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Mlangheni, Makoma Charlotte

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AN EVALUATION OF THE CLINICAL MANAGEMENT OF HYPERTENSION IN PRIMARY HEALTH CARE FACILITIES IN THE BUSHBUCKRIDGE SUB-DISTRICT: 2013 to 2014

Makoma Charlotte Mlangheni

A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, in fulfilment of the requirements for the degree of Master of Medicine in the branch of Community Health

October 2015

DECLARATION

I, Makoma Charlotte Mlangheni, declare that this research report is my own work. It is being submitted for the degree of Master of Medicine in the branch of Community Health, in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other university.



Makoma Charlotte Mlangheni

12th day of October 2015

DEDICATION

This work is dedicated to

My mother, Nkomo Mlangheni, for her unwavering support and prayers

God for guiding my steps and opening doors for me

ABSTRACT

Introduction: Hypertension is a known modifiable risk factor for cardiovascular disease. The World Health Organization estimates that 42.2% of South Africans have hypertension. The control of hypertension is of public health importance because poorly controlled hypertension places patients at risk of developing complications such as strokes, heart disease, renal disease and target organ damage.

Aim: To evaluate the health services provided in primary health care (PHC) facilities for the management of hypertension in the Bushbuckridge sub-district in 2014.

Methods: An analytical cross sectional study design. An audit of PHC facilities was conducted between February and June 2014 to determine if the facilities had the equipment, consumables and anti-hypertensive drugs to enable them to manage hypertension. A retrospective record review of patients' clinical records over a 22 month period from 01 June 2012 to 31 March 2014 was conducted to assess whether the management of patients was in line with current guidelines.

Findings: All 38 PHC facilities in the sub-district were audited. All facilities had at least one functional sphygmomanometer, weighing-scale, stethoscope, blood glucose device and a blood pressure cuff. Twenty four (63.2%) facilities had all recommended anti-hypertension drugs. None of the facilities had all the consumables required to manage hypertension appropriately. Eight facilities were selected for the record review and 404 patient records were reviewed. Forty four (10.9%) patients had their cardiovascular risk assessed during the review period. Blood pressure and weight measurements were done in 188 (46.5%) and 199 (49.3%) patients at all their visits. Abdominal circumference was never measured in 329 (81.4%) patients and 277 (68.5%) never had their BMI calculated. Urinalysis and glucose tests were performed in 352 (87.1) and 302 (74.7) patients.

Creatinine, cholesterol and potassium tests were done in 77(19%), 61 (15.1%) and 8 (2%) patients respectively. The period prevalence over of controlled hypertension over the 22 months was 61.4% (95% CI 56.4-66.2). Diabetic patients were ten times more likely to have an uncontrolled hypertension than non-diabetics (adjusted OR 9.6; 95% CI 5.1-17.8, $p<0.001$). Patients who were on two or three and more anti-hypertensive drug classes were five and 13 times (respectively) more likely to have uncontrolled hypertension compared to those on one drug (adjusted OR 4.5; 95% CI 2.1-9.8; $p<0.001$) (adjusted OR 12.8; 95% CI 5.7-29.0; $p<0.001$).

Conclusion: The evaluation of the management of hypertension in the Bushbuckridge sub-district has shown overall that there is no clear link between the inputs, processes and the outcome. The inputs were available, processes were not consistently followed but hypertension control was found to be high.

Keywords: Hypertension, hypertension control, primary health care, clinical management, treatment guidelines

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GLOSSARY OF TERMS

Audit: an evaluation of the quality of health care, the use of resources, and outcomes (1).

Clinic: is a permanent health facility that offers a range of primary health care services and is open for eight hours a day on at least four days of the week (2).

Community health centre: is a permanent health facility that offers a wide range of primary health care services, including emergency and midwifery services, and is open 24 hours a day for seven days of the week (2).

Controlled hypertension: the Seventh Report of the Joint National Committee on the Prevention, Detection, Evaluation and Treatment of High Blood Pressure defines controlled hypertension as a systolic blood pressure ≤140 mmHg and a diastolic blood pressure ≤90 mmHg in patients with no comorbid diseases. In those with comorbid diseases it is a systolic blood pressure ≤130 mmHg and a diastolic blood pressure ≤80 mmHg (3).

Evaluation: a process that systematically and objectively assesses the relevance, effectiveness, and impact of activities in the light of their objectives. This can be done through the evaluation of structure (inputs), process and outcome (1).

Hypertension: the Seventh Report of the Joint National Committee on the Prevention, Detection, Evaluation and Treatment of High Blood Pressure defines hypertension as an elevated systolic blood pressure equal to >140 mmHg and a diastolic blood pressure >90 mmHg (3).

Non-communicable disease: a disease or health condition that cannot be passed from a person, an animal or the environment to another (4).

Prevalence of hypertension control: in this study, the prevalence of hypertension control refers to the period prevalence of controlled hypertension over a 22 month period.

Sphygmomanometer: is a device used to measure blood pressure. A sphygmomanometer can be of an aneroid, mercury or electronic type.

Stadiometer: is equipment used to measure height using a sliding ruler.

