowledge based on ten (10) knowledge items/questions with each item having a dichotomous response of 'yes' or 'no', and they include; 'is hypertension a lifelong disease?. 'Is the treatment for hypertension a lifelong one?.

Pretesting and validity: The hypertension knowledge questionnaire was considered to be a valid instrument since it was used in previous works by Barreto *et al.* (2014); Malik *et al.* (2014) and Almas *et al.* (2012). However, it was pretested on 34 patients (Appendix 7) in order to determine the internal-consistency reliability coefficient (Cronbach's alpha) and the test-retest reliability (intraclass correlation coefficient) over a six weeks interval.

Construct validity: A principal component analysis (PCA) was conducted with orthogonal rotation (Varimax). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett's test of sphericity for the factor analysis were determined.

3.4.2.2 Questionnaire for the determination of patients' attitudes towards antihypertensives

Design: The attitude questionnaire consist of 8 questions with each having a dichotomous response of 'yes' or 'no'. They include; 'Can you remember the name(s) of your medications?. 'Do you always afford the cost of your medications? (Appendix 8).

Pretesting and validity: The attitude questionnaire was not used as a scale since items were not designed to measure a particular construct and were unrelated.

3.4.2.3 Questionnaire for the evaluation of patients' beliefs about antihypertensives

Design: Patients' beliefs about their medications were assessed with the BMQ. The BMQ comprises two five-item scales assessing patients' beliefs about the necessity of prescribed medication for controlling their illness and their concerns about the potential adverse consequences of taking it. Examples of items from the necessity scale include: "My health, at present, depends on my medicines" and "My medicines protect me from becoming worse." Examples of items from the concerns scale include: "I sometimes worry about the long term effects of my medicines" and "I sometimes worry about becoming too dependent on my medicines" (Appendix 9).

Pretesting and validity: The internal-consistency reliability coefficient (Cronbach's alpha) (Appendix 10) and the test-retest reliability (intraclass correlation coefficient) over a six weeks interval were determined.

Construct validity: A principal component analysis (PCA) was conducted with oblique rotation (Direct Oblimin). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett's test of sphericity for the factor analysis were determined.

3.4.2.4 Questionnaire for the evaluation of patient's acceptability and satisfaction with care

Design: This data instrument has two sections and section one evaluated patients' acceptability for antihypertensives based on their willingness to use the medications in the future and their satisfaction with the facility (Appendix 11). In this respect, patients were asked whether they were willing to continue taking their antihypertensives, and whether they were satisfied with the overall management of their hypertension in the facility.

Section two of the instrument assessed patient-centred factors affecting swallowability of antihypertensives, like the table shape, size, smell and taste. In this respect, patients were asked to rate the shape, size or taste of their antihypertensive tablets. Patients who had concerns regarding particular antihypertensive drugs, were persuaded to either mention the name, describe, or bring it.

Further, respondents were asked whether they were satisfied with the care they received in the healthcare facility which was measured on the categorical level and expressed in numbers and percentages.

Pretesting and validity: The instrument was not used as a scale because items were not designed to measure a particular construct.

3.5 Data Collection

The data was collected prospectively and in continuum for 12 months, with the target sample of hypertensive patients recruited at different times between February 2016 and February 2017, at the MOPD of ABUTH. Patients' folders were reviewed, questionnaires were interviewer administered at the start of intervention, and after a telephone call intervention the questionnaires were readministered at six weeks.

A two-page subject information sheet containing detail information about the research was distributed, after which patients' consent was sought for and then asked to sign or thumb print a written consent form (Appendix 12). On every Clinic day, one patient was selected from each consultation room and this was carried for one year. This sampling enabled a good trade-off between resource and time allocation, while preserving the potential to generalise the findings.

Information regarding patients' socio-demographic characteristics that include patients' gender, age, marital status, educational level, ethnicity and religion was collected. The five set of questionnaires were administered in order to obtain the pre-intervention data on adherence to medications and the patient-related determinants of adherence (knowledge, attitude, beliefs and acceptability and satisfaction). The questionnaires were administered to the patients and questions that were not clear to the patients were further clarified to avoid ambiguity. Patients' medications, blood pressure readings and co-morbid conditions, past medication history, social history, drug allergies, and fresh complaints were obtained from their folders.

A pharmacist-delivered telephone-based education and counselling was carried out once every week for a period of six weeks per patient. The education and counselling sessions were delivered to patients individually and outcome measures were also assessed individually. Patients were called via telephones beginning with self-introduction and the purpose of the call, then asked how they were getting along with their medications. Based on individual patient's result of the pre-intervention evaluations, education and advice on the importance of adherence to medications were given. Patients were asked about their adherence problems and pinpoint specific concerns regarding their medications and the reasons for non-adherence. Patients who were confused with their medications and could not express themselves over the telephone were visited at homes.

The telephone-based education and counselling sessions were guided by a predesigned education and counselling tool (Appendix 13) that comprised four aspects: Risk of hypertension and its complications, Medication education and counselling, Adherence to healthy lifestyle, and Medication handling.

3.5.1 Aspects of the intervention

3.5.1.1 Risk of hypertension and its complications

During the baseline evaluations, patients were asked questions designed to test their knowledge on hypertension risks and complications. Based upon a screen of 10 questions, patients who had poor understanding of the risks associated with poor blood pressure control, were educated. The importance of controlling one's blood pressure was emphasized by underscoring the association between benefits of maintaining adequate blood pressure control and prevention of heart failure, stroke, and renal failure.

3.5.1.2 Medication education and counselling

Medication names and strength, prescribed dose and dosing frequencies were emphasized to the patients. Reasons for alterations to treatment plan such as change of medication, addition, removal, or dose titration (up or down) were discussed. Medications instructions were reinforced and information on the benefits of the medication, and potential side effects was passed. Patients were advised on the possible strategies to cope with side effects of medications.

More so, the importance of adherence to medication was stressed, and those patients who were observed to be non-adherent during baseline evaluation, received detailed adherence counselling.

3.5.1.3 Adherence to healthy lifestyle

All patients received counselling on lifestyle and dietary modifications such as eating fruits and vegetables, avoiding saturated fat and the use of unsaturated oil, as well as stress reduction. Also, the benefit of physical exercise was highlighted.

3.5.1.4 Medication handling

The importance of purchasing medication preferably from the hospital pharmacy was mentioned, and additionally, patients were advised to ensure that all purchased medicines were registered by the National Agency for Food and Drug Administration and Control (NAFDAC), and to check medicines expiration dates at purchase and during storage. Importance of appropriate storage of all medicines was elaborated.

Each education/counselling session was allowed to run for as much time as a patient needed it while the telephone conversations and call duration were recorded. A telephone call chart containing patients' identification code and a column for number of counselling sessions received by patient was used to monitor counselling sessions (Appendix 14).

At six weeks, assessment of patients' blood pressure and adherence was conducted. Self-reported measurement of the patient-related determinants of adherence (knowledge, attitude, beliefs, and acceptability and satisfaction) was gathered. The same data instruments used for the baseline evaluations were used for the post-intervention assessments. For those patients whose follow-up visit was due at the end of the intervention, the post-intervention evaluation was conducted at the Clinic, while for those patients whose follow-up visit was not due at the end of the intervention, the post-intervention evaluation was conducted at homes.

3.6 Data Presentation and Analysis

Statistical analyses were carried out with the IBM® SPSS for Windows statistical software package version 20 (Chicago, IL USA). In terms of descriptive statistics, categorical variables were presented in numbers and percentages. The distributions of continuous data were graphically assessed. Chi squared tests were used to compare relationships between categorical

variables. The *t*-test or ANOVA and Mann Whiteney U or Kruskall Wallis H were used to compare two groups or more, of a parametric and non-parametric data respectively. Continuous data were presented in mean and standard deviation. Univariate logistic regression analysis was conducted to assess the association between each determinants of adherence and each outcome variable (knowledge, attitude, beliefs and acceptability and satisfaction). A *p*-value of .05 in the univariate analysis was used as an upper threshold for inclusion in the multivariate logistic regression model. Using a stepwise backward (LR) method, variables were selected for the final model. Only determinants' variables that were statistically significant ($p \leq .05$) contributors to the multivariate model were considered to be related to adherence.

Measurement of adherence variables: Adherence was measured on both continuous scale and ordinal levels. The MMAS-8 asks patients to respond with ''yes" or ''no" to a set of 7 questions and to one 5-point Likert scale question with responses scored on a 5-point Likert scale where 5 = never/ rarely, 4 = once in a while, 3 = sometimes, 2 = usually, and 1 = all the time. The score for full adherence is 8, with lower scores indicating a poorer level of adherence with a lower boundary of zero. Each of the 7 questions were scored 1 for correct answer or 0 for wrong answer. In this study, scale score of 8 was considered high adherence, medium adherence score of 6 to <8 and low adherence score of <6.

Measurement of knowledge variables: Knowledge was measured on both scale/continuous and ordinal levels as "knowledge" score and level respectively. For the scale measurement level, each of the 10 items on the knowledge questionnaire was scored '1' for correct answer and '0' for a wrong answer. The maximum total knowledge score was '10' and the minimum knowledge score was zero. Additionally, for the knowledge level, knowledge score of 1 – 4 was considered inadequate, 5 – 8 moderate and 9 – 10 adequate.

Measurement of attitude variables: The attitude was measured on categorical/nominal level. The proportion of participants' responses was calculated and expressed in numbers and percentages.

Measurement of beliefs about medicines variables: The belief about medicines was measured on both continuous scale and nominal levels based on the necessity and concerns scores. For the nominal measurement level, each of the beliefs questions was assigned five options; strongly disagree, disagree, uncertain, agree, and strongly agree.

For the scale measurement level, the five options assigned to each of the 5 beliefs questions were assigned scores from 1 to 5; strongly disagree = 1, disagree = 2, uncertain = 3, agree = 4, and strongly agree = 5 and scores obtained were summed to give a total score for the necessity or concerns scale between 5 and 25. In this way, it is possible to differentiate between patients on the basis of their beliefs about the necessity of their medication and their concerns about taking it. Scores can be interpreted in two ways: as a continuous scale where higher scores indicate stronger beliefs in the concepts represented by the scale (necessity or concern) or by dichotomizing at the scale midpoint. The latter method is a convenient way of categorizing respondents according to the strength of their views about medication. Additionally, the necessity and concerns scales assess positive and negative attitudes toward medication. An indication of the relative importance of these attitudes for individual patients was obtained by calculating the necessity–concerns differential. This was calculated as the difference between necessity and concerns scores, and thus had a possible range of –20 to 20.

Using the necessity-concerns beliefs to assess a balance between 'perceived benefit and costs' associated with prescribed medication: The necessity–concerns differential may be thought of as the result of a cost–benefit analysis for each patient in whom their perceptions of cost

(concerns) are weighed against their perception of benefit (necessity beliefs). If the difference is positive, the patient perceives that the benefits of medication outweigh the costs. Conversely, if it is negative, the patient perceives greater cost than benefit.

Measurement of acceptability variables: Acceptability was measured as 'willingness to use in future'. The proportion of patients who were willing, not willing or uncertain about using their medications in the future was evaluated and expressed in numbers and percentages. In order to validate this information, respondents were asked to state whether they dislike the taste, smell or size of their tablets. Patients were asked to state whether their medications have any negative effect on their daily life activities. These were measured on the categorical/nominal level and expressed in numbers and percentages.

3.7 Ethical Clearance

The Health Research Ethics Committee (HREC) of Ahmadu Bello University Teaching Hospital Zaria, granted ethical approval for this research. An ethical clearance certificate with identification number ABUTH/HREC/S03/2015 was granted (Appendix 15).

CHAPTER FOUR

4.0 RESULTS

4.1 Description of the Population

The total number of patients who completed the study was 130. One hundred and fifty-one patients were enrolled, but 21 patients were lost to follow-up. Fifty-one (39%) were males and 79 (61%) were females. The minimum age was 20 years and the maximum age was 86 years. The mean±SD age was 53.7±13.1 years. Majority (58%) of the patients' age was between 41 and 60 years. Majority (91%) of the patients were married and of the Islamic faith (83%). Most (38%) of the patients were house wives, and the majority (44%) had no formal education (Table 4.1).

At baseline, the mean±SD systolic and diastolic blood pressure values were 142.8±27.6 and 88.6±16.8 respectively. The maximum systolic and diastolic blood pressure values were 224 mmHg and 150 mmHg respectively. Seventy patients (54%) had uncontrolled systolic blood pressure. Sixty-nine patients (53%) had uncontrolled diastolic blood pressure. Majority of the patients (88%) were on either angiotensin converting enzyme inhibitors or angiotensin receptor blockers (Figure 4.1). Fewer than half of the patients (49; 38%) were adherent to medication (Figure 4.2).

Table 4.1: Socio-Demographic Characteristics of the Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Characteristic	N (%)
Age categories	
≤40	19 (15)
41-60	76 (58)
61-80	31 (24)
>80	4 (3)
Gender	
Male	51 (39)
Female	79 (61)
Marital status	
Divorced	3 (2)
Married	118 (91)
Single	1 (1)
Widowed	8 (6)
Religion	
Islam	108 (83)
Christianity	22 (17)
Ethnicity	
Hausa	87 (67)
Yoruba	16 (12)
Other*	27 (2)
Educational status	
Primary level	27 (21)
Secondary level	13 (10)
Tertiary level	33 (25)
No formal education	57 (44)
Occupation	
House wife	49 (38)
Business	47 (36)
Other*	34 (26)

Ethnicity: *Adara 1, Afamei 2, BaburBura 2, Chawai 1, Egbira 2, Fulani 2, Idoma 2, Igbo 2, Igala 2, Jaba 1, Kagoro 3, Kataf 2, Kono 1, Marwa 1, Nupe 2. **Occupation:** *Civil servant 7, Casual worker 1, Driver 6, Farmer 2, Nurse 1, Pensioner 3, Retiree 4, Student 1, Security 1, Teacher 7, Unemployed 1. N = 130.

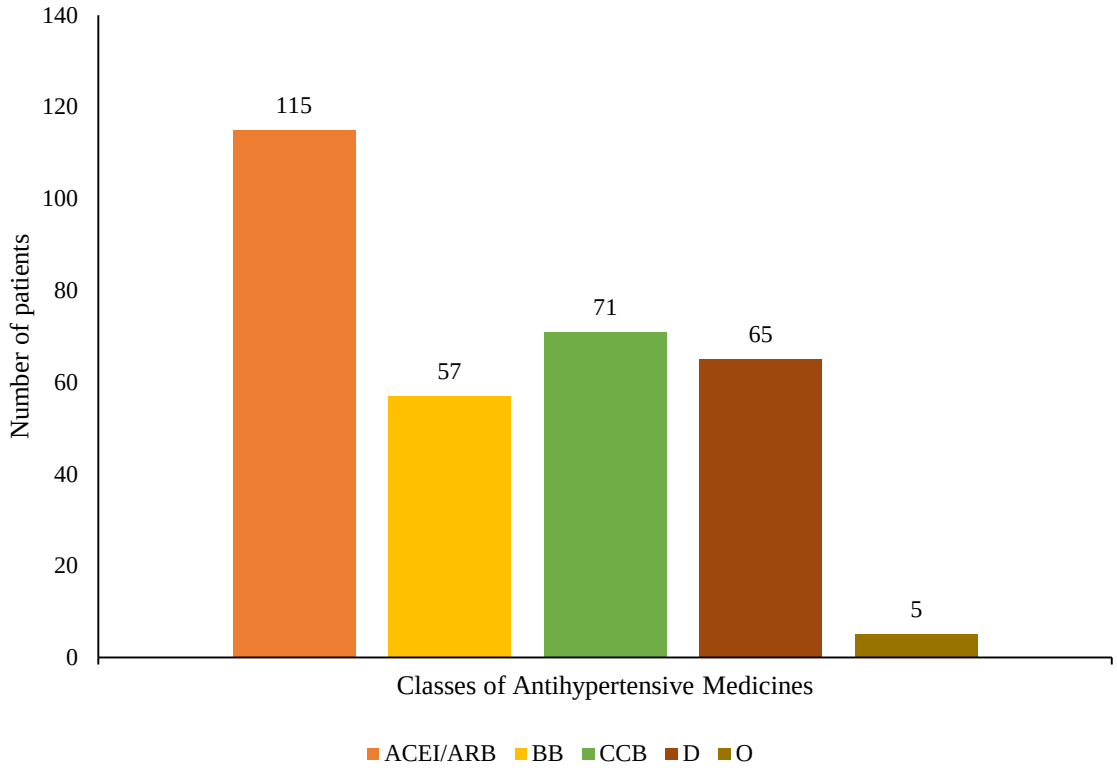

Figure 4.1: Antihypertensive Drug Classes Included in the Patients' Regimens in a Tertiary Health Facility in North-West Nigeria

ACEI = Angiotensin converting enzyme inhibitor; ARB = Angiotensin receptor blocker; BB = Beta blocker; CCB = Calcium channel blocker; D = Diuretics; O = Other: Alpha methyldopa 4; Doxazocin 1. N = 130.