ABBREVIATIONS

ACE-I	Angiotensin converting enzyme inhibitor
AIC	Aikaikes Information Criterion
BMI	Body mass index
CCB	Calcium channel blocker
CCF	Congestive cardiac failure
CHC	Community health centre
CI	Confidence interval
CVD	Cardiovascular disease
DBP	Diastolic blood pressure
ECG	Electrocardiograph
GP	General practitioner
HIV	Human immunodeficiency virus
ICDM	Integrated Chronic Disease Management
IQR	Interquartile range
JNC7	Seventh Report of the Joint National Committee on the Prevention, Detection, Evaluation and Treatment of High Blood Pressure
NCD	Non-communicable disease
NDoH	National Department of Health
NHANES	National Health and Nutrition Survey
OR	Odds ratio
PC101	Primary Care 101
PHC	Primary health care
SBP	Systolic blood pressure
SD	Standard deviation
WHO	World Health Organization

Chapter 1 INTRODUCTION

This chapter will set the background and context of this study. The burden of hypertension globally and in South Africa will be presented. The strategies for the prevention and control hypertension that have been implemented in South Africa will be outlined. This will be followed by a review of recent literature that will focus on the burden of hypertension, the importance and prevalence of hypertension control, and the reasons for the poor control of hypertension. The justification of the study will be provided followed by the aims and objectives of this study.

1.1 Background

According to the World Health Organization (WHO), 38 million people die of non-communicable diseases (NCDs) annually. Cardiovascular diseases alone accounted for 17.5 million of these deaths (5). A recent global burden of disease study conducted in 188 countries reported a 41% increase in deaths attributable to cardiovascular disease between 1990 and 2013 (6).

The WHO estimated that 11% of the deaths in South Africa in 2011 were due to cardiovascular diseases (7).However this estimation is much lower than the figures reported from within South Africa. As early as 2000, the first burden of disease study in South Africa found that cardiovascular diseases accounted for 16.6% of all deaths in the country (8). Statistics South Africa mortality data shows that that cardiovascular diseases accounted for 16.2%, 16.5% and 16.7% of notified deaths during 2011, 2012 and 2013 respectively (9).

Hypertension is a known modifiable risk factor for cardiovascular disease (10,11). In 2011, the WHO estimated that 42.2% of South Africans had a raised blood pressure (7). According to Statistics South Africa, hypertensive diseases ranked eighth on the list of the top ten underlying causes of death between 2011 and 2013.

The Seventh Report of the Joint National Committee on the Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC7), which was published by the United States Department of Health and Human Services, defined controlled hypertension as a systolic blood pressure (SBP) that was less than or equal to 140 mmHg and a diastolic blood pressure (DBP) that was less than or equal to 90 mmHg in hypertensive patients who were on treatment and have uncomplicated hypertension. For patients with specific co-morbid diseases and complications such as diabetes, congestive cardiac failure (CCF) and kidney disease a lower blood pressure target for hypertension control was introduced in 2003. Hypertension control in these patients was defined as a SBP $\leq$130 mmHg and DBP $\leq$80 mmHg (3).

South Africa is a signatory to the declaration of the 66th United Nations General Assembly (12). By signing this declaration, South Africa has committed to increasing its efforts to reduce NCDs. In keeping with this commitment, a South African Summit on the Prevention and Control of Non-Communicable Diseases was held in 2011. The delegates at the summit decided that government should develop a strategic plan to address NCDs. In 2013, the South African Department of Health published the Strategic Plan for the Prevention and Control of Non-Communicable diseases 2013-2017 (13).

Although the baseline prevalence of hypertension and uncontrolled hypertension were yet to be established through a survey, two targets that focus on the prevention and control of hypertension were set. These targets were: (13)

i. To achieve a 20% reduction in the prevalence of high blood pressure through lifestyle interventions and medication, and
ii. To increase the percentage of people with controlled hypertension by 30% by the year 2020.

One of the strategies introduced to improve the control of hypertension was the implementation of the Integrated Chronic Disease Management model (ICDM). The ICDM model was introduced for the purpose of integrating the management of chronic diseases in order to improve the quality of care and health outcomes. The model also focuses on ensuring a reliable supply of medication and basic equipment in PHC facilities (13,14).

The Standard Treatment Guidelines and Essential Medicines List were used for the management of hypertension and other chronic diseases (15). In 2013 this was changed and ICDM was rolled out. With the roll out of ICDM, new Primary Care 101 (PC101) guidelines were introduced (16). The PC101 guidelines were produced in the form of a simplified manual of colour coded algorithms for the management of chronic conditions and common symptoms. The two guidelines were not different as they were both based on the South African Hypertension Guidelines which were published by the Southern African Hypertension Society and the Department of Health in 2011(17). These treatment guidelines specify how blood pressure measurements should be taken, what clinical

assessments should be made, what measurements and investigations should be done and how often, what anti-hypertensive drugs and adjuvant therapy should be prescribed to patients and the target blood pressure levels to be achieved on treatment.

The control of hypertension is of public health importance. Uncontrolled hypertension is an important risk factor for cardiovascular diseases such as stroke, ischaemic heart disease and congestive cardiac failure. Uncontrolled hypertension results in damage to vital organs such the heart and kidneys. Therefore, it is important to control hypertension as this would contribute significantly to a reduction in morbidity and mortality from cardiovascular diseases (3).

1.2 Literature review

1.2.1 Burden of hypertension

Kearney et al. have predicted that the prevalence of hypertension in the world would increase from 26.4% (95% CI 26.0-26.8) in 2000 to 29.2% (95% CI 28.8-29.7) by 2025. The largest increase in prevalence would come from developing regions, with an expected increase of 80% as compared to 24% in developed regions (18).Lawes et al. estimated that in 2001, hypertension accounted for 7.6 million (13.5%) deaths globally. Eighty percent of this burden was in low and middle income countries (19). In 2015 Lloyd-Sherlock et al. published a study conducted amongst elderly people above the age of 50 years in six low to middle income countries which included China, Russia, Ghana, India, Mexico and South Africa. They found a hypertension prevalence of 52.9% (95% CI 52.3-53.4) across the countries, with the lowest prevalence of 32.3% (95% CI 30.3-34.3) in India and the highest in South Africa at 77.9% (95% CI 76.4-79.4) (20).

The burden of hypertension in South Africa has been measured in a number of community based studies. These studies have found the prevalence of hypertension of around 40% in the general population. In 2013, Peer et al. found the prevalence of hypertension to be 38.9% in people aged between 25 and 74 years in Cape Town (21). Day et al. found that in 2010 more than 40% of South Africans above the age of 25 years had hypertension (22). In 2007, Thorogood et al. found that 43% of the general population in the Bushbuckridge sub-district in Mpumalanga had hypertension (23).

1.2.2 Importance of hypertension control

Poorly controlled hypertension places patients at risk of developing complications such as strokes, heart disease, renal disease and target organ damage (24,25). By controlling hypertension, these cardiovascular diseases and complications of hypertension are reduced (26). If hypertension is not controlled, the increased morbidity and mortality associated with cardiovascular diseases and other NCDs will impact on the delivery of health services for both acute and chronic diseases (27). The impact of hypertension spreads beyond the health sector. Hypertension has a greater impact on the economy in developing regions (18). Uncontrolled hypertension has implications of the South African economy in terms of years of life lost due to premature deaths, direct costs of hospitalisation and the indirect losses due to morbidity in those who are economically active (24).

1.2.3 Prevalence of hypertension control

The following studies in public sector PHC facilities have reported a low prevalence of hypertension control. In 2007, Rayner et al. assessed the management of hypertension in

two community health centres (CHCs) in the Western Cape. In this study, blood pressure measured by the clinic nurse was compared to that which was measured by a trained nurse (part of the research team). The measurement taken by the study nurse was used to determine blood pressure control. This study found that 40% of the 161 patients had a blood pressure less than the recommended 140/90 mmHg (28). In another study in the Western Cape in 2008, Steyn et al. conducted a record review of 923 patients with hypertension in 18 CHCs where patients were managed by nurses and doctors. Their study population included patients who were 15 years and older and had attended the clinic at least four times in the previous year and had received treatment for hypertension at each of those visits. Hypertension control was defined as a blood pressure below 140/90 mmHg. This study found that there was poor control of hypertension with only 33% having controlled blood pressure (29).

In 2007, Thorogood et al. reported that 51.4% of the 422 hypertensive patients above the age of 35 in Bushbuckridge had a blood pressure below 140/90 mmHg (23). In this study a nurse visited patients in their homes and measured blood pressure by taking three measurements three minutes apart, and using the mean of the second and third blood pressure.

Some studies have showed that the prevalence of hypertension control was higher in the private sector. In 2009, Rayner et al. found a prevalence of controlled hypertension of 61.2% (95% CI 56.7-65.7) in a study conducted on 451 patients in 15 private general practitioner (GP) practices. Blood pressure was measured by the GPs themselves and control was defined as a blood pressure below 140/90 (11). Peer et al. conducted a study in

three public CHCs and 11 private GP practices in Cape Town. The study population was made up of 403 black South Africans aged between 35 and 65 years. Three blood pressure measurements were taken two minutes apart and the mean of the second and third measurement was used to measure control at a blood pressure less than or equal to 140/90 mmHg. They found that the level of hypertension control in the private sector was 51%, which was higher than the 36% found in the public sector (24).

National population surveys have also looked at the prevalence of hypertension control amongst hypertensive South Africans who were taking anti-hypertensive treatment. In a national population based survey in 2008, three measurements were taken and the mean of the last two was used to measure control. In national survey, 48.8% of those aged 50 years and older had controlled hypertension (30). In 2014, using a similar methodology in a multi-site study in six middle and low income countries (i.e. China, Ghana, India, Mexico, Russia and South Africa), in people aged 50 years and older who were taking antihypertensive treatment, 24% and 55%, in South Africa and India respectively, had a controlled blood pressure (20).

The prevalence of controlled hypertension in some high income countries has been reported to be much higher than in lower and middle income countries. Using data from the National Health and Nutrition Survey (NHANES), studies in the United States have reported prevalence of controlled hypertension above 56% (31,32). The NHANES uses a slightly different methodology of measuring blood pressure. Four measurements are taken in one sitting and a mean of the last three is used to measure blood pressure control using the JNC7 definition.