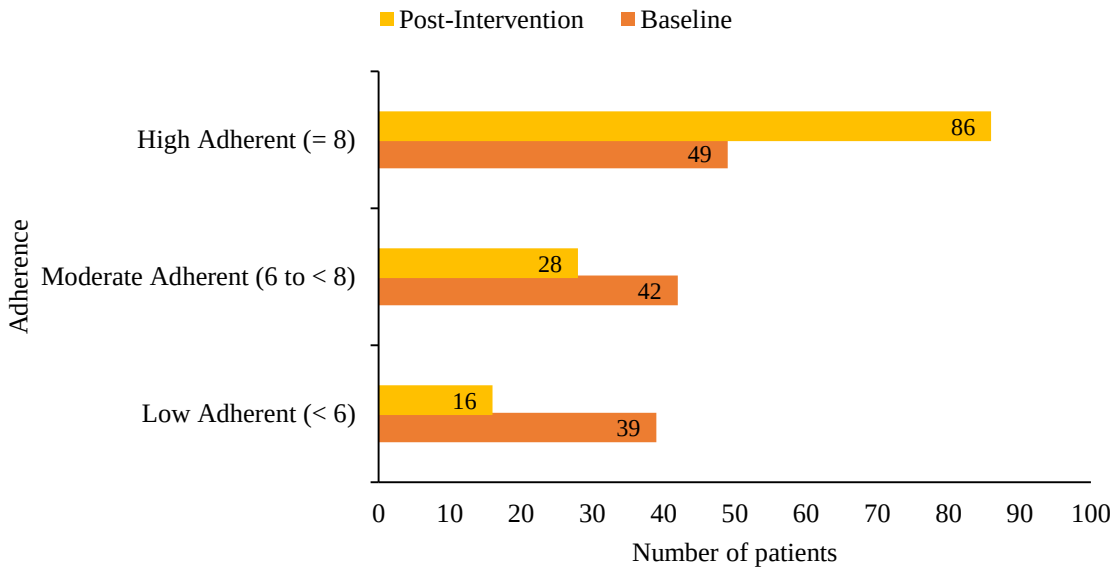

Figure 4.2: Difference in Adherence Level before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria (N = 130)

4.2 Difference in Blood Pressure Reductions and Control

Table 4.2 shows that, on average, participants experienced significantly reduced systolic blood pressure after the telephone voice call intervention (mean±SD (132.2±17.5)) than before the intervention (mean±SD (142.8±27.6)), $t(129) = 4.14$, $p < .01$, (CI = 5.48 -15.57). Standardized effect size was estimated at Cohen's $d = 0.38$. Participants experienced statistically insignificant decrease in diastolic blood pressure after the telephone voice call intervention (mean±SD (86.3±14.2)) than before the intervention (mean±SD (88.6±16.8)), $t(129) = 1.42$, $p = .159$, (CI = -0.91 – 5.55). Effect size was estimated at Cohen's $d = 0.14$. At baseline, 47% of the patients had control. Overall, there was reduction in both systolic and diastolic blood pressure values of 10.6±3.1 mmHg and 2.3±1.9 mmHg respectively. At six weeks, significant proportion (70%) of the patients had controlled blood pressure (Table 4.3).

Table 4.2: Blood Pressure Reduction after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

	Mean±SD	*t*-test	*p*
SBP (mmHg)			
Baseline	142.8±27.6	4.14	<.001
Post-intervention	132.2±17.5		
Difference in SBP	10.6±3.1		
DBP (mmHg)			
Baseline	88.6±16.8	1.42	.079
Post-intervention	86.3±14.2		
Difference in DBP	2.3±1.9		

SBP = Systolic Blood Pressure; DBP = Diastolic Blood Pressure; SD = Standard Deviation
P = Significance level at .05. The difference in blood pressure mean was tested with the *t*- test. N = 130.

Table 4.3: Blood Pressure Control before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

	Controlled (%)		***p***
mmHg	Baseline	Post-intervention	
SBP	60 (46)	99 (76)	< .001
DBP	61 (47)	83 (64)	.002

SBP = Systolic Blood Pressure; DBP = Diastolic Blood Pressure; *P* = Significance level at .05. Difference in blood pressure control was determined with χ^2 test. N = 130.

4.3 Treatment Adherence

4.3.1 Relationship between treatment adherence at baseline and background characteristics

At baseline, there was no statistically significant difference in adherence between the categories of patients' gender, age, religion, marital status and educational level (Table 4.4). Table 4.5 shows that patients who were controlled reported higher mean adherence score than those who were uncontrolled. The difference in adherence among patients between controlled and uncontrolled diastolic blood pressure was statistically significant (p = .030). There was also statistically significant difference in concerns belief between adherent and non-adherent patients (p = .030). Patients who reported weak concerns about their medication were more adherent than those who reported strong concerns beliefs.

Table 4.4: Scores on Measures of Treatment Adherence at Baseline among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Variable	N (%)	Score		
		Mean ±SD	F/*t*/*U*/$\chi^2_{(2)}$	*P*
Gender				
Male	51 (39)	6.35 ±1.9	1758.0	.207
Female	79 (61)	5.90 ±2.2		
Age categories				
≤40	19 (14)	6.00 ±2.5	6.06	.109
41-60	76 (60)	5.78 ±2.5		
61-80	31 (23)	6.71 ±1.8		
>80	4 (3)	7.25 ±1.5		
Religion				
Muslim	107 (82)	6.13 ±2.2	1069.5	.311
Christian	23 (18)	5.83 ±1.9		
Marital status				
Married	118 (91)	6.05 ±2.1	1.57	.665
Single	1 (1)	8.00		
Divorced	3 (2)	6.00 ±3.5		
Widowed	8 (6)	6.25 ± 2.4		
Educational level				
No formal education	57 (44)	6.07 ±2.1	1.36	.715
Primary	27 (21)	6.48 ±2.0		
Secondary	13 (10)	5.85 ±2.4		
Tertiary	33 (25)	5.85 ±2.2		

F = ANOVA; *t* = Students't; *U* = Mann Whiteney U; $\chi^2_{(2)}$ = Kruskall Wallis H; *p* = significance level ≤ .05; SD = Standard Deviation; Adherence: Low = < 6, Moderate = 6 – 7, High = 8. N = 130.

Table 4.5: Scores on Treatment Adherence, Hypertension Duration, Blood Pressure and Beliefs at Baseline among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Variable	N (%)	Score		
		Mean ±SD	F/t/U/$\chi^2_{(2)}$	P
Hypertension duration (year)				
< 5	39 (30)	6.82 ±1.6	13.54	.095
5 – 9	14 (11)	5.57 ±2.7		
10 – 14	48 (37)	5.77 ±2.4		
15 – 19	11 (8)	5.45 ±2.0		
20 – 24	4 (3)	4.75 ±1.3		
25 – 29	6 (5)	6.33 ±2.2		
30 – 34	4 (3)	5.25 ±1.7		
35 – 39	1 (1)	8.00 ±0.0		
> 39	3 (2)	7.67 ±0.6		
SBP (mmHg)				
Controlled	60 (45)	6.37 ±2.0	1735.5	.083
Uncontrolled	70 (55)	5.83 ±2.2		
DBP (mmHg)				
Controlled	61 (47)	6.51 ±2.0	2.19	.030*
Uncontrolled	69 (53)	5.70 ±2.1		
Necessity beliefs				
Strong	107 (82)	6.01 ±2.2	0.79	.453
Neutral	8 (6)	7.00 ±1.4		
Weak	15 (12)	6.07 ±2.2		
Concerns beliefs				
Strong	31 (24)	5.32 ±2.4	3.59	.030*
Neutral	3 (2)	4.67 ±0.6		
Weak	96 (74)	6.36 ±2.0		

SBP = Systolic Blood Pressure; DBP = Diastolic Blood Pressure; F = ANOVA; t = Students't; U = Mann Whiteney U; $\chi^2_{(2)}$ = Kruskall Wallis H; p = significance level ≤ .05; * = Statistically Significant; SD = Standard Deviation; Adherence: Low = < 6, Moderate = 6 – 7, High = 8. N = 130.

4.3.2 Relationship between changes in treatment adherence and background characteristics at six weeks

Table 4.6 shows that patients' adherence increased from the baseline, but the difference in adherence between patients' background characteristics was not statistically significant. Table 4.7 shows that at six weeks, patients who had strong necessity belief about their medication were more adherent than those who had weak necessity belief. The difference in adherence between necessity belief categories was not statistically significant (p = .169). Patients who had strong concerns about their medication were less adherent than those who had weak concerns beliefs, however, the difference was not statistically significant (p = .446). Table 4.8 shows that at six weeks, patients who had no comorbidities were more adherent than those with comorbidities but the difference in adherence was not statistically significant (p = .802). Additionally, there was no statistically significant difference in mean adherence score between patients taking either one or more than one antihypertensives (p = .919). However, patients who were taking four antihypertensives had higher mean adherence score (7.56±0.7).

The multivariate logistic regression analyses showed that, short hypertension duration (<5 years) had statistically significant relationship with better adherence to medication (p = .028) compared to long hypertension duration (Table 4.9).

Table 4.6: Scores on Treatment Adherence at Six Weeks among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Variable	N (%)	Score		
		Mean ±SD	F/t/U/$\chi^2_{(2)}$	P
Gender				
Male	51 (39)	7.38 ±1.5	0.75	.233
Female	79 (61)	7.15 ±1.7		
Age categories (years)				
≤40	19 (15)	7.12 ±2.0	1.08	.362
41-60	76 (58)	7.08 ±1.7		
61-80	31 (24)	7.67 ±0.7		
>80	4 (3)	8.00 ±0.0		
Religion				
Muslim	107 (82)	7.14 ±1.7	-2.65	.933
Christian	23 (18)	7.76 ±0.7		
Marital status				
Married	118 (91)	7.24 ±1.6	0.24	.868
Single	1 (1)	8.00		
Divorced	3 (2)	7.67 ±0.6		
Widowed	8 (6)	6.94 ±1.6		
Educational level				
No formal education	57 (44)	6.99 ±1.8	1.75	.161
Primary	27 (21)	7.79 ±0.5		
Secondary	13 (10)	7.58 ±0.8		
Tertiary	33 (25)	7.03 ±1.9		

F = ANOVA; t = Students't; U = Mann Whiteney U; $\chi^2_{(2)}$ = Kruskall Wallis H; p = significance level ≤ .05; * = Statistically Significant; SD = Standard Deviation; Adherence: Low = < 6, Moderate = 6 – 7, High = 8. N = 130.

Table 4.7: Treatment Adherence Score, Hypertension Duration, Blood Pressure and Beliefs at Six Weeks among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Variable	N (%)	Score		
		Mean ±SD	F/t/*U*/$\chi^2_{(2)}$	*P*
Hypertension duration (years)				
< 5	39 (30)	7.00 ±1.7	0.28	.970
5 – 9	14 (11)	7.21 ±1.3		
10 – 14	48 (37)	7.47 ±1.7		
15 – 19	11 (8)	7.18 ±1.6		
20 – 24	4 (3)	7.50 ±0.6		
25 – 29	6 (5)	7.33 ±0.8		
30 – 34	4 (3)	7.33 ±1.2		
35 – 39	1 (1)	8.00		
> 39	3 (2)	6.67 ±2.3		
SBP (mmHg)				
Controlled	99 (76)	7.22 ±1.7	0.39	.898
Uncontrolled	31 (24)	7.27 ±1.3		
DBP (mmHg)				
Controlled	83 (64)	7.20 ±1.7	-0.22	.823
Uncontrolled	47 (36)	7.27 ±1.4		
Necessity beliefs				
Strong	107 (82)	7.32 ±1.5	1.81	.169
Neutral	8 (6)	7.60 ±0.9		
Weak	15 (12)	6.50 ±2.2		
Concerns beliefs				
Strong	31 (24)	6.95 ±1.9	0.81	.446
Neutral	3 (2)	8.00		
Weak	96 (74)	7.32 ±1.5		

SBP = Systolic Blood Pressure; DBP = Diastolic Blood Pressure; F = ANOVA; *t* = Students't; *U* = Mann Whiteney U; $\chi^2_{(2)}$ = Kruskall Wallis H; *p* = significance level ≤ .05; SD = Standard Deviation; Adherence: Low = < 6, Moderate = 6 – 7, High = 8. N = 130.

Table 4.8: Treatment Adherence Score, Comorbidity and Number of Antihypertensives among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Variable	N (%)	Scores		
		Mean ±SD	F/U/$\chi^2_{(2)}$	P
Comorbidity				
None	90 (69)	7.30 ±1.5	0.22	.802
One	38 (29)	7.09 ±1.9		
Two	2 (2)	7.00 ±0.0		
Number of antihypertensives				
1	10 (8)	7.05 ±1.8	0.17	.919
2	62 (48)	7.23 ±1.7		
3	47 (36)	7.22 ±1.6		
4	11 (8)	7.56 ±0.7		

F = ANOVA; U = Mann Whiteney U; $\chi^2_{(2)}$ = Kruskall Wallis H; p = significance level ≤ .05; SD = Standard Deviation; Adherence: Low = < 6, Moderate = 6 – 7, High = 8. N = 130.

Table 4.9: Relationship between Socio-demographic Characteristics and Adherence among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Variable	N	Adjusted OR	*P*	95% CI
Age (years)				
≤ 40	19	0.41	.312	0.07 – 2.33
41 – 60	76	0.39	.135	0.11 – 1.34
≥ 61	35	Reference		
Gender				
Male	51	0.79	.660	0.27 – 2.29
Female	79	Reference		
Marital status				
Married	118	0.94	.949	0.16 – 5.67
Unmarried	12	Reference		
Educational status				
Tertiary	33	0.71	.588	0.21 – 2.43
Secondary	13	0.48	.376	0.09 – 2.41
Primary	27	2.03	.302	0.53 – 7.81
No formal education	57	Reference		
Hypertension duration (years)				
< 5	39	4.54	.028*	1.18 – 17.51
5 – 9	14	0.21	.179	0.02 – 2.07
10 – 14	48	1.41	.648	0.32 – 6.19
15 – 19	11	1.07	.938	0.21 – 5.42
≥ 20	18	Reference		

OR = Odds Ratio; *p* = significance level ≤ .05; CI = Confidence Interval; *Statistically Significant. Odds ratios of determinants of high adherence. Multivariate logistic regression was used to determine the relationship. N = 130.

4.3.3 Change in adherence and its relationship with blood pressure control

On average, participants experienced significantly increased adherence after the telephone voice call intervention (mean±SD (7.23±1.6)) than before the intervention (mean±SD (6.08±1.9), $z = -5.01$, $p < .001$.

There was statistically significant relationship between baseline systolic blood pressure readings and baseline adherence score. The relationship was compared using the Pearson's correlation coefficient (r = -.219, $p = .019$). There was a significant negative correlation between patients' systolic blood pressure and adherence score. A simple linear regression was calculated to predict patients' systolic blood pressure based on their adherence score. A significant regression equation was found (F (1, 128) = 7.400, $p = .007$), with an R^2 of 0.055. Patients' predicted systolic blood pressure equal to 164.13 + (-3.27) (adherence) mmHg. Patients' systolic blood pressure decreased 3.27 mmHg for each adherence score. However, there was no statistically significant relationship between post-intervention systolic blood pressure readings and post-intervention adherence score. The relationship was compared using the Pearson's correlation coefficient (r = -.056, $p = .576$). There was a statistically non-significant negative correlation between post-intervention systolic blood pressure and post-intervention adherence score (Figure 4.3).

Table 4.10 shows that at baseline 46% and 47% of the patients had controlled systolic and diastolic blood pressure respectively. At six weeks, 76% and 64% of the patients had controlled systolic and diastolic blood pressure respectively.

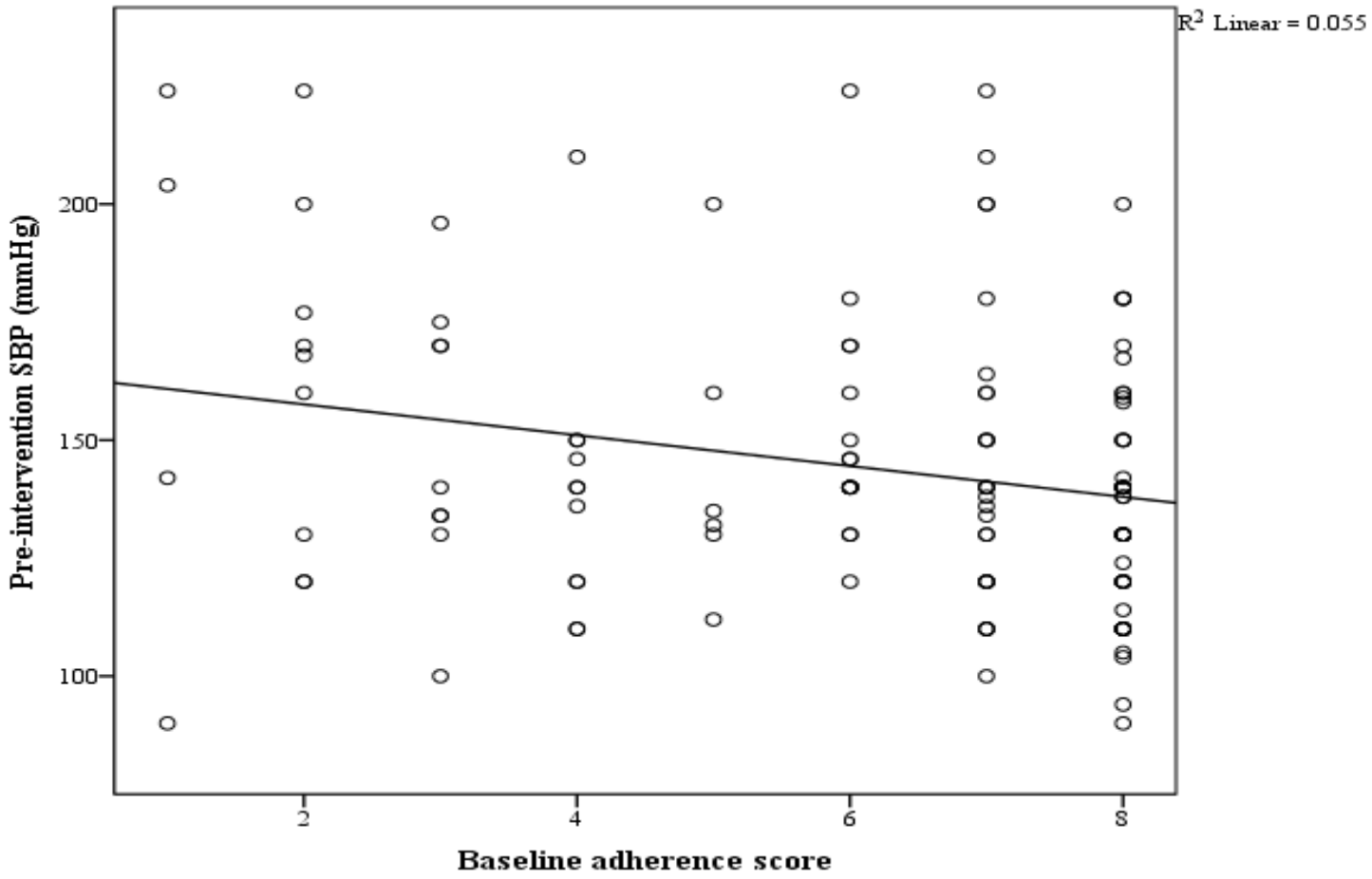

Figure 4.3: Relationship between Baseline Adherence and Systolic Blood Pressure in Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria (N = 130)

Table 4.10: Level of Adherence and its Relationship with Blood Pressure Control in Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Adherence	**SBP (mmHg)**				**DBP (mmHg)**			
	Controlled (%)		Uncontrolled (%)		Controlled (%)		Uncontrolled (%)	
	Baseline	Post-intv.	Baseline	Post-intv.	Baseline	Post-intv.	Baseline	Post-intv.
Low	17 (28)	13 (13)	22 (31)	3 (10)	14 (23)	9 (11)	25 (36)	7 (15)
Moderate	16 (27)	20 (20)	26 (38)	8 (26)	17 (28)	16 (19)	25 (36)	12 (26)
High	27 (45)	66 (67)	22 (31)	20 (65)	30 (49)	58 (70)	19 (28)	28 (60)
Total (%)	**60 (46)**	**99 (76)**	**70 (54)**	**31 (24)**	**61 (47)**	**83 (64)**	**69 (53)**	**47 (36)**

Adherence: Low = score < 6; moderate = score 6 to < 8; high = 8; SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure; intv. = intervention. N = 130.