Using the mean of only two blood pressure measurements at one sitting, and a definition of blood pressure control below 140/90 mmHg, Chow et al. found that the proportion of those on anti-hypertensive treatment who had controlled hypertension in 2013 was 40.7%, 32.3%, 26.9% and 40.2% in high, upper-middle, low-middle and low income countries respectively (33). Blood pressure control was lowest in the African region at 22.7% and highest in South Asia at 41.5%. The two African countries that were included in the regional analyses were South Africa and Zimbabwe (33).

Using the same definition of hypertension control as the studies above and a mean of two measurements at one sitting, other studies in Southern Africa have reported similar prevalence to those reported in South African studies. Two studies published in 2014 from Zimbabwe reported that 22% and 32.8% of the patients in out-patient departments in district hospitals had controlled hypertension (25,26). A study conducted in Mozambique in 2009 found that nearly 40% of those on hypertensive treatment had a controlled blood pressure (34).

1.2.4 Reasons for poor control of hypertension

A number of studies have tried to establish the reasons for the low prevalence of hypertension control. There are a number of factors that contribute to the poor control of hypertension. These include health system and patient related factors. Although patient related factors such as adherence to treatment are important, they are not the focus of this study (28,35). Health system related factors include the availability of resources for the management of hypertension and what doctors and nurses do to manage hypertension.

Although effective anti-hypertensive treatment and guidelines are available, the prevalence of controlled hypertension remains low because of the poor management of the condition (11,29). The unavailability of equipment and medication for the treatment of hypertension has been cited as another reason for the poor control of blood pressure (23,28,36,37). Previous studies have found that stock-outs of anti-hypertensive medication contributed to the poor management of hypertension in both clinics and district hospitals (23,25,26).

Connor et al. conducted an audit of sphygmomanometers and blood pressure cuffs in six clinics in Bushbuckridge in 2006. They found that the equipment used for measuring blood pressure was dysfunctional and had never been serviced (37). Daniels et al. found that the unavailability of equipment, specifically sphygmomanometers and large cuffs, had a negative impact on the quality of care and contributed to poor blood pressure control (38).

Doctor's non-compliance with treatment guidelines has also been cited as a reason for uncontrolled hypertension (11,28). Generally, clinical guidelines are developed to improve quality and promote equity in the delivery of health services (39,40). The purpose of guidelines is to assist health professionals when they make decisions about the appropriate treatment for specific medical conditions (41).

The South African Department of Health and the South African Hypertension Society have over the years published the South African Hypertension Guidelines in an attempt to improve quality of care (29). The current South African Hypertension Guidelines were published in 2011. These guidelines were published to promote evidence based approaches in the management of hypertensive patients (17).

The use of treatment guidelines in the management of hypertension in PHC has been the subject of a number of studies. Studies conducted in 2008 and 2011 on doctors in CHCs in the Western Cape found that the publication of hypertension guidelines in journals and their widespread dissemination in poster form did not translate into knowledge of the guidelines nor did it improve the management of hypertension (29,36). In a study in PHC facilities in the Western Cape, two thirds of the doctors were aware of the existence of the South African Hypertension Guidelines. However, the majority did not know the contents of these guidelines despite the fact that the guidelines were readily available and displayed on the walls (36). A study conducted in private GP practices in four South African provinces found that GPs applied one target for blood pressure control of 140/90 mmHg and did not aim for a lower target in those with co-morbid conditions and cardiovascular risk in line with recommendations in treatment guidelines (11). Parker et al. found that doctors ignored the blood pressure targets for patients with and without co-morbid conditions (36).

1.3 Justification for the study

Although studies have been conducted to investigate the level of hypertension control in PHC facilities, the majority of these were done in the Western Cape, mostly in urban settings, and the focus was mainly on the management of hypertension by doctors (28,29,36). The setting for this study differs from previous studies in that the Bushbuckridge sub-district is a rural setting and the management of hypertensive patients in PHC facilities is provided mainly by nurses. Nurses' compliance with treatment guidelines has not been studied. It is also not known if the introduction of the 2011

treatment guidelines has led to an improvement in hypertension control in the Bushbuckridge sub-district. Previous studies have all assessed hypertension control by using blood pressure measurements at one sitting (i.e. point prevalence) and have not looked at blood pressure over a period of time. In this study, period prevalence of hypertension will be assessed using clinic blood pressure measurements over a twenty two month period.

Essentially by evaluating the management of hypertension, one is evaluating the quality of care provided to hypertensive patients. A framework has been developed by Donabedien which evaluates components of a programme by looking at the inputs, processes and outcomes of care (42). Other studies have looked at these components separately and not together. For the purpose of this study, the framework used by Donabedien has been adapted to focus on all three components in the management of hypertension. The adapted framework is illustrated in Figure 1.1.