4.3.4 Difference in adherence and the relationship between significant adherence question and blood pressure control

There was difference in the number of patients who responded to the adherence questions before and after the intervention (Table 4.11). A binary logistic regression showed that at baseline, patients were less likely to have controlled systolic blood pressure (OR = 0.3 to 0.8) when they reported non-adherence. Patients who reported taking their high blood pressure medication the day before were less likely to have controlled systolic blood pressure but the association was not statistically significant (OR = 0.4 p = .107). At six weeks patients were more likely to have controlled systolic blood pressure when they reported non-adherence (OR = 1.2 to 5.6). Patients who have never cut back or stopped taking their medication without telling their doctor were less likely to have controlled systolic blood pressure (OR = 0.9, p = .962) but the association was not statistically significant (Table 4.12).

Table 4.11: Difference in Adherence before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Variable[+]	Yes		No	
	Pre	Post	Pre	Post
Do you sometimes forget to take your high blood pressure pills?	45	21	85	109
Over the past 2 weeks, were there any days when you did not take your high blood pressure pills?	51	31	79	99
Have you ever cut back or stopped taking your medication without telling your doctor?	25	16	105	114
When you travel or leave home, do you sometimes forget to bring along your high blood pressure medication?	25	16	105	114
Did you take your high blood pressure medication yesterday?	113	115	17	15
When you feel your blood pressure is under control, do you sometimes stop taking your medication?	36	23	94	107
Taking medication every day is real inconvenience for some people, do you ever feel hassled about sticking to your high blood pressure treatment plan	27	15	103	115

[+]Distribution of patients who responded 'yes' or 'no' to the 8-item MMAS. N = 130.

Table 4.12: Significant Adherence Question Determining Blood Pressure Control before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Adherence[+]		**Baseline SBP (mmHg)**		*P*	OR	**Post SBP (mmHg)**		*P*	OR
		Controlled	Uncontrolled			Controlled	Uncontrolled		
Do you sometimes forget to take your high blood pressure pills?	Yes	15	30	.035*****	0.4	18	3	.270	2.1
	No	45	40			81	28		
Over the past 2 weeks, were there any days when you did not take your high blood pressure pills?	Yes	21	30	.361	0.7	25	6	.505	1.4
	No	39	40			74	25		
Have you ever cut back or stopped taking your medication without telling your doctor?	Yes	10	15	.493	0.7	12	4	.962	0.9
	No	50	55			87	27		
When you travel or leave home, do you sometimes forget to bring along your high blood pressure medication?	Yes	6	19	.017*****	0.3	15	1	.102	5.6
	No	54	51			84	30		
Did you take your high blood pressure medication yesterday?	**Yes**	49	64	.107	0.4	13	2	.362	2.9
	No	11	6			86	29		
When you feel your blood pressure is under control, do you sometimes stop taking your medication?	Yes	15	21	.526	0.8	20	3	.302	2.2
	No	45	49			79	28		
Taking medication every day is real inconvenience for some people, do you ever feel hassled about sticking to your high blood pressure treatment plan	Yes	10	17	.288	0.6	12	3	.764	1.2
	No	50	53			87	28		

[+]The odds ratios of controlled systolic blood pressure for 'yes' response; SBP = Systolic Blood Pressure, OR = Odds Ratio, *P* = Significance level at ≤ .05,
[*]Statistically Significant at $p \leq .05$. The bolded responses denote adherence. Binary logistic regression. N = 130.

4.3.5 Difference in adherence and comorbidity

Mean adherence score between comorbidity categories of patients was compared using ANOVA to determine whether patient with no, one or two comorbidities potentially have lower mean adherence score, and to determine whether the difference in mean adherence score was statistically significant. The result of the ANOVA showed that there was no statistically significant difference between baseline adherence scores of participants with none, one or two comorbidities ($F = 0.554$, $df = 2$, $p = .576$) (Table 4.13)

Table 4.13: Relationship between Adherence and Comorbidity among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Comorbidity difference	Sum of squares	df	Mean square	F	*P*
Between groups	5.1	2	2.6	0.554	.576
Within groups	584.1	127	4.6		
Total	589.2	129			

df = degrees of freedom; F = ANOVA; p = level of significance at ≤ .05. N = 130.

4.4 Determinants of Adherence

4.4.1 Knowledge

The Wilcoxon signed-rank test showed a statistically significant change in the patients' knowledge after the pharmacist intervention (z = -7.795, $P < .000$).

4.4.1.1 Relationship between knowledge at baseline and background characteristics

Table 4.14 shows that at baseline, all patients exhibited moderate to adequate knowledge (score of 6.8 – 9.0). There was no statistically significant difference in mean knowledge score between categories of patients' gender, age, religion, marital status and educational status. Table 4.15 shows that patients who had controlled systolic blood pressure reported higher mean knowledge score than those who were uncontrolled which was not statistically significant (p =.472). Patients who had uncontrolled diastolic blood pressure got higher mean knowledge score. The difference in knowledge between controlled and uncontrolled diastolic blood pressure was statistically not significant (p = .054). There was no statistically significant difference in knowledge between adherent and non-adherent patients (p = .136). Patients who showed moderate knowledge exhibited either low, moderate or high adherence to treatment.

Table 4.14: Scores on Knowledge Measure at Baseline among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Variables	N (%)	Scores	
		Mean ±SD	*P*
Gender			
Male	51 (39)	7.5 ±1.9	.304
Female	79 (61)	7.7 ±1.8	
Age categories (years)			
≤40	19 (15)	7.4 ±1.7	.163
41-60	76 (58)	7.9 ±1.8	
61-80	31 (24)	7.4 ±1.8	
>80	4 (3)	6.8 ±1.3	
Religion			
Islam	108 (83)	7.8 ±1.9	.299
Christianity	22 (17)	7.1 ±1.8	
Marital status			
Married	118 (91)	7.6 ±1.8	.475
Single	1 (1)	7.0 ±0.0	
Divorced	8 (6)	9.0 ±0.0	
Widowed	3 (2)	8.1 ±1.9	
Educational level			
No formal education	57 (44)	7.4 ±1.9	.440
Primary	27 (21)	8.0 ±1.6	
Secondary	13 (10)	8.2 ±1.3	
Tertiary	33 (25)	7.7 ±1.8	

SD = Standard Deviation, Inadequate = < 5, Moderate = 5 – 8, Adequate = ≥ 9. *p* = Significance level. Mann Whiteney U, Kruskall Wallis H. N = 130.

Table 4.15: Relationship between Scores on Knowledge, Hypertension Duration, Blood Pressure and Adherence at Baseline among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Variables	N (%)	Scores	
		Mean ±SD	*P*
Hypertension duration (years)			
< 5	39 (30)	7.7 ±1.9	.696
5 – 9	14 (11)	7.3 ±1.8	
10 – 14	47 (36)	7.5 ±1.9	
15 – 19	11 (8)	8.1 ±1.7	
20 – 24	4 (3)	8.8 ±0.9	
25 – 29	6 (5)	8.3 ±1.6	
30 – 34	4 (3)	7.8 ±0.9	
35 – 39	1 (1)	9.0 ±0.0	
> 39	3 (2)	8.0 ±2.6	
SBP (mmHg)			
Controlled	60 (46)	7.8 ±1.9	.472
Uncontrolled	70 (54)	7.6 ±1.9	
DBP (mmHg)			
Controlled	61 (47)	7.3 ±1.9	.054
Uncontrolled	69 (53)	7.9 ±1.8	
Adherence level			
Low	39 (30)	7.8 ±1.9	.136
Moderate	42 (32)	8.1 ±1.5	
High	49 (38)	7.3 ±1.9	

SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, SD = Standard Deviation, Inadequate = < 5, Moderate = 5 – 8, Adequate = ≥ 9, *p* = Significance level. Mann Whiteney U, Kruskall Wallis H. N = 130.

4.4.1.2 Relationship between knowledge at six weeks and background characteristics

Table 4.16 shows that at six weeks patients exhibited high knowledge (score of 9 – 10). However, there was no statistically significant difference in mean knowledge score among patients' gender, age categories, religion, marital status and educational level. Table 4.17 shows that there was no significant difference in the mean knowledge score between patients who had controlled or uncontrolled blood pressures. Patients who had uncontrolled blood pressures exhibited higher knowledge score than those who had controlled blood pressures. Patients who exhibited higher knowledge score were more adherent than those who exhibited lower knowledge score (p = .750).

Table 4.16: Scores on Knowledge Measure at Six Weeks among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Variables	N (%)	Scores	
		Mean ±SD	*P*
Gender			
Male	51 (39)	9.43 ±0.9	.736
Female	79 (61)	9.33 ±1.0	
Age categories (years)			
≤40	19 (15)	9.24 ±1.0	.302
41-60	76 (58)	9.50 ±1.0	
61-80	31 (24)	9.23 ±1.1	
>80	4 (3)	9.35 ±1.5	
Religion			
Islam	108 (83)	9.42 ±0.9	.330
Christianity	22 (17)	9.27 ±0.9	
Marital status			
Married	118 (91)	9.38 ±1.0	.732
Single	1 (1)	10.00 ±0.0	
Divorced	8 (6)	9.33 ±0.6	
Widowed	3 (2)	9.13 ±1.4	
Educational level			
No formal education	57 (44)	9.23 ±1.1	.327
Primary	27 (21)	9.37 ±0.9	
Secondary	13 (10)	9.69 ±0.9	
Tertiary	33 (25)	9.48 ±0.9	

SD = Standard Deviation, Inadequate = < 5, Moderate = 5 – 8, Adequate = ≥ 9. *p* = Significance level. Mann Whiteney U, Kruskall Wallis H. N = 130.

Table 4.17: Relationship between Score on Knowledge, Hypertension Duration, Blood Pressure and Adherence at Six Weeks among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Variables	N (%)	Scores	
		Mean ±SD	*P*
Hypertension duration (years)			
< 5	39 (30)	9.51 ±0.9	.742
5 – 9	15 (12)	9.07 ±1.4	
10 – 14	47 (36)	9.27 ±1.0	
15 – 19	11 (8)	9.45 ±1.0	
20 – 24	4 (3)	10.00	
25 – 29	6 (5)	9.17 ±1.2	
30 – 34	4 (3)	9.50 ±1.0	
35 – 39	1 (1)	9.00	
> 39	3 (2)	9.67 ±0.6	
SBP (mmHg)			
Controlled	99 (70)	9.33 ±1.0	.848
Uncontrolled	31 (30)	9.60 ±0.8	
DBP (mmHg)			
Controlled	83 (64)	9.31 ±1.1	.719
Uncontrolled	47 (36)	9.54 ±1.0	
Adherence level			
Low	15 (12)	8.49 ±1.0	.750
Moderate	27 (21)	9.02 ±1.2	
High	88 (68)	9.68 ±1.1	

SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, SD = Standard Deviation, Inadequate = < 5, Moderate = 5 – 8, Adequate = ≥ 9, *p* = Significance level. *Statistically Significant at ≤ .05. Mann Whiteney U, Kruskall Wallis H. N = 130.

4.4.1.3 Difference in knowledge and blood pressure control

Table 4.18 shows that majority (58%) of the respondents were unaware that hypertension is a lifelong disease. Also, majority (69%) of the respondents had a misconception that hypertension can be treated without the use of medication. As shown in table 4.19, a binary logistic regression showed that at baseline, patients were more likely to have controlled systolic blood pressure when they reported better knowledge (responded positively to the individual knowledge questions) (OR = 1.2 to 3.1). Patients who responded correctly to 5 out of the 10 knowledge questions were more likely to have control. The relationships were not statistically significant except for treating hypertension without medication (p = .006). At six weeks patients were more likely to have controlled systolic blood pressure when they had knowledge (OR = 1.6 to 3.7). Patients who reported that hypertension can be treated without medication were less likely to have controlled systolic blood pressure and but the association was not statistically significant (OR = 0.9, p = .934).

These two questions; 'Does reducing salt intake help control hypertension?' and 'Does reducing stress help control hypertension?' were removed from the regression analysis because all patients answered them correctly at six weeks.

Table 4.20 shows that at baseline, patients were more likely to have controlled diastolic blood pressure if they had knowledge (OR = 1.3 to 2.9). The relationship was statistically significant for; 'is hypertension a lifelong disease? Yes (OR = 2.1 p = .044) and 'Is the treatment for hypertension a lifelong one? Yes (OR = 2.4 p = .019). At 6 weeks patients were more likely to have controlled diastolic blood pressure when they had knowledge (OR = 1.6 to 2.5) except for the question 'can hypertension be treated without medication? (OR = 0.9 p = .939).

Table 4.18: Difference in Knowledge about Hypertension before and after intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Knowledge[+]	N (%)			
	Baseline		Post-intervention	
	Yes	No	Yes	No
Is hypertension lifelong?	76 (58)	54 (42)	108 (83)	22 (17)
Most times, do people with hypertension feel anything different?	108 (83)	22 (17)	130 (100)	0 (0)
Is the pressure high when it is 140/90mmHg?	72 (55)	58 (45)	114 (88)	16 (12)
Can hypertension cause heart, brain, kidney or eye problems?	90 (69)	40 (31)	130 (100)	0 (0)
Is the treatment for hypertension a lifelong one?	80 (62)	50 (38)	109 (84)	21 (16)
Can hypertension be treated without medication?	90 (69)	40 (31)	21 (16)	109 (84)
Does regular physical exercise help control hypertension?	120 (92)	10 (8)	130 (100)	0 (0)
Does losing weight help control hypertension?	105 (80)	25 (20)	130 (100)	0 (0)
Does reducing salt intake help control hypertension?	130 (100)	0 (0)	130 (100)	0 (0)
Does reducing stress help control hypertension?	130 (100)	0 (0)	130 (100)	0 (0)

[+]Distribution of patients who responded 'yes' or 'no' to 10 items of the knowledge scale. N = 130.

Table 4.19: Significant Knowledge Question Determining Systolic Blood Pressure Control among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Variable		Pretest SBP (mmHg)		*P*	OR	Post-intervention SBP (mmHg)		*P*	OR
		Controlled	Uncontrolled			Controlled	Uncontrolled		
Is hypertension lifelong?	**Yes** [+]	31	45	.147	1.68	79	29	.089	3.72
	No	29	25			20	2		
Most times, do people with hypertension feel anything different?	**Yes**[+]	50	58	-	-	99	31	-	-
	No	10	12			0	0		
Is the pressure high when it is 140/90mmHg?	**Yes**[+]	37	35	.213	0.64	86	28	.576	1.60
	No	23	35			13	3		
Can hypertension cause heart, brain, and kidney or eye problem?	**Yes**[+]	45	45	.202	0.61	99	31	-	-
	No	15	25			0	0		
Is the treatment for hypertension a lifelong one?	**Yes**[+]	34	46	.325	1.44	80	28	.240	2.55
	No	26	24			19	3		
Can hypertension be treated without medication?	Yes	11	29	.006*****	3.11	16	5	.934	0.95
	No[+]	49	41			83	26		
Does regular physical exercise help control hypertension?	**Yes**[+]	55	65	.816	1.17	99	31	-	-
	No	5	5			0	0		
Does losing weight help control hypertension?	**Yes**[+]	47	58	.485	1.37	99	31	-	-
	No	13	12			0	0		

Odds of having controlled SBP for the 'no' respondents except for treating hypertension without medication. [+]The bolded answer was considered to be the right answer, [*]Statistically Significant, *p* = Significant level at ≤ .05, OR = Odds Ratio, SBP = Systolic Blood Pressure. Binary logistic regression was used to determine relationship. N = 130.

Table 4.20: Significant Knowledge Question Determining Diastolic Blood Pressure Control among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Variable		**Baseline DBP (mmHg)**		*P*	OR	**Post DBP (mmHg)**		*P*	OR
		Controlled	Uncontrolled			Controlled	Uncontrolled		
Is hypertension lifelong?	**Yes**[+]	30	46	.044*****	2.07	66	42	.318	2.46
	No	31	23			17	5		
Most times, do people with	**Yes**[+]	48	60	.337	1.59	83	47	-	-
hypertension feel anything different?	No	12	10			0	0		
Is the pressure high when it is	**Yes**[+]	31	41	.320	1.42	71	42	.582	1.59
140/90mmHg?	No	30	28			11	5		
Can hypertension cause heart, brain,	**Yes**[+]	40	50	.520	1.28	83	47	-	-
and 0kidney or eye problem?	No	20	20			0	0		
Is the treatment for hypertension a	**Yes**[+]	31	49	.019*****	2.38	67	42	.278	2.34
lifelong one?	No	30	20			16	5		
Can hypertension be treated without	Yes	15	25	.224	1.62	13	8	.939	0.94
medication?	**No**[+]	45	45			70	39		
Does regular physical exercise help	**Yes**[+]	54	66	.139	2.85	83	47	-	-
control hypertension?	No	7	3			0	0		
Does losing weight help control	**Yes**[+]	46	59	.241	1.72	83	47	-	-
hypertension?	No	14	11			0	0		

Odds of having controlled DBP for the 'no' responses ('yes' response for treating hypertension without medication). [+]The bolded answer was considered to be the right answer, [*]Statistically Significant, p = Significant level at ≤ .05, OR = Odds Ratio. DBP = Diastolic Blood Pressure. N = 130.

4.4.1.4 Predictor for controlled systolic blood pressure

Multivariate logistic regression analyses was executed in order to find out what factors contributed to controlled systolic blood pressure. Variables for which *p*-value was <0.1 in the univariate analyses were put in the regression model for stepwise selection. Eventually, there was only one factor that came out to be significant in the final model for predicting controlled systolic blood pressure, and that was treating hypertension without medication (OR = 0.3, $p = .003$).

4.4.1.5 Relationship between knowledge and adherence

Multivariate logistic regression showed that when adjusted for age, gender, educational level and blood pressure, both at baseline and at six weeks, patients were less likely to be adherent to treatment when they responded incorrectly to the statistically significant knowledge factor identified to predict systolic blood pressure control (treating hypertension without medication). The relationship was not statistically significant (OR = 0.9 $p = .941$) and (OR = 0.4 $p = .144$) respectively (Table 4.21).

Table 4.21: Relationship between Significant Knowledge Question and Adherence among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Knowledge	High adherence			
	Baseline		Post-intervention	
	Adjusted OR	*P*	Adjusted OR	*P*
Hypertension can be treated without medication	0.96	.941	0.39	.144
Age	1.02	.319	0.99	.664
Gender (Male)	2.08	.159	0.69	.495
Education level				
Tertiary	0.79	.685	0.97	.961
Secondary	0.89	.864	1.29	.772
Primary	1.35	.665	2.91	.217
SBP (mmHg)	0.99	.792	0.98	.408
DBP (mmHg)	0.96	.052	1.00	.954

Odds of having high adherence rate, p = Significance level at ≤ .05, OR = Odds Ratio, SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure. Multivariate logistic regression was used to determine the relationship (Baseline: -2 log likelihood = 252.38, p = .114. Post-intervention: -2 log likelihood = 208.01, p = .829). N = 130.

4.4.2 Attitude

4.4.2.1 Difference in attitude and blood pressure control

Majority (59%) of the respondents could remember the names of their drugs after the intervention, however, those who could not afford the cost of their medication was not affected by the intervention. All (N = 130) the respondents admitted that their medicines have benefits and they were taking them to improve their health (Table 4.22). As shown in table 4.22, a binary logistic regression showed that at the start of the intervention, patients were more likely to have controlled systolic blood pressure if they had good attitude (responded positively to attitude questions) (OR = 1.0 to 1.2). Patients who could not always afford the cost of their medication were less likely to have controlled systolic blood pressure. The relationship was statistically significant (OR = 0.3 p = .025). At six weeks patients were less likely to have controlled systolic blood pressure when they had poor attitude (OR = 0.6 to 0.9). The relationships were not statistically significant (p >.05). Ironically, patients who reported that their medicines were not readily available were more likely to have controlled systolic blood pressure, however, the relationship was not statistically significant (OR = 2.1, p = .436) (Table 4.23).

Table 4.22: Difference in Attitude before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Attitude	N (%)			
	Baseline		Post-intervention	
	Yes	No	Yes	No
Can you remember the name(s) of your medication?	53 (41)	77 (59)	77 (59)	53 (41)
Do you always afford the cost of your medication?	106 (82)	24 (18)	106 (82)	24 (18)
Is your medication readily available?	122 (94)	8 (6)	113 (87)	17 (13)
Is your treatment regimen complex?	13 (10)	117 (90)	0 (0)	130 (100)
Are you taking this medicine(s) to improve your health?	130 (100)	0 (0)	130 (100)	0 (0)
Do you think this medicine(s) have benefits?	130 (100)	0 (0)	130 (100)	0 (0)
Do you combine your drugs with traditional medicine(s)?	15 (12)	115 (88)	19 (6)	111 (94)
If yes, do you think it/they (traditional medicine(s)) is/are effective?	14 (93)	1 (7)	12 (63)	7 (37)

Distribution of patients who responded ‘yes’ or ‘no’ to 8 items of the attitude questionnaire. N = 130.

Table 4.23: Significant Attitude Question Determining Systolic Blood Pressure before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Attitude[a]		**Baseline SBP (mmHg)**		*P*	OR	**Post SBP (mmHg)**		*P*	OR
		Controlled	Uncontrolled			Controlled	Uncontrolled		
Can you remember the name(s) of your medication(s)?	**Yes**[+]	25	28	.838	0.93	60	17	.785	0.86
	No	35	42			40	13		
Do you always afford the cost of your medication(s)?	**Yes**[+]	54	52	.025*****	0.32	81	25	.796	0.87
	No	6	18			18	6		
Is your medication readily available?	**Yes**[+]	56	66	.822	1.18	84	29	.436	2.08
	No	4	4			15	2		
Is your treatment regimen complex?	Yes	6	7	1.00	1.00	0	0	-	-
	No[+]	54	63			99	31		
Are you taking this medicine(s) to improve your health?	**Yes**[+]	60	70	-	-	99	31	-	-
	No	0	0			0	0		
Do you think this medicine(s) have benefits?	**Yes**[+]	60	70	-	-	99	31	-	-
	No	0	0			0	0		
Do you combine your drugs with traditional medicine(s)?	Yes	7	8	.966	0.98	16	3	.502	0.60
	No[+]	53	62			83	28		
If yes, do you think it/they (traditional medicine(s)) is/are effective?	Yes	7	7	.701	0.80	10	2	.788	0.74
	No	53	63			89	29		

[+]Bolded responses were considered to be correct. [a] Odds of having controlled SBP for 'no' responses. SBP = Systolic Blood Pressure, p = Significance level at ≤ .05, OR = Odds Ratios, [*]Statistically Significant. The relationship was tested with binary logistic regression. N = 130.

4.4.2.2 Predictor for controlled systolic blood pressure

Multivariate logistic regression analyses was executed in order to find out what factors contributed to controlled systolic blood pressure. Variables for which p-value was <0.1 in the univariate analyses were put in the regression model for stepwise selection. Eventually, there was only one factor that came out to be significant in the final model for predicting controlled systolic blood pressure, and that was attitude towards the cost of hypertension medication (OR = 0.3, p = .031).

4.4.2.3 Relationship between attitude and adherence

Multivariate logistic regression showed that when adjusted for age, gender, educational level and blood pressure, both at baseline and at six weeks, patients were more likely to be non-adherent to treatment when they could not always afford the cost of their medication. This factor was identified to be statistically significant in the final model for predicting controlled systolic blood pressure. The relationship was not statistically significant (OR = 2.4 p = .162) and (OR = 2.8 p = .101) respectively. The multivariate logistic regression has shown that as non-adherence increases so does systolic blood pressure (OR = 1.0 p = .659) and (OR = 1.0 p = .375) respectively (Table 4.24). Table 4.25 shows that both at baseline and at six weeks, patients who could not always afford the cost of their medication had lower mean adherence score, and higher systolic and diastolic blood pressure.

Table 4.24: Relationship between Significant Attitude Question and Adherence before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Attitude	**Low adherence**			
	Baseline		**Post-intervention**	
	Adjusted OR	*P*	Adjusted OR	*P*
Cannot always afford the cost of medication(s)	2.39	.162	2.84	.101
Age	0.98	.257	1.01	.581
Gender				
Male	0.48	.155	1.48	.471
Education level				
Tertiary	1.23	.732	1.01	.984
Secondary	0.79	.770	0.82	.827
Primary	0.67	.575	0.40	.286
SBP	1.01	.659	1.02	.375
DBP	1.04	.153	0.99	.940

SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, OR = Odds Ratio, p = Significance level at ≤ .05. Multivariate logistic regression. (Baseline: -2 log likelihood = 256.31, p = .044; Post-intervention: -2 log likelihood = 204.57, p = .590). N = 130.

Table 4.25: Relationship between Significant Attitude Question, Adherence and Blood Pressure before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Variable		**Adherence**		**Blood pressure (mmHg)**			
		Mean±SD		Systolic		Diastolic	
		Pre	Post	Pre	Post	Pre	Post
Do you always afford the cost of your medication?	No	5.25±2.4	6.22±2.1	153±31	134±13	91±17	87±10
	Yes	6.26±2.0	7.40±1.4	142±29	132±15	88±18	86±12

SD = Standard Deviation. N = 130.

4.4.3 Beliefs

4.4.3.1 Difference in beliefs at baseline and at six weeks

Necessity: On average, participants experienced significantly increased necessity beliefs after the telephone voice call intervention (mean±SD = 19.62±5.60) than before the intervention (mean±SD = 17.82±5.50), $z = -2.62$, $p = .009$.

Concern: Participants experienced significantly decreased concerns beliefs after the telephone voice call intervention (mean±SD = 7.28±3.30) than before the intervention (mean±SD = 8.16±3.80), $z = 2.10$, $p = .035$.

Table 4.26 shows that at baseline patients' mean necessity score was lower than at six weeks. Patients reported higher concerns at baseline than at six weeks. Additionally, patients had higher necessity-concerns differential at six weeks than at the start of the intervention.

Table 4.27 shows that there was statistically significant difference in necessity beliefs about medicines at the start of the intervention and at six weeks ($p < .001$). At baseline and at six weeks, 50 (39%) and 60 (46%) patients strongly agreed that their health, depends on their medicines, respectively. At baseline and at six weeks, 86 (66%) and 93 (72%) patients strongly agreed that without their medicines they would be very ill, respectively. At baseline and at six weeks, 2 (1%) and 11 (8%) patients strongly disagree that their medicines protect them from becoming worse.

Table 4.26: Difference in Beliefs before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

	Baseline			**Post-intervention**		
	Necessity	Concerns	Necessity-concerns differential	Necessity	Concerns	Necessity-concerns differential
Mean	17.8	8.3	9.57	20.5	7.6	13.10
SD	5.4	3.9	6.83	5.6	3.3	6.34
Maximum	25	20	20	25	20	20
Minimum	8	5	-7	5	5	-7
First quartile (25%)	13	5	5	16	5	8
Third quartile (75%)	23	9	14	25	9	19

SD = Standard Deviation. N = 130.

Table 4.27: Distribution of Necessity Beliefs at Baseline and at Six Weeks among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Necessity	N (%)										*P*
	Strongly agree		Agree		Uncertain		Disagree		Strongly disagree		
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	post	
My health, at present, depends on these medicines	50 (39)	60 (46)	15 (12)	11 (8)	7 (5)	17 (13)	16 (12)	8 (6)	42 (32)	34 (27)	< .001
My life would be impossible without these medicines	37 (28)	46 (35)	15 (12)	17 (13)	18 (14)	23 (18)	17 (13)	11 (9)	43 (33)	32 (25)	< .001
Without these medicines I would be very ill	86 (66)	93 (72)	12 (9)	10 (8)	14 (11)	13 (10)	10 (8)	7 (5)	8 (6)	7 (5)	< .001
My health in the future will depend on these medicines	43 (33)	59 (45)	11 (8)	13 (10)	14 (11)	15 (12)	18 (14)	8 (6)	44 (34)	35 (27)	< .001
These medicines protect me from becoming worse	104 (80)	101 (78)	14 (11)	8 (6)	6 (5)	10 (8)	4 (3)	0 (0)	2 (1)	11 (8)	< .001

P = Significance level at ≤ .05. Mc Nemar test was used to test for difference. N = 130.

4.4.3.2 Relationship between necessity beliefs and systolic blood pressure control

Table 4.28 shows that at the start of the intervention and at six weeks patients who had strong necessity beliefs about their treatment were less likely to have controlled systolic blood pressure. The relationship was not statistically significant (OR = 0.6, p = .306) and (OR = 0.3, p = .070) respectively.

4.4.3.3 Relationship between necessity beliefs and adherence

Table 4.29 shows that there was statistically significant difference in adherence between patients who believed that their health depends on their medicines and they protect them from becoming worse (p = .046) and (p = .004). There was increase in mean adherence score at six weeks among the necessity categories.

Table 4.28: Relationship between Necessity Beliefs and Systolic Blood Pressure Control before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Necessity	Baseline SBP (mmHg)				Post-intervention SBP (mmHg)			
	Controlled	Uncontrolled	*P*	OR	Controlled	Uncontrolled	*P*	OR
Strong[a]	47	60	.306	0.61	87	30	.070	0.32
Weak	13	10			12	1		

[a]Odds of having controlled SBP for strong necessity belief. SBP = Systolic Blood Pressure, *p* = Significance level at ≤ .05, OR = Odds Ratio. Binary logistic regression was used to test for the relationship. N = 130.

Table 4.29: Relationship between Necessity Beliefs and Adherence before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Necessity beliefs about antihypertensives	**Mean adherence score ±SD**			
	Baseline		Post-intervention	
		P		*P*
My health, at present, depends on these medicines	6.13 ±2.1	.970	7.23 ±1.6	.046*****
My life would be impossible without these medicines	6.13 ±2.1	.441	7.23 ±1.6	.804
Without these medicines I would be very ill	6.09 ±2.1	.920	7.23 ±1.6	.082
My health in the future will depend on these medicines	6.10 ±2.1	.097	7.23 ±1.6	.144
These medicines protect me from becoming worse	6.17 ±2.0	.197	7.23 ±1.6	.004*****

*Statistically Significant, p = Significance level at ≤ .05, SD = Standard Deviation. The Mean difference between the five categories of the likert scale was tested with Kruskal Wallis H. N = 130.

4.4.3.4 Difference in concerns beliefs at baseline and at six weeks

Table 4.30 shows that there was statistically significant difference between concerns categories ($p < .001$). At baseline, and at six weeks 99 (76%) and 100 (77%) patients strongly disagreed that having to take their medicines worries them respectively while at six weeks, 7 (5%) and 0 (0%) patients were uncertain that having to take their medicines worries them respectively. At baseline and at six weeks, 4 (3%) and 0 (0%) patients strongly agreed that their medicines were a mystery to them and the medicines disrupt their lives respectively.

Table 4.30: Difference in Concerns Beliefs at Baseline and at Six Weeks among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Concerns	N (%)										*P*
	Strongly agree		Agree		Uncertain		Disagree		Strongly disagree		
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	
Having to take these medicines worries me	7 (5)	10 (8)	8 (6)	9 (7)	7 (5)	0 (0)	9 (7)	11 (8)	99 (76)	100 (77)	< .001
I sometimes worry about the long term effects of these medicines	20 (15)	15 (12)	10 (8)	17 (13)	22 (17)	16 (12)	13 (10)	5 (4)	65 (50)	77 (59)	< .001
These medicines are a mystery to me	4 (3)	0 (0)	11 (8)	12 (9)	9 (7)	12 (9)	13 (10)	8 (6)	93 (72)	99 (76)	< .001
These medicines disrupt my life	4 (3)	0 (0)	8 (6)	11 (8)	8 (6)	0 (0)	12 (9)	14 (11)	98 (75)	105 (81)	< .001
I sometime worry about becoming too dependent on these medicines	19 (15)	22 (17)	15 (12)	8 (6)	13 (10)	16 (12)	14 (11)	10 (8)	69 (53)	74 (57)	< .001

p = Significance level at ≤ .05. The difference was tested with Mc Nemar test. N = 130.

4.4.3.5 Relationship between concern beliefs and systolic blood pressure control

Table 4.31 shows that both at baseline and at six weeks, patients who reported strong concerns about their medicines were less likely to have control. The relationship was statistically significant (OR = 0.4, p = .039) and (OR = 0.2, p = .002)

4.4.3.6 Relationship between concerns beliefs and adherence

Table 4.32 shows that patients' mean adherence score was higher at six weeks (7.23±1.6) than at baseline (6.05 to 6.16±2.1). There was a statistically significant difference in the adherence between the concerns categories. At baseline, there was statistically significant difference among patients who were sometimes worried about the long term effects of their medicines and those who believed that their medicines were a mystery to them (p = .002) and (p = .014) respectively. Also, at six weeks there was statistically significant difference among patients who were worried about taking their medicines and who believed that their medicines were a mystery to them respectively (p = .004) and (p = .041).

Table 4.31: Relationship between Concerns Beliefs and Blood Pressure Control before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Concern	Baseline SBP (mmHg)				Post-intervention SBP (mmHg)			
	Controlled	Uncontrolled	P	OR	Controlled	Uncontrolled	P	OR
Strong[a]	9	22	.039*	0.40	6	25	.002*	0.22
Weak	50	49			52	47		

Odds of having controlled SBP for strong concerns about treatment. SBP = Systolic Blood Pressure, p = Significance level at ≤ .05, OR = Odds Ratio. Binary logistic regression was used to test for the relationship. N = 130.

Table 4.32: Relationship between Concerns Beliefs and Adherence before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Concerns beliefs about antihypertensives	**Mean adherence score ±SD**			
	Baseline		Post-intervention	
		P		*P*
Having to take these medicines worries me	6.10 ±2.1	.439	7.23 ±1.6	.004*****
I sometimes worry about the long term effects of these medicines	6.05 ±2.1	.002*****	7.23 ±1.6	.453
These medicines are a mystery to me	6.16 ±2.1	.014*****	7.23 ±1.6	.041*****
These medicines disrupt my life	6.11 ±2.1	.524	7.23 ±1.6	.604
I sometime worry about becoming too dependent on these medicines	6.12 ±2.1	.304	7.23 ±1.6	.657

*Statistically Significant, SD = Standard Deviation, p = Significance level at $\leq .05$. Mean difference between the five categories of the likert scale was tested with Kruskal Wallis H. N = 130.

4.4.3.7 Relationship between necessity-concern differential and systolic blood pressure control

Table 4.33 shows that both at the start of the intervention and at six weeks, patients who had consideration for the cost of treatment were less likely to have control. The relationship was not statistically significant (OR = 0.6, p = .355) and (OR = 0.2, p = .143)

4.4.3.8 Relationship between beliefs and adherence at baseline and at six weeks

Table 4.34 shows that at baseline patients who reported weak necessity beliefs about their medicines were more likely to report better adherence (OR = 1.4). The relationship was not statistically significant (p = .545). Patients who reported weak concerns were two times more likely to report better adherence (OR = 2.3). The relationship was not statistically significant (p = .113). Patients who reported concerns about the cost of their medicines (necessity-concerns differential) were less likely to report better adherence (OR = 0.1) than those who reported positive perception for the benefit of the medicines and the relationship was statistically significant (p = .050). At six weeks, table 4.34 shows that patients who reported weak necessity beliefs about their medicines were less likely to report better adherence (OR = 0.3) but the relationship was not statistically significant (p = .185). Patients who reported weak concerns were three times more likely to report better adherence (OR = 3.9) but the relationship was not statistically significant (p = .208). Also, patients whose perception for the cost of their medicines outweighed the benefit were less likely to report better adherence (OR = 0.4) but the relationship was not statistically significant (p = .421).

Table 4.33: Relationship between Necessity-Concern Differential and Blood Pressure Control before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

NcD	**Baseline SBP (mmHg)**				**Post-intervention SBP (mmHg)**			
	Controlled	Uncontrolled	P	OR	Controlled	Uncontrolled	P	OR
High (benefit)	50	64	.355	0.61	54	71	.143	0.19
Low (cost)	9	7			4	1		

NcD = necessity-concerns differential. Odds of having controlled SBP for patients with low NcD level. SBP = Systolic Blood Pressure, p = Significance level at ≤ .05, OR = Odds Ratio. Binary logistic regression was used for the relationship. **Note:** Cost represent respondents' perception not actual cost of medicines. N = 130.