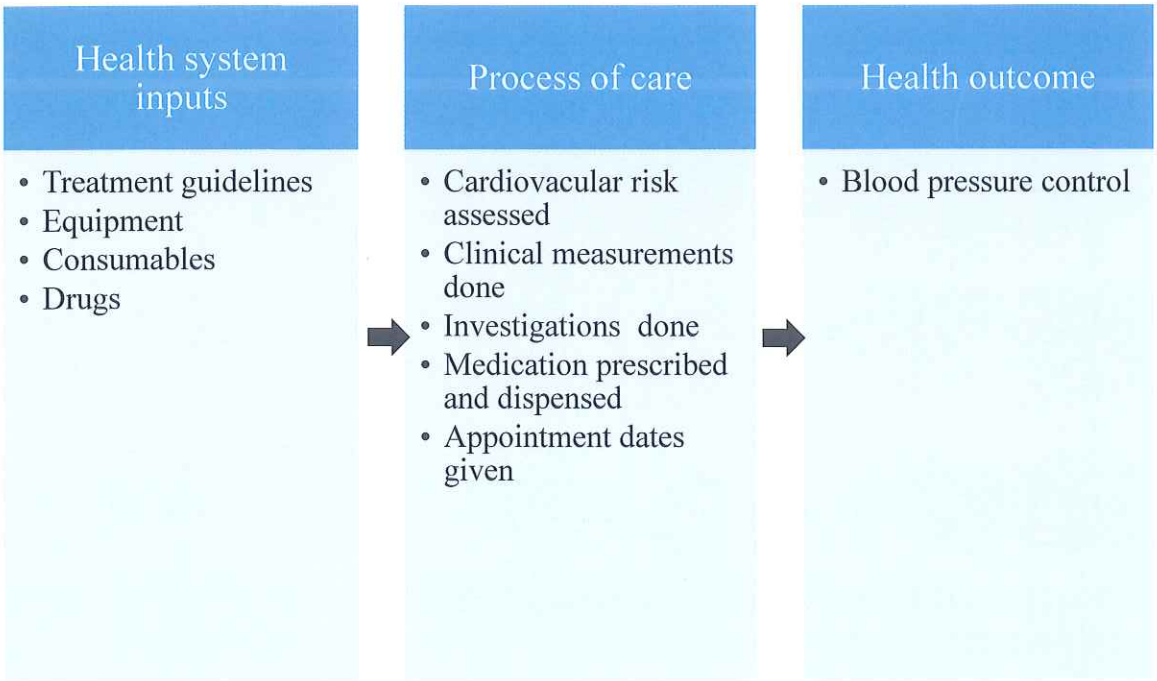


Figure 1.1 Framework for the evaluation of inputs, processes and outcomes

This study therefore will focus on the relationship between the health system inputs, processes and health outcomes in the management of hypertension. To be able to manage hypertension appropriately, in accordance with guidelines, the necessary resources for the management of hypertension should be available in the PHC facilities. Therefore, the first part of this study will focus on establishing the availability of only four inputs; i.e. treatment guidelines, equipment, consumables and anti-hypertensive drugs required for the management of hypertension. The process of management of hypertension will be assessed by looking at whether nurses followed available treatment guidelines in their management of hypertension in terms of conducting cardiovascular risk assessments, taking a number of clinical measurements, doing the right investigations at the right time, dispensing all medication and giving patients an appointment date. Other processes that are patient

related such as compliance with treatment will not be assessed. Finally this study will then assess the health outcome by measuring the period prevalence of controlled hypertension.

1.4 Study aim and objectives

1.4.1 Aim

The aim of this study was to evaluate the clinical management of hypertension in PHC facilities in the Bushbuckridge sub-district during the period 01 June 2012 to 31 March 2014 and measure 22 month period prevalence of hypertension control.

1.4.2 Objectives

1. To assess the availability of treatment guidelines, functional equipment, consumables and anti-hypertensive medication necessary for the management of patients with hypertension in PHC facilities in the Bushbuckridge sub-district between February and April 2014.

2. To determine if the management of hypertension by nurses in PHC facilities in the Bushbuckridge sub-district during the period from 01 June 2012 to 31 March 2014 was in line with recommendations set out in the 2011 South African Hypertension Guidelines

3. To measure the period prevalence of controlled hypertension in PHC facilities in the Bushbuckridge sub-district during the period from 01 June 2012 to 31 March 2014.

Chapter 2 MATERIALS AND METHODS

This chapter will describe the methods used in this study. Details of the study design, setting, scope and population will be provided. The data collection tools, data management and statistical analysis will be described. The study was conducted in two phases and this chapter will be outlined accordingly.

2.1 Study design

This study used an analytical cross-sectional study design composed of two parts:

A. An audit of primary health care facilities to assess the availability of the inputs necessary for the management of hypertension.

B. A retrospective record review of patients' clinical records to assess the process of care and health outcomes.

2.2 Study setting and scope

The study was conducted in the Bushbuckridge Local Municipality, which is one of five local municipalities within the Ehlanzeni District Municipality in Mpumalanga province. There are 135 villages in Bushbuckridge which are grouped into 34 municipal wards. According to the 2011 national census, Bushbuckridge had a population size of 541 248 with black Africans constituting 99.5% of the population (43).