Table 4.34: Relationship between Beliefs about Medicines and Adherence before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Beliefs	**High adherence**			
	Baseline		**Post-intervention**	
	Unadjusted OR (CI)	*P*	Unadjusted OR (CI)	*P*
Necessity level				
Strong	Reference		Reference	
Weak	1.41 (0.463 – 4.293)	.545	0.33 (0.064 – 1.710)	.185
Concerns level				
Strong	Reference		Reference	
Weak	2.28 (0.823 – 6.304)	.113	3.92 (0.411 – 37.420)	.208
Necessity-concern differential				
High (benefit)	Reference		Reference	
Low (cost)	0.12 (0.013 – 1.007)	.050*****	0.38 (0.036 – 4.009)	.421

OR = Odds Ratio, CI = Confidence Interval, p = Significance level at ≤ .05, *Statistically Significant. Multivariate logistic regression was used to test for the relationship: Necessity: -2 log likelihood ratio = 16.37; p = .812; Concerns: -2 log likelihood ratio = 19.54; p = .252. **Note:** Cost represent respondents' perception not actual cost of medicines. N = 130.

4.4.3.9 Relationship between beliefs, adherence and blood pressure at baseline and at six weeks

Table 4.35 shows that at baseline patients who had weak necessity beliefs had higher adherence score (6.39±2.0), and lower systolic and diastolic blood pressure (134±28) and (87±20) respectively, than those who had strong necessity beliefs. Patients who had weak concerns had higher mean adherence score (6.32±1.9), lower systolic (140±28) and diastolic (86±17) blood pressure than those who had strong concerns. Also, patients who were concerned about the cost of their treatment (low necessity-concerns differential) had lower mean adherence score (5.08±1.8), systolic blood pressure (140±18) and higher diastolic blood pressure (91±11) than those who were concerned about the benefits of the treatment. At six weeks, patients who had strong necessity beliefs had higher mean adherence score (7.31±1.6), higher systolic and diastolic blood pressure (133±14) and (87±11) respectively, than those who had weak necessity beliefs. Patients who had weak concerns had higher mean adherence score (7.34±1.4), lower systolic (131±15) and higher diastolic (87±13) blood pressure than those who had strong concerns. Patients who were concerned about the cost of their treatment (low necessity-concerns differential) had lower mean adherence score (5.08±1.8), higher systolic blood pressure (134±9) and lower diastolic blood pressure (80±20) than those who were concerned about the benefits of the treatment.

4.4.3.10 Predictor for systolic blood pressure control at baseline and at 6 weeks

Univariate logistic regression analyses was executed in order to find out, between necessity and concern, what factor contributed to controlled systolic blood pressure. Eventually, there was only one factor that came out to be significant in the final model for predicting controlled systolic blood pressure, and that was strong concern about treatment (OR = 0.4, p = .039) and (OR = 0.2, p = .002) respectively.

Table 4.35: Relationship between Beliefs, Adherence and Blood Pressure before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Beliefs	**Adherence**		**Blood pressure (mmHg)**			
	Mean±SD		SBP Mean±SD		DBP Mean±SD	
	Pre	Post	Pre	Post	Pre	Post
Necessity level						
Strong	6.01±2.2	7.31±1.6	144±28	133±14	89±18	87±11
Weak	6.39±2.0	6.69±1.8	134±28	124±15	87±20	80±13
Concerns level						
Strong	5.27±2.4	6.53±2.4	146±32	137±11	95±20	86±7
Weak	6.32±1.9	7.34±1.4	140±28	131±15	86±17	87±13
Necessity-concern differential						
High (benefit)	6.22±2.1	7.25±1.6	142±28	132±18	88±17	87±14
Low (cost)	5.08±1.8	6.80±2.1	140±18	134±9	91±11	80±20

SD = Standard Deviation, SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure. N = 130.

4.4.4 Acceptability and satisfaction with care

4.4.4.1 Difference in 'willingness to use' at baseline and at 6 weeks

Table 4.36 shows that there was statistically significant difference between patients who were willing to continue with their medications at baseline and at six weeks. At baseline 90% and 10% of the patients were willing and uncertain respectively, while at six weeks, 82% and 18% were willing and uncertain respectively

Table 4.36: Difference in the Willingness to Use before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Acceptability	**Willing**		**Uncertain**		***P***
	Pre	Post	Pre	post	
Willingness to use (%)	117 (90)	107 (82)	13 (10)	23 (18)	.001

P = Significance level at ≤ .05. Mc Nemar test was used to determine the difference. N = 130.

4.4.4.2 Relationship between patients' willingness to use medications and systolic blood pressure control

Table 4.37 showed that there was no statistically significant association between willingness to use and systolic blood pressure control both at baseline and at six weeks (OR = 0.9, p = .861) and (OR = 1.1, p = .897). At six weeks, patients were more likely to have controlled systolic blood pressure when they were willing to use their medications.

Table 4.37: Relationship between Willingness to Use and Systolic Blood Pressure Control before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Willingness to use	Baseline SBP (mmHg)				Post-intervention SBP (mmHg)			
	Controlled	Uncontrolled	*P*	OR	Controlled	Uncontrolled	*P*	OR
Willing[a]	55	62	.861	0.90	81	26	.897	1.08
uncertain	6	7			18	5		

[a]Odds of having controlled SBP for patients willing , SBP = Systolic Blood Pressure, p = Significance level at ≤ .05,OR = Odds Ratio. Binary logistic regression was used to test for the relationship. N = 130.

4.4.4.3 Relationship between patients' willingness to use medications and adherence

Table 4.38 shows that at baseline, patients who were uncertain about continuing their antihypertensives were less likely to be adherent, however, the relationship was not statistically significant (OR = 0.3, p = .096). At six weeks, patients who were uncertain were more likely to be adherent but the relationship was not statistically significant (OR = 1.0, p = .996). Table 4.39 shows that at baseline, patients who were uncertain about continuing with their antihypertensives were less likely to report high adherence (OR = 0.4) but the relationship was not statistically significant (p = .343).

Table 4.38: Univariate Relationship between Willingness to Use and Adherence before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria (N = 130)

Willingness to use in future	**High adherence**			
	Baseline		**Post-intervention**	
	Unadjusted OR (95% CI)	*P*	Unadjusted OR (95% CI)	*P*
Willing	Reference		Reference	
		.096		.996
Uncertain	0.298 (0.072 – 1.241)		1.005 (0.113 – 8.930)	

p = Significance level at ≤ .05, OR = Odds Ratio, CI = Confidence Interval. Univariate logistic regression was used to test for the relationship. N = 130.

Table 4.39: Multivariate Relationship between Willingness to Use and Adherence before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

	Baseline		**Post-intervention**	
Willingness to use	Adjusted OR (95% CI)	*P*	Adjusted OR (95% CI)	*P*
Willing	Reference		Reference	
Uncertain	0.47 (0.09 – 2.25)	.343	0.65 (0.14 – 3.06)	.583
Gender				
Male	1.28 (0.45 – 3.62)	.647	2.03 (0.59 – 6.92)	.260
Female	Reference		Reference	
Educational level				
No formal education	Reference		Reference	
Primary	1.59 (0.39 – 6.54)	.514	2.37 (0.46 – 12.30)	.304
Secondary	0.98 (0.34 – 4.05)	.975	1.57 (0.32 – 7.60)	.576
Tertiary	0.79 (0.24 – 2.63)	.703	1.40 (0.33 – 6.02)	.650
Age (years)				
≤40	0.38 (0.08 – 1.82)	.224	0.32 (0.04 – 2.52)	.280
41 – 60	0.24 (0.07 – 0.81)	.021	0.12 (0.02 – 0.66)	.015
≥80	Reference		Reference	
Duration of hypertension (years)				
<5	5.00 (1.29 – 19.30)	.019	4.30 (0.89 – 20.69)	.068
5 – 9	1.76 (0.41 – 7.51)	.447	1.97 (0.36 – 10.71)	.433
10 – 14	1.86 (0.45 – 7.66)	.391	2.76 (0.52 – 14.73)	.236
15 – 19	0.67 (0.09 – 4.60)	.684	0.48 (0.04 – 5.98)	.564
≥20	Reference		Reference	

p = Significance level at ≤ .05, OR = Odds Ratio, CI = Confidence Interval. Multivariate logistic regression was used to test for the relationship: -2 log likelihood ratio = 178.83; *p* = .126. N = 130.

4.4.4.4 Difference in patients-centered factors affecting tablet swallowability

Table 4.40 shows that at six weeks, all patients were happy with swallowing, taste, smell, and size of their tablet. Patients showed good acceptability for their antihypertensives with 95%, 93%, and 95% of the patients showing the size, smell and the taste to be pleasant respectively at baseline.

Table 4.40: Difference in Patients' Responses to the Factors Affecting Tablet Swallowability before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria (N = 130)

Variable	Pleasant		Uncertain		Unpleasant	
	Pre	Post	Pre	Post	Pre	Post
The effect these tablet(s) have on my daily life is	125	130	5	0	0	0
Swallowing of my tablet(s) is	130	130	0	0	0	0
The taste of my tablet(s) is	123	130	7	0	0	0
The smell of my tablet(s) is	121	130	9	0	0	0
The size of my tablet(s) is	124	130	6	0	0	0

4.4.4.5 Difference in patients' satisfaction with care

Table 4.41 shows that 98% of the patients were satisfied with the facility even before the intervention, however, at six weeks, 14% of the patients became unsatisfied with their management.

Table 4.41: Difference in Patients' Satisfaction with Care before and after Intervention among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Variable	Satisfied		Unsatisfied		*P*
	Pre	Post	Pre	Post	
Overall satisfaction with the management (%)	128 (98)	116 (89)	2 (2)	14 (11)	.106

p = Significance level at ≤ .05. Mc Nemar test was used to test for the difference. N = 130.

4.5 Predictor for Adherence

Multivariate logistic regression analyses was executed in order to find out what factors contributed to high adherence. Variables for which p-value was significant in the regression model for stepwise selection were included. Eventually, no factor came out significant in the final model for predicting high adherence, however, patients who had less concern about the adverse consequences of their treatment, were found out to be two times more likely to be adherent (OR = 2.1, p = .166). Patients who had a misconception that hypertension can be treated without medication were less likely to be adherent (OR = 0.9, p = .911) and those patients who could not afford the cost of their medication were also less likely to be adherent (OR = 0.4, p = .167).

4.6 Feasibility of Intervention

Contact occurs every week and the average intervention phone call required 3.6 minutes. The range of calls was from less than 1 to 9 minutes. Among the 130 patients enrolled 75% of the patients had phone call time of 4 minutes. The first phone call required more time and required 4.1 minutes. The range of calls was from 2.7 to 3.7 for phone calls 2 – 6.

4.6.1 Relationship between intervention time and blood pressure

Figure 4.4 shows that there was no linear relationship between the intervention time and post-intervention systolic blood pressure. Figure 4.5 shows that there was no linear relationship between patients' systolic blood pressure difference and the intervention time. Likewise, Figure 4.6 and 4.7 show that there was no linear relationship between intervention time and post-intervention diastolic blood pressure value and the diastolic blood pressure

difference respectively. At six weeks, some patients had their blood pressure increased while some had their blood pressure decreased.

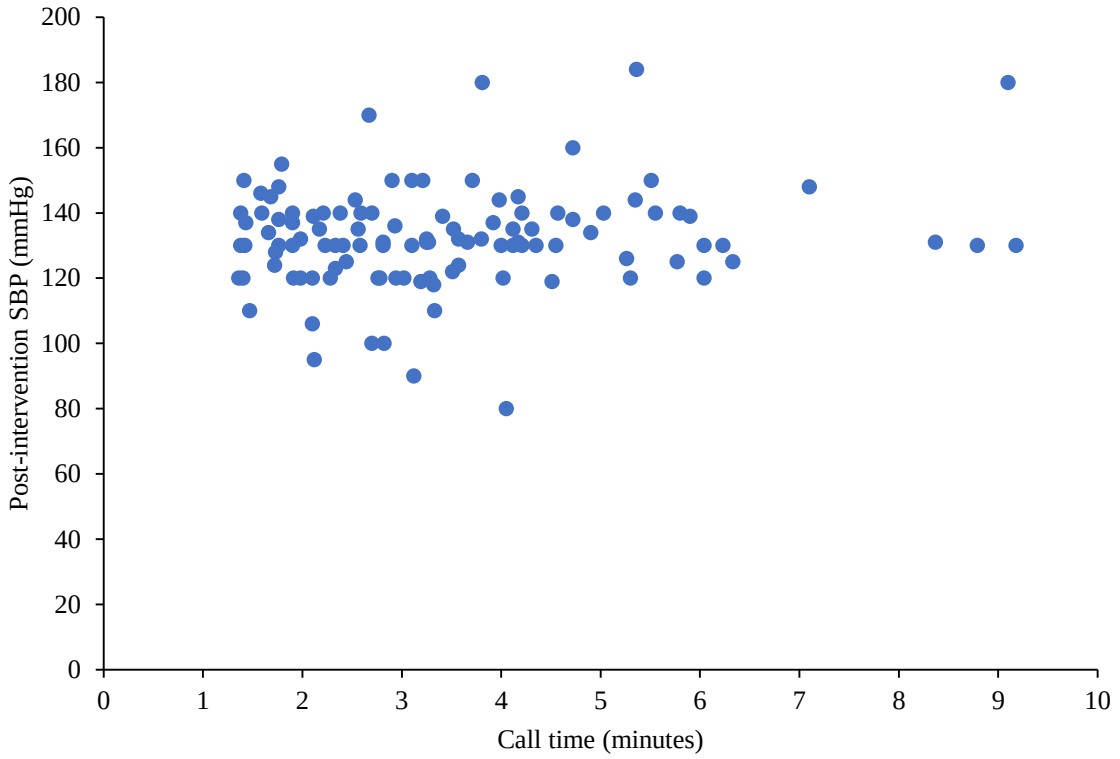

Figure 4.4: Relationship between Intervention Time and Systolic Blood Pressure among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria (N = 130)

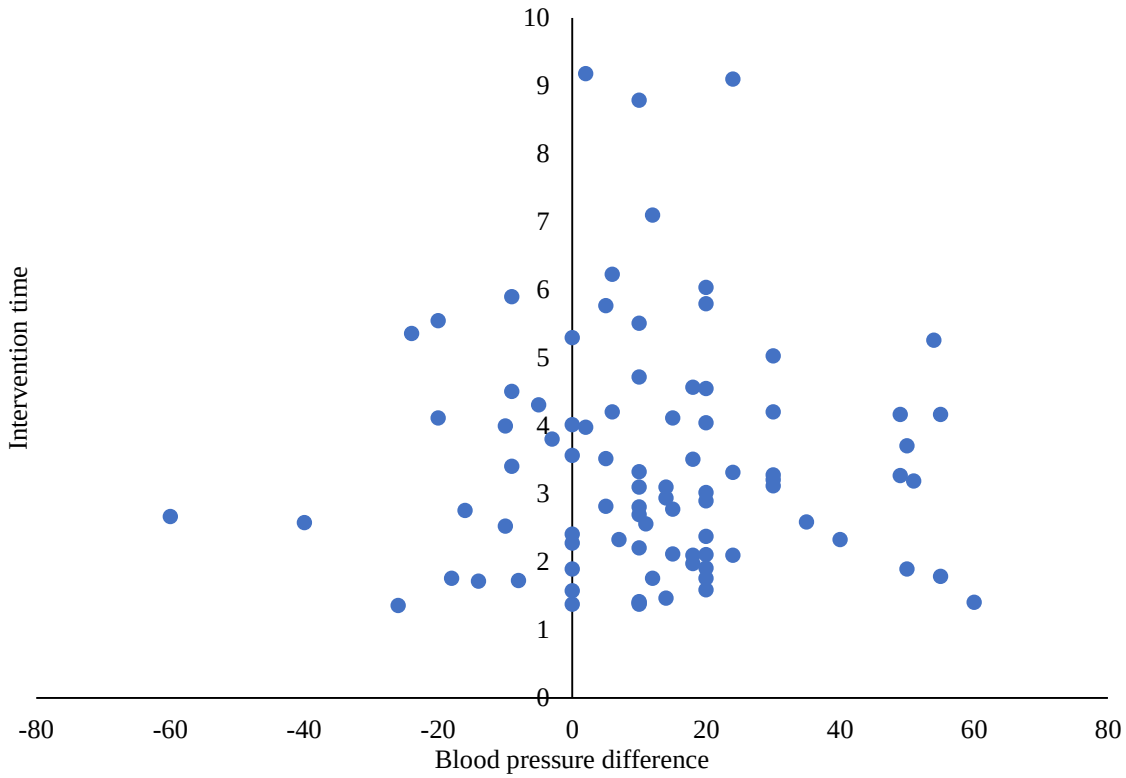

Figure 4.5: Relationship between Intervention Time and Systolic Blood Pressure Difference among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria (N = 130)

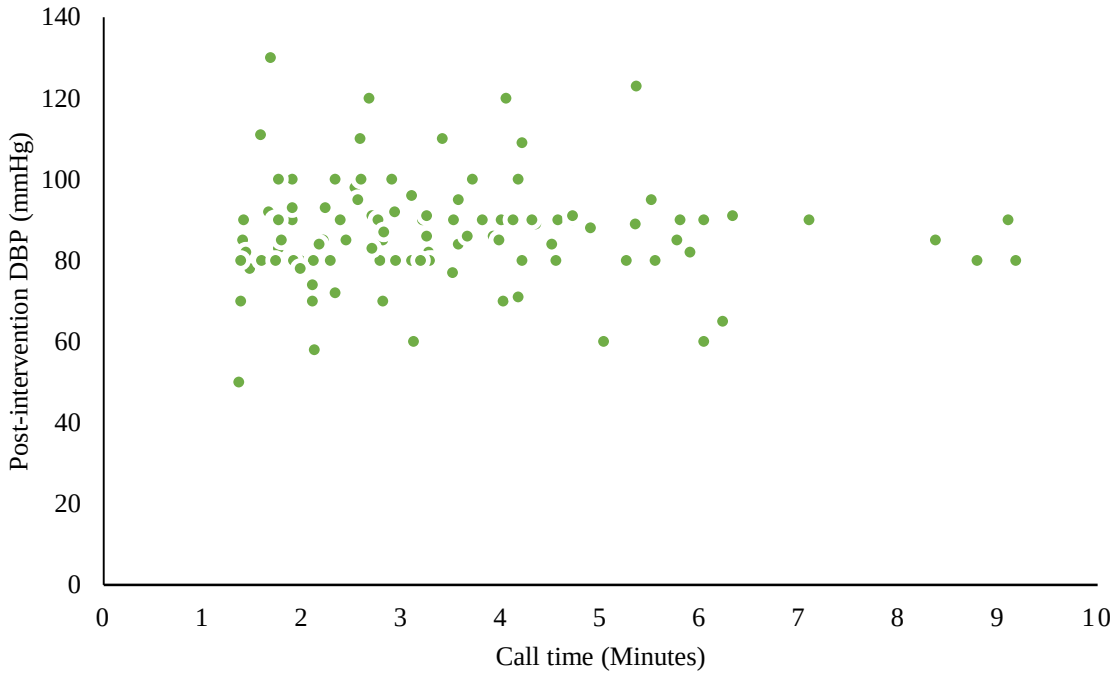

Figure 4.6: Relationship between Intervention Time and Diastolic Blood Pressure among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria (N = 130)