Bushbuckridge is both a local municipality and a health sub-district. The Bushbuckridge health sub-district is managed by a sub-district manager. The Bushbuckridge sub-district has been further divided into seven local areas for administrative purposes. Each local area is under the supervision of a local area manager who is based at the health sub-district

office. Each local area has five to six primary health care (PHC) facilities. At the time of the study there were 38 PHC facilities in Bushbuckridge. Four of these were community health centres (CHC) and 34 were clinics (Appendix A).

The study site was chosen for a number of reasons. The principal investigator was doing her public health medicine rotation in Bushbuckridge at the time and therefore it was feasible for the study to be conducted in this sub-district. The principal investigator had engaged with other researchers in Bushbuckridge who had identified the lack of equipment and poor hypertension control as a problem in previous studies. Finally, Bushbuckridge was one of the pilot sites for the ICDM and it was an opportunity to assess the impact of this programme.

Part A of the study was an audit which was conducted in all 38 PHC facilities. This was an audit of the resources necessary for the management of patients with hypertension. The resources that were audited included medical equipment, consumables and essential anti-hypertensive drugs.

Part B of the study was a retrospective record review which was conducted in eight PHC facilities. Patients' clinical records were assessed to determine if the management of patients by the nurses was in line with the recommendations set out in the 2011 South African Hypertension Guidelines and to measure the prevalence of controlled hypertension.

This study was limited to the patients who attended the selected clinics in the study period and thus the findings of the study only apply to these patients and not those who did not attend or those who attended other clinics.

2.3 Study period

The audit of facilities was started at the beginning of February 2014 and was followed by a record review at the beginning of April 2014. All data collection was completed by the end of June 2014. A study period of 22 months was chosen to ensure that all patients would have attended the facility at least three times during the study period.

2.4 Study population and sampling method

Part A: Facility Audit

All 38 PHC facilities in Bushbuckridge were included in the facility audit.

Part B: Record review

The study population for the record review was all hypertensive patients who attended and had records kept at one of the 38 clinics between 01 April 2014 and 30 June 2014.

The following criteria for inclusion in the record review were applied:

- There was no ongoing research of a similar nature or on hypertension taking place during the period under review.
- Patient's clinical records were stored in the facility and available for review.

- The clinical records from 01 June 2012 to 31 March 2014 were available for review.

Out of a total of 38 facilities, only eight clinics met all of the above mentioned criteria. All eight facilities were included as the study sample. (Figure 2.1).

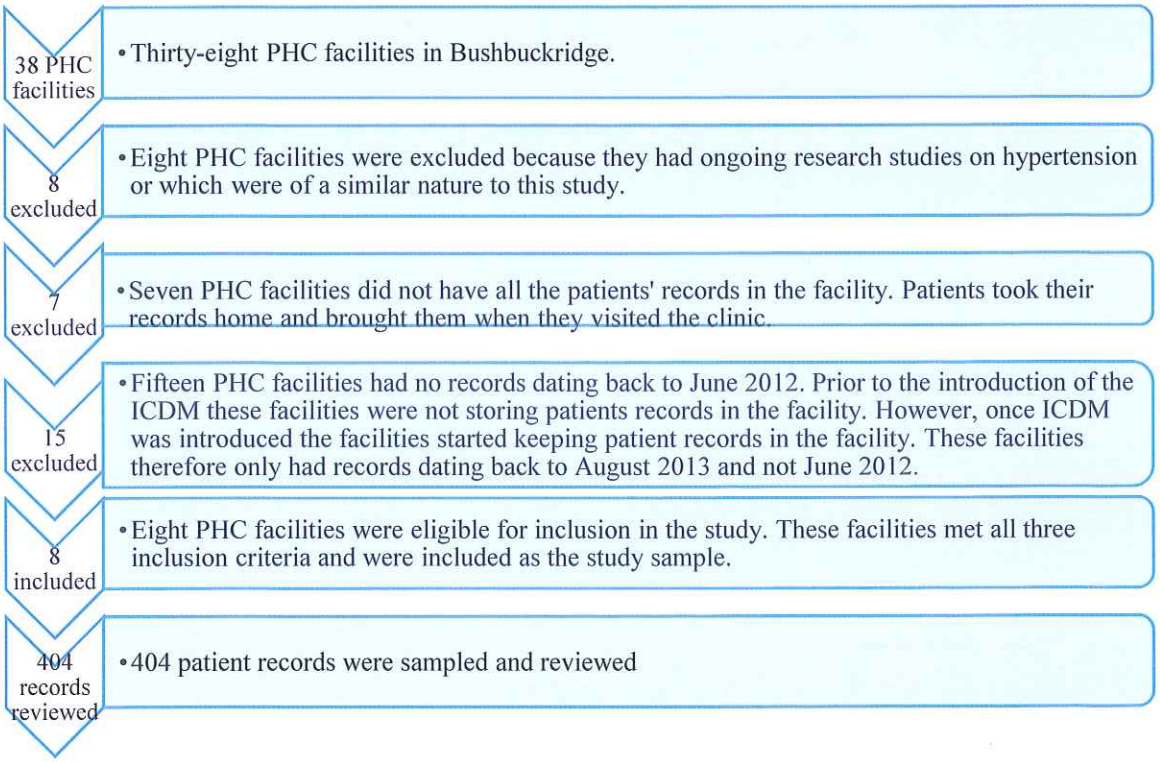


Figure 2.1Flow diagram of the facility selection process

A sample size was calculated to ensure that the sample was representative of the population and to allow for inferences to be made about the population in the Bushbuckridge sub-district. The sample size was calculated using a 5% margin of error with a confidence level of 95% for the entire Bushbuckridge population. The calculated

minimum required sample size was 369. To obtain this minimum sample size, a minimum of 50 records were sampled in each of the eight facilities.