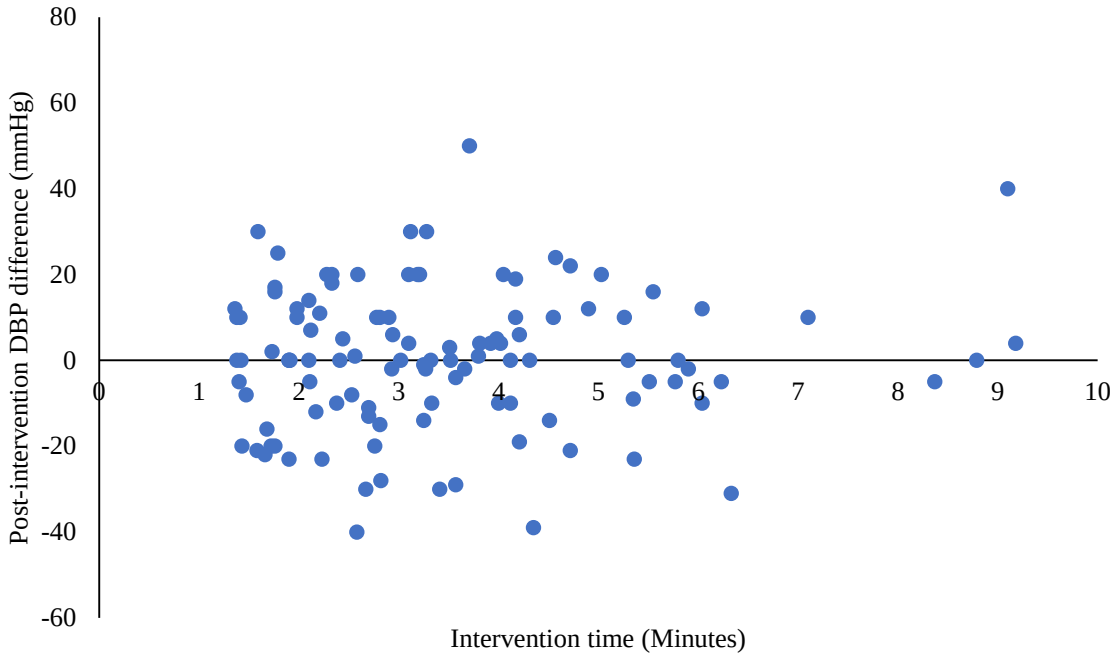

Figure 4.7: Relationship between Intervention Time and Diastolic Blood Pressure Difference among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria (N = 130)

4.7 Validity of Questionnaire for the Measurement of Patients' Self-reported Adherence

4.7.1 Reliability of adherence scale

The internal-consistency reliability coefficient (Cronbach's alpha) for the MMAS was 0.79, which is above the acceptable value of 0.70 (Lance *et al.,* 2006); the test-retest reliability over a six weeks interval showed a fair intraclass correlation coefficient (ICC of 0.52 ($p < .001$).

4.7.2 Known-group validity of adherence scale

A significant relationship between the MMAS and diastolic blood pressure control was obtained ($t = 2.2$; $p = .030$), ($\chi^2 = 6.6$; $p = .036$). Significantly reduced odds ratio for having controlled systolic blood pressure was found in the patients who responded negatively (*yes*) to 'Do you sometimes forget to take your high blood pressure pills?' (OR = 0.46, p = .045) and 'When you travel or leave home, do you sometimes forget to bring along your high blood pressure medication?' (OR = 0.30, $p = .017$). For the systolic blood pressure control, 0.31, 0.72, 0.56 and 0.47 were the sensitivity, specificity, positive and negative predictive values respectively. This sensitivity means that 31% of patients who had uncontrolled systolic blood pressure were not adherent, while the specificity indicates that 72% of patient who were adherent had controlled systolic blood pressure. The positive predictive value means that 56% of patients with low adherence were poorly controlled whereas, the negative predictive value means that 47% of patients who were adherent had good control. However, for the diastolic blood pressure, the sensitivity, specificity, positive and negative predictive

values were 0.36, 0.77, 0.64, and 0.52 respectively. Thus, the MMAS has shown slightly more sensitivity and specificity for the diastolic blood pressure.

4.7.3 Construct validity of adherence scale

A principal component analysis (PCA) was conducted with oblique rotation (Direct Oblimin). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy for the factor analysis was significantly adequate KMO = .75. Bartlett's test of sphericity χ^2 (130) = 402.38, $p < .001$, indicated that correlations between items were significantly adequate for PCA. Two components had eigenvalues greater than 1 on Kaiser's criterion and in combination explained 58.8% of the total variance. The scree plot was unambiguous and showed inflexion that would justify retaining both components. Factor loadings on the 2 components after rotation are presented in table 4.42. The items that cluster on component 1 suggest that it represent patients stopping their medication because of financial constraint while those items that cluster on component 2 suggest that it represent forgetfulness.

Table 4.42: Summary of Exploratory Factor Analysis for Results for the MMAS-8 Questionnaire used among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Adherence	**Rotated factor loadings**			
	Intentional		Unintentional	
	Pattern	Structure	Pattern	Structure
Do you sometimes forget to take your high blood pressure pills?	.26	**.48**	**.69**	**.73**
Over the past 2 weeks, were there any days when you did not take your high blood pressure pills?	**.42**	**.54**	.38	**.51**
Have you ever cut back or stopped taking your medication without telling your doctor?	**.75**	**.72**	-.08	.15
When you travel or leave home, do you sometimes forget to bring along your high blood pressure medication?	-.14	.13	**.87**	**.83**
Did you take your high blood pressure medication yesterday?	**.67**	**.61**	-.21	.01
When you feel your blood pressure is under control, do you sometimes stop taking your medication?	**.63**	**.69**	.16	.36
Taking medication every day is real inconvenience for some people, do you ever feel hassled about sticking to your high blood pressure treatment plan	**.73**	**.76**	.10	.33
How often do you have difficulty remembering to take all your blood pressure medication?	**.75**	**.88**	.39	**.63**
Eigenvalues	3.65		1.05	
% of variance	45.58		13.17	

Note: Factor loadings over .40 appear in bold. N = 130.

4.8 Validity of Questionnaire for the Assessment of Patients' Knowledge about Hypertension

4.8.1 Reliability of knowledge scale

In this study, the internal-consistency reliability coefficient (Cronbach's alpha) for the knowledge scale was found to be 0.62.

4.8.2 Construct validity of knowledge scale

A principal component analysis (PCA) was conducted with orthogonal rotation (Varimax). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy for the factor analysis was significantly adequate KMO = .61. Bartlett's test of sphericity χ^2 (130) = 160.07, $p < .001$, indicated that correlations between items were significantly adequate for PCA. Three components had eigenvalues greater than 1 on Kaiser's criterion and in combination explained 60.1% of the total variance. The scree plot was ambiguous and did not show inflexion that would justify retaining the three components. Factor loadings on the 3 components after rotation are presented in table 4.43. The items that cluster on component 1 suggest that it represent patients' knowledge on hypertension duration. Items that cluster on component 2 suggest that it represent knowledge on lifestyle modification while items that cluster on component 3 suggest that it represent knowledge on consequences of hypertension.

Table 4.43: Summary of Exploratory Factor Analysis of the Knowledge Questionnaire used among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Knowledge	**Rotated factor loadings**		
	Hypertension Duration	Lifestyle Modification	Consequences of Hypertension
Is hypertension lifelong?	**.47**	-.09	-.04
Most times, do people with hypertension feel anything different?	-.29	.15	**.52**
Is the pressure high when it is 140/90mmHg?	.16	.16	.06
Can hypertension cause heart, brain, kidney or eye problems?	.07	.05	**.42**
Is the treatment for hypertension a lifelong one?	**.46**	.00	-.03
Can hypertension be treated without medication?	.12	-.33	**.52**
Does regular physical exercise help control hypertension?	-.04	**.57**	-.19
Does losing weight help control hypertension?	-.03	**.43**	.16
Eigenvalues	2.29	1.33	1.18
% of variance	28.59	16.73	14.77

Note: Factor loadings over .40 appear in bold. N = 130.

4.9 Validity of Questionnaire for the Evaluation of Patients' Beliefs about Antihypertensives

4.9.1 Reliability of beliefs about medicines scale

The internal-consistency reliability coefficient (Cronbach's alpha) for the BMQ scale was found to be 0.66. However, on the necessity scale, the test-retest reliability over a six weeks interval showed adequate intraclass correlation coefficient (ICC of 0.75 $p < .001$). The intraclass correlation coefficient on the concerns scale was 0.71 $p < .001$.

4.9.2 Construct validity of the necessity scale

A principal component analysis (PCA) was conducted with oblique rotation (Direct Oblimin). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy for the factor analysis was significantly adequate KMO = .77. Bartlett's test of sphericity χ^2 (130) = 221.27, $p < .001$, indicated that correlations between items were significantly adequate for PCA. One component had eigenvalue greater than 1 on Kaiser's criterion and in combination explained 55.2% of the total variance. The scree plot was unambiguous and showed inflexion that would justify retaining one component. Factor loadings on the component are presented in table 4.44. The items that cluster on the component suggest that it represent patients' necessity belief for their medication.

4.9.3 Construct validity of concerns scale

A principal component analysis (PCA) was conducted with oblique rotation (Direct Oblimin). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy for the factor analysis was significantly adequate KMO = .73. Bartlett's test of sphericity χ^2 (130) = 177.33, $p < .001$, indicated that correlations between items were significantly adequate for

PCA. Two components had eigenvalue greater than 1 on Kaiser's criterion and in combination explained 77.4% of the total variance. The scree plot was ambiguous and did not show clear inflexion that would justify retaining the two components. Factor loadings on the components are presented in table 4.45. The items that cluster on the component 1 suggest that it represent patients' concerns belief about or their medication.

Table 4.44: Summary of Exploratory Factor Analysis of Necessity Questionnaire used among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Necessity	Need for medication
My health in the future will depend on this medicine(s)	**.89**
My health at present depends on this medicine(s)	**.88**
My life would be impossible without this medicine(s)	**.85**
Without this medicine(s) I would be very ill	**.55**
This medicine(s) protects me from becoming worse	.40
Eigenvalue	2.76
% of variance	55.21

Note: Factor loadings over .40 appear in bold. N = 130.

Table 4.45: Summary of Exploratory Factor Analysis of Concerns Questionnaire used among Respondents on Antihypertensives in a Tertiary Health Facility in North-West Nigeria

Concerns	**Rotated factor loadings**			
	Adverse effects		Affordability	
	Pattern	Structure	Pattern	Structure
This medicine(s) disrupts my life	**.91**	**.88**	-.12	.14
This medicine is a mystery to me	**.88**	**.89**	.05	.29
Having to take this medicine worries me	**.86**	**.88**	.09	.34
I sometimes worry about becoming too dependent on this medicine	-.12	.13	**.91**	**.88**
I sometimes worry about the long term effects of this medicine	.19	**.41**	**.78**	**.83**
Eigenvalues	2.68		1.19	
% of variance	53.54		23.82	

Note: Factor loadings over .40 appear in bold. N = 130.

CHAPTER FIVE

5.0 Discussion

This study reports the impact of pharmacist intervention on adherence to medication and blood pressure control. The mean±SD age of 54±13 years obtained in this study, is similar to the 57±12, 58±12 and 59±12 years found in other hypertension surveys reported by Bolarinwa *et al.* (2017), Almas *et al.* (2012) and Al-Ramahi (2015) respectively. This age value could in part be due to the physiological age dependent increase in blood pressure, because it has been shown that blood pressure increases with age development and growth and results in high blood pressure by middle-age (Akinlua *et al.,* 2015). In part, it could be due to societal socio-economic responsibilities associated with the middle-age, which put individuals at an increased risk of psychosocial stress thereby leading to blood pressure elevation.

The sex distribution of males (39%) and females (61%) indicated more females than males, which is in agreement with the sex distribution of 36% males and 65% females; 34% males and 66% females obtained in previous related studies conducted in Nigeria by Ajayi *et al.* (2016) and Daniel *et al.* (2013) respectively. Globally, the prevalence of hypertension is higher in men than in women before the women attain the age of menopause and when cut-off of 140/90mmHg was used. However, because of the societal socio-economic roles assigned mostly to men than women whereby men have to provide most of the finances for family maintenance, men could be at an increased risk of hypertension compared to women. Nevertheless, the high number of women in this study could be because of the higher health seeking behaviour of women compared to men as reported by Ogedegbe *et al.* (2004).

This study has revealed that majority of the patients had no formal education, were married and of the Islamic faith, which is consistent with Bolarinwa's *et al.* (2017) finding. This was not unexpected because the inhabitants of the study area are predominantly Muslims, with farming and small scale business or trading, being their major occupation. Especially those from the surrounding villages, who may be relatively more disposed to the informal education compared to the formal, and who may prefer being married in order to assume wifely/husbandly role so as to be respected by the society.

The result from this study show that majority of the patients were prescribed ACEIs/ARBs. Similarly, in the Southeastern Nigeria, ACEIs/ARBs have been shown to remain favourites for prescribers perhaps due to their documented benefits in hypertensives suffering from other diseases, their increased efficacy in blacks especially when used in combination with diuretics and/or their proven benefits in cardiovascular protection and renoprotection (Ukwe and Ubaka, 2012).

The low adherence rate, with most patients exhibiting uncontrolled blood pressure at baseline corroborated the claim by Osterberg and Blaschke (2005), that, one of the critical factors determining blood pressure control is the patient's adherence to the prescribed regimen. Meaning that for many patients, adherence needs to be improved, since poorly controlled blood pressure causes gradual irreversible organ damage, leading to life-threatening complications or even death (Jankowska-Polańska *et al.,* 2016). Although adherence to antihypertensive agents has been shown to be the bedrock for achieving hypertension control, adherence among patients from the developing countries has been shown to be below average (Gwadry-Sridhar *et al.,* 2013; Lloyd-Sherlock *et al.,* 2014; Irazola *et al.,* 2016; Abegaz *et al.,* 2017). Non-adherence has been shown to be a

multidimensional phenomenon, with patients reporting different rate of and reasons for their non-adherence. Nevertheless, both the disease (hypertension) and the medicines (antihypertensives) characteristics have been shown to be important barriers to adherence in Nigeria. Previous works by Okwuonu *et al.* (2014), Akpa *et al.* (2008) and Kabiru *et al.* (2004) have shown that adherence rate among hypertensive Nigerians could range between 30%, in Abia, 55% in Kano and 60% in Port Harcourt respectively. In all the three states, affordability was the second most important barrier to adherence. In Port Harcourt, it was observed that forgetfulness was the major reason for low adherence while in Kano, absence of symptoms was the main reason for low adherence in addition to high pill burden, feeling of well-being and cure as well as side effects of medications.

Patients experienced significantly reduced systolic blood pressure at six weeks (p <.001). This is in accordance with the result of the Meta analysis by Santchi *et al.* (2014), which has shown that pharmacist's interventions averagely reduced systolic blood pressure by 7.9 mmHg and diastolic blood pressure by 3.9 mmHg.

Furthermore, the proportion of hypertension-controlled patients was significantly higher at six weeks than at baseline. Similarly, a study by Ibrahim *et al.* (2018) has shown blood pressure control and adherence rates to be low among hypertensive patients attending ABUTH, Zaria. Rates of adequate blood pressure control vary widely globally and in Nigeria. The relatively low rate of blood pressure control (47%) obtained in this study is consistent with the 42.7% and 53.3% reported in Sokoto and Ilorin respectively. Lower blood pressure control rate found in Nigeria range between 31% and 36%. In other countries like the USA, 34% have been reported while in Cuba, 39% was reported (Okwuonu *et al.*, 2014).

At baseline, older men with primary level of education were more adherent. The multivariate logistic regression showed that the older age, female gender, marriage, and the lower education level were associated with high adherence. Although, the relationship was not statistically significant ($p > .05$). Agreeably, Liu *et al.* (2014), Wang *et al.* (2014), Al-Ramahi (2015) and Kang *et al.* (2015) have shown that adherence was significantly associated with advanced age and level of education with older patients and low education level being associated with better adherence.

The relationship between age and adherence has been a subject of debate, and both negative and positive relationships have been reported in the literature. In this study, the age was not a significant predictor of antihypertensive medication adherence, although older adults were more likely to report better medication adherence than their younger counterparts ($p > .05$). Similarly, a study conducted in Ilorin Nigeria by Bolarinwa *et al.* (2017) has shown that medication adherence among hypertensive patients increased by 1.12 fold with one year increase in patients' age, with older patients who had no formal education being significantly more adherent. It has been proposed that the better adherence at older age could be due to the concomitant presence of comorbidities in the older adults, leading to their perception of themselves being sick and helpless, which causes them to ensure they take their medication. It has also been argued that the older adults may receive more attention from their family members and this entails more constant reminders to take their medication, implying that, patients may depend on carers who could be sons and/or daughters that are dedicated in making sure medicines are made available and consumed appropriately. Therefore, the other studies that reported an inverse relationship between age and medication adherence, proposed that the age could be dependent on other factors such as the family support in order to cause improved adherence. It is likely that older adults, with poor family support and a

higher tendency to be absent-minded, may not adhere to their antihypertensive medicines. In this light, it has been suggested that investigating the levels of family support among older adults may help confirm this hypothesis. In another perspective, it has been suggested that the older patients probably have more regard for their health and are more prone to complications, therefore feel more inclined to using their medications (Bolarinwa *et al.*, 2017).

Furthermore, low education level was found to be non-significantly associated with better adherence ($p > .05$). Although not in agreement with other studies (Morris *et al.*, 2006 and Trivedi *et al.*, 2008). It has been implied that doctors are regarded as experts and are rarely challenged by patients, especially those with a low education level. These patients follow strictly the medication regimen prescribed, any queries or challenges are highly unlikely as they may be perceived to have resulted in interpersonal conflict and disharmony. Therefore, it has been suggested that a low education level could result in patients having unquestioning obedience and trust in the competence and authority of their physician and, therefore, strictly adhere to medication (Wang *et al*., 2014).

Nonetheless, patients with higher education level could be less adherent due to their inquisitiveness concerning potential unwanted effects associated with the prescribed medicines, which might instill fear and in turn make them more skeptical towards the medicines. In this regard, pharmacist and possibly other healthcare professionals should always discuss potential side effects of medicines with possible coping strategies when dispensing them.

In the contrary, marriage has been shown to be associated with high adherence (Lee *et al.*, 2013 and Wang *et al.*, 2014). The finding from this study could have been due to chance

because majority (91%) (Table 4.1) of the patients were married, suggesting that the other 9% of patients might have been more adherent.

This study found that at baseline, patients who achieved blood pressure control were more likely to report better adherence than those who did not achieve blood pressure control. Low adherence has been shown to be the primary cause of unsatisfactory blood pressure control Consistently, a review of electronic health record from a Veterans Affairs healthcare system of Central Alabama USA, has found that the likelihood of achieving blood pressure control among patients treated with antihypertensive medication was higher for those considered adherent than patients who had less than 80% of eligible days covered by antihypertensive medication. However, for patients who did not attain blood pressure control nearly three quarters were adherent. Meaning that 80% adherence to antihypertensive medicines is required for achieving blood pressure control and factors other than adherence contribute to hypertension control (Claxton *et al.,* 2001; Malik *et al.,* 2014; Piercefield *et al.,* 2016). The significant relation observed between blood pressure control and adherence is in agreement with previous studies. Gwadry-sridhar *et al.* (2013) has reported that, in 49% of reviewed studies on the intervention strategies to improve adherence and blood pressure control, either adherence or blood pressure was statistically significantly improved.

In this study it was observed that duration of hypertension strongly predicted adherence, with patients showing four fold likelihood of adherence if they had short duration of hypertension compared to non-adherent patients. This is in accordance with the findings of Thomas *et al.* (2010), which has shown that, duration of hypertension was a significant predictor of adherence to antihypertensive medication among patients attending the Internal Medicine outpatient department of Kempe Gowda Institute of Medical Sciences (KIMS) and

Research Centre, Bangalore, India. The possible explanation for this outcome could be that patients with short duration of hypertension were relatively new to the treatment compared to those with long duration which could possibly make them more inclined to the antihypertensive medicines. Nonetheless, the evidence that short hypertension duration predicts better adherence to antihypertensive medicines has not been consistent. Patients who generally dislike medicines or whose perception of the cost and/or side effects of antihypertensive medicines outweigh its benefit may not accept the medicines thereby leading to non-adherence even at the start of treatment. This may be corroborated with the finding of this study, which showed that patients' weak concerns about their medicines significantly predicted better adherence. Patients who reported weak concerns about side effects were more likely to be adherent, and consistently, previous studies have shown that strong concerns about side effects were associated with non-adherence (Horne and Weimann, 1999; Horne *et al.,* 2013). Invariably, in a study among the Chinese hypertensive patients, Wang *et al.* (2014) has previously observed that long-term antihypertensive medication use was the most significant factor influencing better adherence, which could be due to participants implicitly and habitually accepting that this improves and/or maintains physical functioning.

At six weeks, the duration of hypertension was not significantly related to adherence as it was observed at the baseline. This could possibly be because patients' post-intervention adherence has increased at six weeks, suggesting that the adherence of patients with long hypertension duration might have improved to the extent of closing the gap in difference of adherence with patients having short hypertension duration. Likewise, at six weeks, the difference in mean adherence score between hypertension-controlled and uncontrolled patients was not significant, which was inconsistent with the baseline. This outcome may

imply the effectiveness of the intervention, suggesting that the threshold for achieving control might have reduced through the medication education and counselling, implying that patients who were uncontrolled at baseline achieved control at six weeks.

In this study, there was non-significant relationship between comorbidities and adherence, with the patients who did not have other comorbidities more adherent to treatment than those who had comorbidities. Possibly, patients without comorbidities were more adherent because they may require fewer number of medicines compared to those with comorbidities who could be on several medicines for other conditions, thereby becoming more inclined and receptive to the antihypertensive medicines. Contrary to this, having comorbidity has been shown to be significant predictor of better antihypertensive medication adherence among the Chinese hypertensive patients. Patients with other comorbidities may consider their ill health deteriorated and at danger thereby experience more obvious benefits brought about by medication and thus be more receptive toward antihypertensive medication (Liu *et al.,* 2014 and Wang *et al.,* 2014).

Patients who were taking four antihypertensives were more adherent than those taking less than four, though, the relationship was not significant. This may possibly be because patients might be using fixed dose combinations, meaning that patients on four antihypertensives could actually be taking only two pills rather than four of the free combination. Accordingly, it has been shown that the use of medications combined in a single daily dose, rather than the free combination of the medication taken in different times, was associated with a significant increase in the treatment adherence (Barreto *et al.,* 2014).

Higher adherence to treatment can lead to adequate hypertension control. It was found that at six weeks, majority of the patients with controlled systolic blood pressure were highly

adherent compared to the patients' adherence at baseline. This finding may also suggest the validity of the translated adherence tool used. One factor that has been studied in conjunction with adherence was the relative risk in the patients' adherence to antihypertensives at baseline and post-intervention. The baseline was considered to be the exposed state while the post-intervention was considered unexposed state, thus, the calculation of the relative risk made it possible to conclude that the intervention reached its purpose since the risk was higher at baseline.

Moreover, significant adherence variables determining systolic blood pressure control were identified, and at baseline, non-adherence to all seven variables (except taking medication the day before) was associated with poor systolic blood pressure control. Non-adherence to the factors related to forgetfulness was significantly associated with poor systolic blood pressure control.

This study indicated that overall knowledge scores of hypertensive patients was not inadequate, however, it didn't reveal any significant associations of hypertension knowledge with demographic characteristics. Interestingly, formal education did not show any relation with high knowledge scores in these hypertensive patients, suggesting that specific knowledge about disease is needed and just education alone may not suffice (Almas *et al.*, 2012). Although, no significant relationship was observed between the improved knowledge and demographic characteristics, higher proportion of the patients had significantly improved knowledge and adherence. The fact that the patients had a moderate knowledge about the disease is very positive and at least an indication that these patients are having more access to information, or even due to a better performance of health care professionals. Sufficient knowledge about hypertension in patients has been associated with greater

medication adherence and better blood pressure control (Almas *et al.*, 2012), however, it is worthy of note that the problem of adherence is complex, because the access to information about the disease does not necessarily imply greater adherence to the control measures. From this perspective, a randomized study developed in Spain with 996 people with systemic arterial hypertension, showed that educational interventions did not have a significant impact on the patients' adherence to the medication (Barreto *et al.*, 2014).

Hypertension knowledge can be considered satisfactory in this community, and this claim can be consolidated with the high proportion of patients responding correctly to the 10 knowledge questions at baseline. In addition, the education and counselling provided was beneficial for hypertensive patients in this community since the proportion of correct respondents was significantly improved at six weeks ($p < .001$). This finding is interesting and justifies the need for improved communication and mutual understanding between pharmacists and patients. Implementation of interventions aimed at improving communication and mutual understanding between care providers and patients would improve hypertension management. In addition to comprehensive explanations on the disease itself, patients should be informed about the side-effects of the drugs, that hypertension management is lifelong and the consequences of interrupting treatment. Poor awareness especially regarding symptoms, treatment results and consequence were reported to have been associated with treatment non-completion (Tachfouti *et al.*, 2012). Patient education can improve blood pressure control. Before treatment is started, the hypertensive patient needs medical information on the meaning of hypertension, its causes, the duration of treatment, and the need for adherence to medication, lifestyle modification, and regular follow-up visits. A well informed patient is more likely to accept treatment and comply with the physician's prescriptions, and be less likely to discontinue treatment prematurely

(Okwuonu *et al.,* 2014). The risk estimation of the knowledge questions used indicated that lack of knowledge about the disease was associated with risks.

It was revealed that a significant relation exist between the misconception about treating hypertension without medication and systolic blood pressure control, with the patients having the misconception that hypertension can be treated without medication showing the chance of poor control. The possible explanation for this could be linked to the role of religious and cultural beliefs on health seeking behaviour among patients. Patients' faith, belief in spirits and superstitions make them to perceive that disease is a test of faith from God Who may cure it at any time and without medicines, or from the spirits who are after their lives and therefore the disease cannot be treated with medicines. On the contrary, the study observed that, patients who did not have the misconception were more likely to have controlled blood pressure. Also, other different knowledge aspects found to determine diastolic blood pressure control were as well related to the misconception since believing that hypertension can be treated without medication may be related to the belief that the disease and its treatment are not lifelong. A similar misconception has been reported in a qualitative study on barriers and facilitators of medication adherence in hypertensive African Americans by Ogedegbe *et al.* (2004), in which patients have been shown to believe that there was no need to take medication because blood pressure can self-regulate. Interestingly, the misconception was found to be related to low adherence, meaning that patients tend to stop or suspend their medicines without the knowledge of their doctors. Similarly, the result of a survey on the knowledge and beliefs of hypertensive patients conducted by Mpinda *et al.* (2014) in Katleho District Hospital in Virginia, Free State, South Africa, has corroborated that beliefs and misconceptions affect interpretation and response to hypertension treatment.

Additionally affordability of medicines was found to be significantly related to the blood pressure control. Majority of the participants' could not afford their medication, a condition which did not change even after the intervention, suggesting that the problem was not addressed. Although, the socio-economic status of the patients was not assessed, the possible reason for the inability to afford medication may be because most of the patients were housewives who are more or less dependent on other family members for support. However, this is in accordance with the result of a systematic review of literature on adherence to cardiovascular medications in resource-limited settings, conducted by Bowry *et al.* (2011), which showed that the most commonly and consistently reported predictors of non-adherence were high medication costs, in addition to poor knowledge, negative perceptions about medications, and the occurrence of side effects. In this study, it has also been revealed that the impact of patients' inability to afford the cost of their medications on their adherence to treatment and systolic blood pressure control was not significant even when discriminated for age, gender and educational level. This may be because the study participants were not beneficiaries of the National Health Insurance Scheme, and the majority being married women with no formal education, who tend to have extended family responsibilities, putting them in financial constraint that might have made it difficult to procure medications out of pocket, thereby forcing patients to purchase their medicines in small quantities or even suspend the treatment.

This study showed that patients held varying beliefs about their medicines. A good percentage of the patients believed that their health do not depend on the medicines, but believed that the medicines protect them from becoming worse. Interestingly, some patients did not believe that the medicines protect them from becoming worse, and insisted that their health was dependent on God. This finding may imply that patients' beliefs about their

medications is to an extent, dependent on their spiritual beliefs, experiences with the adverse effects, blood pressure control, and treatment outcome. Accordingly, patients' beliefs about hypertension and its treatment, and experiences with their medications have been shown to be important barriers to medication adherence, in fact, beliefs were found to shape patients decision on their treatment and adherence and even predict adherence better than clinical and socio-demographic factors (Horne and Weinman, 1999; Horne *et al.*, 2001; Ogedegbe *et al.,* 2004). Patients who exhibited strong necessity beliefs had better chance of having control, and a significant relationship existed between adherence and necessity beliefs, particularly the necessity to depend on the medicines and the protection they provide. Generally, most patients were not concerned about the potential adverse effects of their medicines, in fact some were unaware that medicines have long term effects. Nevertheless, 21% expressed their concerns toward becoming too dependent on their medicines. These were actually concerns about the affordability of medicines not potential adverse effects. Patients claimed that they were concerned about becoming too dependent because they have to constantly buy the medicines. This study showed that patients who had strong concerns had less chance of having controlled systolic blood pressure, meaning that the combination of misconceptions about hypertension and its treatment in addition to concerns about long term effects influenced patients adherence. This is because the strong concerns about the affordability tend to make patients adopt the traditional and alternative remedies that are cheaper or even free (Ogedegbe *et al.,* 2004). Patients claimed to use traditional and alternative medicines that could be ineffective and/or inappropriately used and eventually leading to poor blood pressure control. Since beliefs influence patients' decisions about using their prescribed medicines, this study showed that affordability of medicines was a strong barrier for the patients. The cost-benefit assessment using the necessity-concerns

differential corroborated the fact that patients concerns about being too dependent on their medicines were particularly related to the cost of the medicines rather than potential adverse effects. This study revealed that patients considered purchasing their medicines a burden that out-weighs the need for it.

Acceptability has previously been defined as ‘‘an overall ability of the patient to use a medicinal product as intended’’, and is likely to have a significant impact on the patient’s adherence (Kozarewicz 2014; Liu *et al*., 2014). Acceptability has been conceptualized in several ways, including the hypothetical willingness to use a product, the choice of one product from among a number of other choices and the continued use of a product over time. This study revealed that the hypertensive patients accepted, and were satisfied with their medications, with large difference between those willing to use and those who were uncertain. After the pharmacist intervention, the percentage of patients willing to use their medications was decreased, with only few of them becoming uncertain at 6 weeks. This was possibly because during the course of the intervention, possible side effects which were hitherto unknown to patients were discussed and resulted in risk perception, thereby making some patients uncertain about using their medications. Discussing potential side effects was considered so that the patients did not stop treatment without informing their doctor if they experience them. Nonetheless, the study discovered that patients who were not certain about continuing their medication were less likely to report better adherence and systolic blood pressure control ($p > .05$). The insignificant association that was observed between acceptability and adherence could possibly be due to small sample size. This calls for further studies that may involve larger sample. However, this finding is in agreement with the usual claim that ‘if adherence was high, acceptability was also deemed to be high: likewise, if adherence was low, acceptability was assumed to be low’ (Morrow *et al*., 2013). Overall,

patients' acceptability for the medicines was considerably above average. The acceptability of medicines may be influenced by the setting in which the administration of the medicine takes place. However, the ability to swallow determines the acceptability of conventional medication forms such as tablets and capsules (Liu *et al.*, 2014). In this light, the swallowability factors such as taste, smell when determined, corroborate the findings of less likelihood of adherence among those who were uncertain about continuing their medicines.

Multivariate logistic regression to explore significant predictive factors for medication adherence was conducted. Those factors that were identified to significantly predict blood pressure control in the univariate analyses were entered in the model. Individually, hypertension duration, and strong concerns about the affordability of medication predicted medication adherence, with short duration and strong concerns predicting low adherence.

Despite some hitches such as missed calls, the intervention was very feasible. The most important key points for the education and counseling intervention were delivered through the telephone call in the average of 3.6 minutes per week. The telephone call method was chosen in order to have active conversation with patients when they were at home. In this light, relation between blood pressure and intervention time were assessed, with intervention time having no relation with blood pressure changes. Despite the intervention, blood pressure of some patients was increased, which could possibly be due to the high variability of blood pressure.

CHAPTER SIX

6.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Summary of Major Findings

At baseline, adherence rate and blood pressure control rate were found to be low with fewer than half (38%) and (47%) of the patients adherent and controlled respectively. Patients' adherence rate and blood pressure control rate were increased to 66% and 70% respectively after the pharmacist intervention. Systolic blood pressure significantly decreased by 10.6±3.1 mmHg while diastolic blood pressure decreased by 2.3±1.9 mmHg.

Low level of education, old age and short duration of hypertension were found to be associated with better adherence. Patients' adherence significantly increased after the intervention, with 3.7 mmHg decrease in systolic blood pressure for every 1 unit increase in adherence score.

Although, patients exhibited moderate to adequate knowledge at baseline, all patients reported adequate knowledge after the intervention, which was found to be a significant determinant of diastolic blood pressure control. Patients who reported adequate knowledge were found to be more adherent, and had controlled blood pressure compared to those who reported moderate knowledge. Also, patients' socio-demographic characteristics were not found to significantly influence knowledge. The multivariate logistic regression analyses showed that a misconception that hypertension can be treated without medication was found to be associated with non-adherence and poor systolic blood pressure control.

Furthermore, affordability of antihypertensive medicines was found to be associated with adherence and systolic blood pressure control. Patients were found to be two times more

likely to report low adherence and poor systolic blood pressure control when they could not afford the cost of their medicines. Also, patients had the tendency to stop their medicines without informing their doctors when they could not afford the cost.

This study found that when patients' perception for the cost of their medicines outweighed the benefit they had a higher chance of not adhering to treatment. Patients who reported strong concerns about the cost and consequences of their antihypertensives were less likely to report better adherence than those whose perception for the benefit outweighed that of the cost and consequences. In this study, perception of the necessity for antihypertensive medicines was significantly increased after the intervention. Likewise, patients' perception of the long term effects of their medicines was significantly decreased after the intervention.

At baseline 90% of the patients were willing to use their medicines and those who were uncertain about continuing their medicines were less likely to report high adherence. At the end of the intervention, patients were more likely to have controlled systolic blood pressure if they were willing to use their medicines. All patients confirmed that the swallowability of their tablets was pleasant, with 95%, 93%, and 95% of the patients reporting the size, smell and the taste to be pleasant respectively.

6.2 Conclusion

The pharmacist intervention improved patients' adherence to antihypertensive medicines, knowledge of hypertension, beliefs about antihypertensives and blood pressure control. Patients' systolic and diastolic blood pressure were reduced by 10.6±3.1 mmHg and 2.3±1.9 mmHg respectively, with 70% of the patients achieving target blood pressure control at six weeks. Patients' knowledge, attitude and beliefs were significantly associated with adherence and blood pressure control. Long duration of hypertension, a misconception on the treatment of hypertension and the affordability of antihypertensives were important barriers to adherence and blood pressure control. Patients' perception of the cost and consequences of antihypertensive medicines grossly outweighed that of the benefit, and therefore becoming a significant barrier to adherence and blood pressure control. The antihypertensive medicines were well accepted among the patients, with most patients willing to continue with their medicines.

6.3 Recommendations

Provision of a pharmacist-delivered telephone-based education and counselling service in health care facilities may go a long way in helping patients take their antihypertensive medicines appropriately as well as achieve target blood pressure control.

Additionally, engaging religious leaders in the enlightenment/awareness campaigns in Mosques and Churches may help correct patients' misconception about hypertension treatment.

Moreover, provision of interventions on affordability of medicines through subsidies on the prices, and enrollment in the National Health Insurance Scheme as well as strengthening it, would be beneficial to the patients by relieving the burden of affordability.