Each facility kept an appointment register for all patients with chronic conditions including both communicable (excluding tuberculosis) and non-communicable diseases. The information captured on these registers included the name of the patient, file number, the chronic condition(s) that the patient has and the date of the next appointment. The records to be reviewed were sampled from the appointment registers for the first three months of 2014 (January to March) using a systematic sampling frame.

The number of hypertensive patients per facility was established during the facility audit. The minimum number of hypertensive patients per facility in the eight facilities was 200. Using the January to March appointment registers, every fourth hypertensive patient's record was sampled to ensure that a minimum of 50 records would be sampled at each facility. If the fourth patient on the register was not a hypertensive patient or if the record was missing, the following hypertensive patient on the record was sampled. There was oversampling of records at each facility in case some information in the records was missing or the patients had presented to the facility less than three times in 22 months for the management of hypertension. A total of 404 records were sampled.

The following criteria had to be satisfied for a record to be included:

- The patient was an adult male or a non-pregnant female aged 18 years and older.

- A patient had physically presented to the facility at least three times for consultation (also known as a review) for hypertension or for the collection of anti-hypertensive treatment during the period from 01 June 2012 to 31 March 2014. According to the guidelines, a patient whose blood pressure is well controlled can be seen every three to six months. This would have meant that each patient should have presented to the clinic a minimum of three times during the 22 month review period. Including only patients that had attended at least three times ensured that the patients with a controlled blood pressure were not missed.

2.5 Data collection

The principal investigator was responsible for the collection of data for both the facility audit and record review.

The principal investigator visited each facility for the audit after having informed the local area manager and the facility manager of the visit. The day before the visit, the principal investigator called the facility to confirm the appointment. Once all the facility audits were completed, the principal investigator returned to the eight facilities to conduct the record review. Once again the local area manager and the facility manager were informed telephonically of the visit the following day.

The clinical records were sampled from the appointment register by the principal investigator and retrieved from the filing room by a trained field worker. To ensure that the correct records were retrieved, the principal investigator helped the field worker retrieve the first five files. Each clinical record retrieved by the field worker was checked by the principal investigator to ensure that the patient name and number were correct.

2.5.1 Study tools

The 2011 South African Hypertension Guidelines and the 2008 Standard Treatment Guidelines and Essential Medicines List for Primary Health Care were used in the development of the data collection tools (15,17).

For part A of the study, the guidelines were used to develop a list of equipment, consumables and drugs necessary for the management of hypertension that should be available in PHC facilities. A facility audit tool was developed. (Appendix B). All equipment, consumables and medication had to be available in the facility on the day of the audit and had to be seen by the principal investigator. All observations were made by the principal investigator and recorded on the facility audit tool.

For part B of the study, the guidelines were used to decide which variables should be collected from the patients' clinical records. Data was extracted from the patients' records and recorded on a data extraction tool onsite (Appendix C).

The data extraction tool used for part B of the study was pre-tested in one of the facilities that was not eligible for inclusion in the record review to ensure that the data that was to be collected was routinely recorded by nurses. A total of fifteen records were selected using the same sampling method to be used in the study and reviewed to ensure that the data to be extracted was available in the patients' clinical records.

2.5.2 Study variables

Part A: Facility audit

Table 2.1 describes the variables collected and how each one was measured. Each item that was audited had to be available on the day of the audit and had to be produced upon request. If an object was not produced by the facility staff before the principal investigator left the premises, it was recorded as 'unavailable'.

Part B: Record review

The variables measured in the record review are described in Table 2.2. Six new composite variables were generated. These new variables and the formulae used to generate them are described in Table 2.3.

Table 2.1 Description of variables measured in the facility audit

Variable	Method of measurement
Facility type	The facilities were divided into two groups: • Community health centres (CHC) • Clinics
Availability of treatment guidelines for hypertension	The availability of at least one copy of the 2011 South African Hypertension treatment guidelines in the facility confirmed. If different guidelines were used, the name of the treatment guidelines was recorded.
Availability of health education material	The facility was checked for the following types of health education material: • Posters • Pamphlets • Audio-visual material (videos or audio tapes) • Any other type of health education material The posters, pamphlets and audio-visual material were not counted. The posters had to be placed on a surface were they were accessible for patients to read. The language used in each of these health education materials was recorded.
Consumables	The availability of the following consumables was confirmed: • Blood glucose test strips • Cholesterol test strips • Urinalysis test strips • Blood sample collection tubes (fluoride and serum coated) A consumable was available if a minimum of one unit (test strip or sample collection tube) of each consumable type was produced. The expiry dates of these items were not checked, nor was the number of units counted.
Anti-hypertensive drugs	Anti-hypertensive drugs were grouped into six groups according to their pharmaceutical mechanism of action. Aspirin was included as adjuvant therapy. The availability of stock of at least one drug in each group in the clinic pharmacy or medicines cupboard was confirmed. The individual drugs were not counted nor were the expiry dates checked. • Angiotensin converting enzyme inhibitor (ACE-I) • Beta-blocker • Calcium channel blocker (CCB) • Loop diuretic • Thiazide diuretic • Thiazide-like diuretic • Aspirin