Finally, a similar research on other chronic disease conditions should be conducted in order to find barriers to adherence and/or clinical response, so that appropriate measures can be designed and implemented.

6.4 Contribution to Knowledge

This study has proposed a professional opportunity and potential service model for the pharmacist to be relevant and successful within the multidisciplinary healthcare team.

Also, the study has provided an evidence-based data that pharmacist-patient collaboration serve as a professional opportunity for the pharmacist to monitor medicines use and for the patients to give feedback, which will eventually improve adherence and clinical response.

Furthermore, this study has identified specific group (misconception) of hypertensive patients on treatment with different outlook to their condition that is a barrier to adherence and attainment of target blood pressure control.

Moreover, the study has found affordability of antihypertensive medicines to be yet, a barrier to adherence in our community, despite reports that even where antihypertensive medicines were free, Africans were non-adherent.

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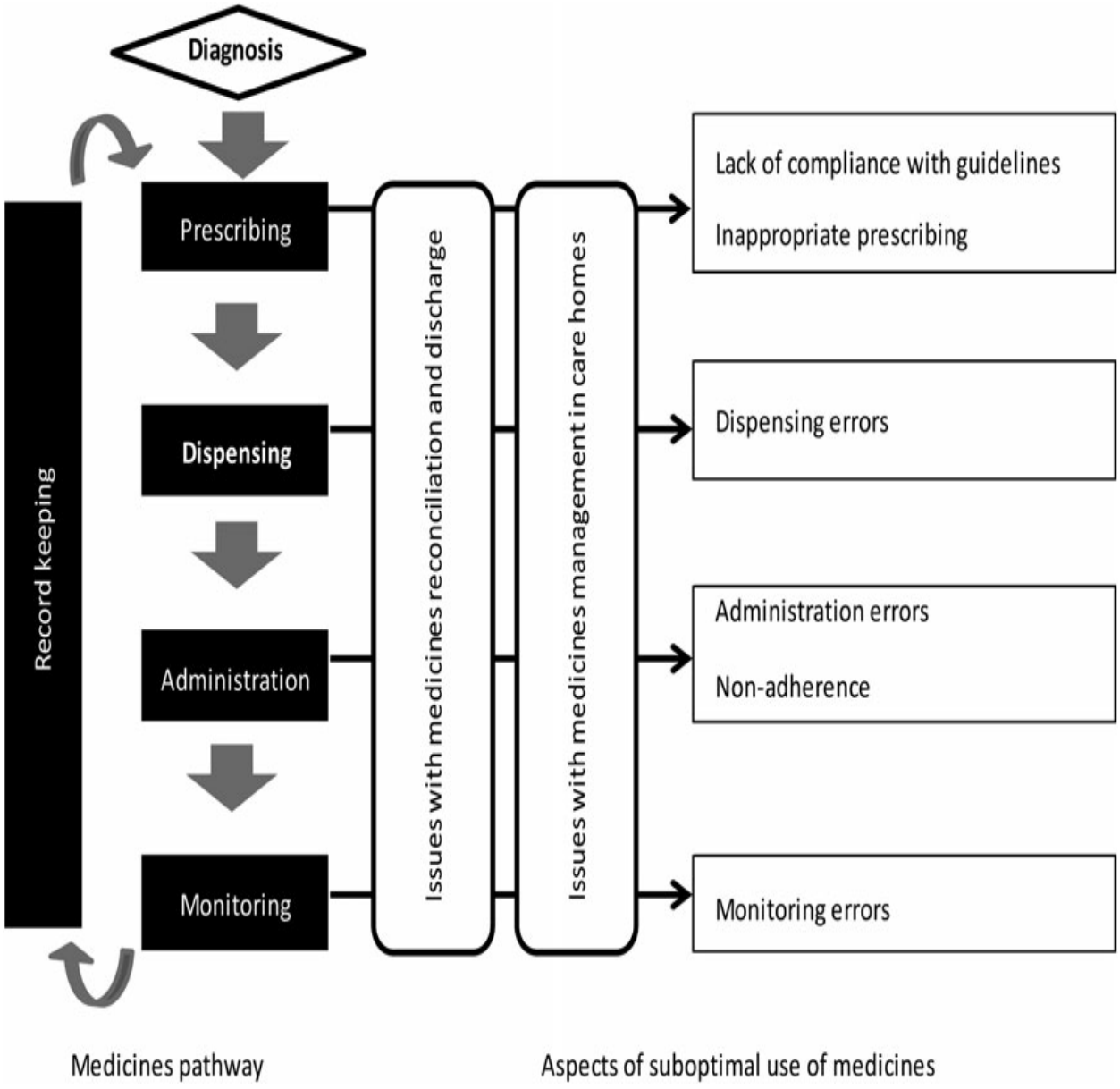
APPENDICES

Appendix 1: Aspects of Suboptimal Use of Medicines



Appendix 2: Medication Counselling Behaviour Guidelines

Medication counselling stages

	Medication information transfer	Medication information exchange	Medication education	Medication counselling
Level of information	Basic, brief, non-individualised	Detailed, individualised	Comprehensive, group or individualised	Detailed discussion and guidance
Spontaneous or planned	Most often spontaneous in response to the medication prescription	Spontaneous or planned	planned	planned
Objective of process	Essential **information** relating to taking prescribed medication as directed **(monologue)**	Provider **responds** to and ask questions related to prescribed medication **(dialogue)**	Collaborative **learning experience** and process regarding prescribed medication **(conversation)**	Guidance that assist in fulfilling needs in managing medical condition and prescribed medication **(discussion)**
Product to patient	Focus is on safe and proper use of drug product	Answers and solicits questions about the drug product. Adapts to the individual, increases knowledge regarding proper and safe use of medication for specific condition	Increases knowledge regarding proper and safe use of medication for specific condition	Enhances problem solving skills and assist with proper management of medical condition and effective use of medication
Nature of relationship	Passive individual receives instruction given by the health care provider	Questions and answers are actively exchanged between patient and provider	Interactive learning about the implication of the medication is shared between patient and provider	Interactive and collaborative discussion and learning between patient and provider

Evaluation table for performance in patient counselling event

Making contact	**Need assessment**	**Providing information**	**Summarise and review**
Approach the patient **Explain the purpose of the counselling session**	Assess the patient's needs, beliefs, feelings, concerns, knowledge, about medication, and patient's expectations for the counselling, session by: • Using patient history appropriately. • Taking the patient's medical history into account. • Openly exploring how the patient is using prescription, non-prescription or alternative therapies. • Establishing whether the patient is both willing and able to adhere to the medication and what practical support may be needed. • Determine whether the information provided by the patient is evidence based or subjective.	Provide information in manageable parts and aim to provide solutions to potential problems through covering: • Indication • Adoption of the dosage regimen, scheduling and duration, into a daily routine. • How long it will take for the drug to show an effect. • Interaction (food, drug, disease). • Side effects. • Precautions and contraindications (e.g. CNS). • Recommendations (e.g. shake well). • When the patient is due back for a refill/repeat. • Other information if needed.	Summarise the information and advice discussed, check how much the patient has understood and gain feedback. In closing ensure that: • An opportunity for final concerns and questions is provided. • There is an opportunity for foolow up. • Agreed actions are reinforced. • Prescribers are followed up with when required. • Monitoring where necessary is arranged.

Appendix 3: Data Collection form for the Patients' Socio-Demographic Characteristics

Hospital number…….
Telephone number……
Contact address……
Age……
Gender……..
Ethnicity……..
Religion…….
Occupation……
Marital status……..
Educational status…….
Date of recruitment……..
Date of next visit……..
Hypertension duration……
Comorbidity……..
Medications……
……
……
……
…….....
Blood pressure at recruitment…….

Call	Duration	Date
1st		
2nd		
3rd		
4th		
5th		
6th		

Blood pressure at the end of intervention……..

Appendix 4: Questionnaire for Measurement of Adherence (MMAS-8)

1. Do you sometimes forget to take your high blood pressure pills? Yes ( ) No ( )
2. Over the past 2 weeks were there any days when you did not take your high blood pressure pills? Yes ( ) No ( )
3. Have you ever cut back or stopped taking medication without telling your doctor because you felt worse when you took it Yes ( ) No ( )
4. When you travel or leave home, do you sometimes forget to bring along your high blood pressure medication? Yes ( ) No ( )
5. Did you take your high blood pressure pills yesterday? Yes ( ) No ( )
6. When you feel like your blood pressure is under control, do you sometimes stop taking your medication? Yes ( ) No ( )
7. Taking medication every day is a real inconvenience for some people, do you ever feel hassled about sticking to your high blood pressure treatment plan? Yes ( ) No ( )
8. How often do you have difficulty remembering to take your blood pressure medication? Never/Rarely ( ), Once in a while ( ), Sometimes ( ), Usually ( ), All the time ( )

Appendix 5: Internal Consistency Reliability of Questionnaire for Measuring Self-reported Adherence (MMAS-8)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.789	.840	8

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Do you sometimes forget to take your high blood pressure pills?	7.85	7.644	.507	.570	.769
Over the past 2 weeks, were there any days when you did not take your high blood pressure pills?	8.09	7.234	.544	.343	.760
Have you ever cut back or stopped taking your medication without telling your doctor?	7.79	7.684	.577	.609	.765
When you travel or leave home, do you sometimes forget to bring along your high blood pressure medication?	7.82	7.604	.566	.666	.764
Did you take your high blood pressure medication yesterday?	7.79	7.865	.480	.284	.774
When you feel your blood pressure is under control, do you sometimes stop taking your medication?	7.85	7.523	.564	.571	.762
Taking medication everyday is real inconvenience for some people, do you ever feel hassled about sticking to your high blood pressure treatment plan	7.74	7.837	.647	.741	.766
How often do you have difficulty remembering to take all your blood pressure medication?	5.59	3.159	.889	.835	.767

Appendix 6: Questionnaire for Assessment of Knowledge

1. Is hypertension a lifelong disease? Yes ( ) No ( )
2. Most times, do people with hypertension feel anything different? Yes ( ) No ( )
3. Is the pressure high when it is ≥140/90 mmHg? Yes ( ) No ( )
4. Can hypertension cause heart, brain, kidney or eye problems? Yes ( ) No ( )
5. Is the treatment for hypertension a lifelong one? Yes ( ) No ( )
6. Can hypertension be treated without the use of medication? Yes ( ) No ( )
7. Do regular physical exercises help control hypertension? Yes ( ) No ( )
8. Does losing weight (for overweight) help control hypertension? Yes ( ) No ( )
9. Does reducing salt intake help control hypertension? Yes ( ) No ( )
10. Does reducing stress help control hypertension? Yes ( ) No ( )

Appendix 7: Internal Consistency Reliability of the Knowledge Scale

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.647	.645	9

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Is hypertension a lifelong disease?	13.92	4.821	.331	.458	.621
Most times, do people with hypertension feel anything different?	13.64	5.266	.413	.494	.604
Is the pressure high when it is 140/90mmHg?	14.08	3.907	.515	.614	.563
Can hypertension cause heart, brain, kidney or eye problems?	13.69	5.533	.239	.585	.637
Is the treatment for hypertension a lifelong one?	13.89	4.673	.489	.502	.576
Can hypertension be treated without medication?	13.78	4.863	.385	.538	.604
Does regular physical exercise help control hypertension?	13.53	6.028	.203	.436	.644
Does losing weight help control hypertension?	13.69	5.818	.156	.243	.651
Does reducing stress help control hypertension?	13.56	5.968	.195	.447	.644

Appendix 8: Questionnaire for Determining Attitude

1. Can you remember the name(s)/strength/side effect(s) of your medication(s)? Yes ( ) No ( )
2. Do you always afford the cost of your medication? Yes ( ) No ( )
3. Is your medication readily available? Yes ( ) No ( )
4. Is your treatment regimen complex? Yes ( ) No ( )
5. Are you taking this medicine(s) to improve your health? Yes ( ) No ( )
6. Do you think this medicine(s) have benefits? Yes ( ) No ( )
7. Do you combine your medication(s) with traditional medicines? Yes ( ) No ( )
8. If yes, do you think it/they (traditional medicine(s)) is/are effective? Yes ( ) No ( )

Appendix 9: Beliefs about Medicines Questionnaire

Views about ( )	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
My health, at present depends on this medicine					
Having to take this medicine worries me					
My life would be impossible without this medicine					
I sometimes worry about the long term effects of this medicine					
Without this medicine I would be very ill					
This medicine is a mystery to me					
My health in the future will depend on this medicine					
This medicine disrupts my life					
I sometimes worry about becoming too dependent on this medicine					
This medicine protects me from becoming worse					

Appendix 10: Internal Consistency Reliability of the Beliefs about Medicines Questionnaire

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.664	.673	10

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
My health at present depends on this medicine(s)	22.41	24.443	.616	.	.559
Having to take this medicine(s) worries me	24.44	35.996	.230	.	.657
My life would be impossible without this medicine(s)	22.72	26.854	.520	.	.591
I sometimes worry about the long term effects of this medicine(s)	23.53	34.322	.120	.	.687
Without this medicine(s) I would be very ill	21.06	32.319	.441	.	.623
This medicine(s) is a mystery to me	24.47	36.515	.258	.	.657
My health in the future will depend on this medicine(s)	22.53	24.322	.641	.	.551
This medicine(s) disrupts my life	24.47	36.515	.258	.	.657
I sometimes worry about becoming too dependent on this medicine(s)	23.66	34.362	.124	.	.685
This medicine(s) protects me from becoming worse	20.78	37.402	.109	.	.669

Appendix 11: Questionnaire for Evaluating Acceptability and Satisfaction with Care

Views	Pleasant	Uncertain	Unpleasant
The effect these drugs have on my daily life is			
Swallowing of my drugs is			
The taste of my drugs is			
The smell of my drugs is			
The size of my tablet(s) is			

View	Willing	Uncertain	Unwilling
Willingness to use in future			

View	Satisfied	Uncertain	Unsatisfied
Overall satisfaction with the management			

Appendix 12: Consent Form

Consent form

Title of Research Project: An Intervention Study on Suboptimal Use of Antihypertensive Medicines in a Tertiary Health Facility in North-west Nigeria.

I have read the information provided above (it has been adequately explained to me).

I have had the opportunity to ask questions about it and any questions I have asked have been answered to my satisfaction. I voluntarily accept to participate/allow my ward or children to participate in this study and understand that I have the right to withdraw from the study at any time, without compromising the quality of care I deserve.

Yes ☐ **No** ☐

……...

Signature/thumb print of research respondent Date

…… ……...

Printed name of Research subject's legal guardian Date

…….. ……..

Signature/thumb print of person obtaining consent Date

……. ……..

Printed name of person obtaining consent: KAMILU SARKI LABARAN

Address: DEPARTMENT OF CLINICAL PHARMACY & PHARMACY PRACTICE, AHMADU BELLO UNIVERSITY, ZARIA

GSM/Telephone Number: 08036830072; 08050970930

Appendix 13: Education Tool

Risk of hypertension and its complications:
What is hypertension
Dangerous
Lifelong
Complications of hypertension: stroke, heart failure, kidney failure, blindness
Prognosis/progression of hypertension: maintain adequate control of BP <140/90 mmHg
Medication education and counselling:
Description of the drugs
Names, strengths, indication, adverse effects and usage instructions for treatment, goals of treatment
General information regarding the benefits of treatment
Cure
Control for life
General information regarding potential side effects of treatment
Access to and acceptance of medication (alternative)
Duration of treatment (lifelong)
Adherence to healthy lifestyle:
Lifestyle and dietary modification
Physical exercise
Salt reduction
Stress reduction
Smoking cessation
Alcohol avoidance
Fruits and vegetable intake
Unsaturated oil intake
High-fat dairy product reduction
Medication handling:
Medicines purchase (preferably hospital): Avoid unreliable source, hawkers. Check NAFDAC number
Medicines storage (check expiry date, store in original package, protect from light)
Medicines disposal (not via water waste or household waste)

Appendix 14: Call Chart

s/n	Patient ID	Baseline	Intervention (weeks)						Post-intervention
			1	2	3	4	5	6	

Appendix 15: Ethical Clearance

HEALTH RESEARCH ETHICS COMMITTEE

AHMADU BELLO UNIVERSITY TEACHING HOSPITAL

SHIKA - ZARIA, NIGERIA.

E-mail: abuthshika@yahoo.com *website: www.abuth.org*

Chairman of Board: **Chief. Shuaib Oyedokun Afolabi** *Fnil*

Chief Medical Director: **Prof. Lawal Khalid,** *MBBS, FMCS, FWACS, FRCS(ED) mnl*

Chairman, Medical Advisory Committee: **Prof. Abdullahi Mohammed,** *MBBS, FWACP, FICS*

Director of Administration: **Barr. Ishak Bello,** *LL.B, BL., LL.M, PGDM, AHAN, FCAI*

ABUTH/HREC/TRG/36 — 4th February, 2016

Our Ref: _____ *Date:* _____

Your Ref: _____

ABUTH HREC FULL ETHICAL CLEARANCE CERTIFICATE

RE: ***" An intervention Study on Suboptimal Use of Antihypertensive Medicines in a Tertiary Health Facility in North-West Nigeria."***

ABUTH Ethics Committee assigned number:	-	**ABUTH/HREC/S03/2015**
Name of the principal Investigator:	-	**Mr. Kamilu Sarki Labaran,**
Address of the Principal Investigator:	-	**Department of Clinical Pharmacy**
		Faculty of Pharmaceutical Sciences
		A.B.U Zaria
Date of receipt of valid application:	-	**15/9/15**
Date of meeting when final determination		
On ethical approval was made:	-	**04/2/2016**

This is to inform you that the research described in the submitted protocol, the consent forms, and other participant information materials have been reviewed and ***given full approval by the ABUTH Ethics Committee.***

Please note: this approval dates from **4th February, *2016* to4th February, *2017***. No participant recruitment into this research may be conducted outside these dates.

All informed consent forms in this study must carry the ABUTH HREC number assigned to this research and the duration of ABUTH HREC approval of the study.

This HREC expects that you submit your application as well as an annual report for ethical clearance renewal 3 months prior to expiration of study dates. This is to enable you obtain renewal of your approval and avoid interruption of your research.

If there is delay in starting the research, please inform the ABUTH HREC so that starting dates can be adjusted accordingly.

No changes are permitted in the research without prior approval by ABUTH HREC, except in circumstances outlined in national code for Health Research Ethics: http://www.nhrec.net.

ABUTH HREC reserves the right to conduct compliance assessment visits to your research site without prior notification.

Prof. Aisha.I.Mamman,MBBS,FMCpath.
Chairperson HREC.