Variable	Method of measurement
Equipment	
Sphygmomanometers • Quantity • Type • Functionality • Calibration date	The sphygmomanometers were counted and the type of device recorded. Functionality was assessed according to the type of sphygmomanometer: • Electronic (automated) devices were checked for the functionality of the on/off mechanisms. • Aneroid and mercury sphygmomanometers were assessed for functionality of the inflation and deflation mechanisms. Inflation was assessed by sealing the valve and pumping the pressure to 50 mmHg and observing the upward movement of the needle. Deflation was assessed by slowly opening the valve and allowing air to escape at a rate of 2 mmHg per second and observing the downward movement of the needle (44). A device was deemed dysfunctional if there was failure of one or more of these mechanisms. The date of the last calibration was recorded to check for evidence of calibration of all the sphygmomanometers within the preceding 12 months. The principal investigator looked for extra sphygmomanometers that were not being used and were stored away for use as a back-up in the event that one of the other sphygmomanometers became dysfunctional. This could have been new sphygmomanometers or old ones that were still functional.
Blood pressure cuffs • Quantity • Cuff size • General condition	The cuffs were counted. The cuff size was measured using a tape measure. The cuffs were grouped into two groups: standard/small (≤15 cm) and large (>15 cm and above) cuffs. The general condition of the cuff was assessed by inspecting for any wear and tear that resulted in the inability of the Velcro to stick properly. The condition of the cuff was 'good' if the Velcro stayed attached when the pressure in the cuff was increased 250 mmHg and 'poor' if it came loose at any pressure at or below 250 mmHg.
Weighing scales • Quantity • Type • Functionality • Calibration date	The scales were counted and the type of scale recorded. Functionality of the scale was assessed according to the type of scale: • Digital scales were checked for functionality of the on and off mechanisms and the appearance of a reading when a weight of a known mass was placed on the scale. • Analog scales were checked for the upward movement of the pointer when a weight of a known mass was placed on the scale. • Balance scales were checked for the up and down movement of the balance and its ability to remain in position when a weight of known mass was placed on the scale. A device was deemed dysfunctional if there was failure in any of the above mentioned mechanisms. The date of the last calibration was recorded to check for evidence of calibration within the previous 12 months. The principal investigator looked for extra scales that were not being used and were stored away for use as a back-up in the event that one of the other scales became dysfunctional. This could have been new scales or old ones that were still functional.

Variable	Method of measurement
Height stadiometers • Quantity • Functionality	The height stadiometers were counted and the type of stadiometer recorded. Functionality was assessed for the ability of the rod to remain in position once pulled up or dropped down (depending on resting position) to allow for a reading to be taken. A device was deemed dysfunctional if there was failure of this mechanism. The principal investigator looked for extra stadiometers that were not being used and were stored away for use as a back-up in the event that one of the other stadiometers became dysfunctional. This could have been new stadiometers or old ones that were still functional.
Measuring tape	The measuring tapes were counted.
Stethoscope	The stethoscopes were counted.
Blood glucose measuring device	The blood glucose measuring devices were counted. Functionality of these devices was assessed by switching on the device and observing that the device came on. If the device did not switch on or the message 'err' appeared the device was recorded as dysfunctional. Devices that did not have batteries were also considered dysfunctional.
Cholesterol measuring device	The blood cholesterol measuring devices were counted. Functionality of these devices was assessed by switching on the device and observing that the device came on. If the device did not switch on or the message 'err' appeared the device was recorded as dysfunctional. Devices that did not have batteries were also considered dysfunctional.

Table 2.2 Description of variables measured in the record review

Variable	Description
Age	Age at the beginning of data collection. This was calculated from the date of birth and the chronological age was captured in years.
Gender	Captured as recorded from the patient information sheet in the patient's record.
Number of visits made to the facility for hypertension management	Number of visits undertaken for consultation for hypertension or collection of antihypertensive drugs in a 22 month period. This excluded the visits when the patient did not physically present to the facility but sent someone to collect their medication. Visits for consultation for other ailments were excluded.
Presence of co-morbid diseases	The records were checked for any recorded co-morbid disease for which the patient was on chronic treatment. The co-morbid disease could have been diagnosed before or during the review period. The name of the disease was recorded and where this was not specified, the treatment that was prescribed was used to determine which other co-morbid diseases the patient was being treated for. Diabetes mellitus is an important co-morbid disease with a different target for blood pressure control. Specific investigations have to be performed in patients with both hypertension and diabetes mellitus. The outcome variable of blood pressure control was stratified according to the presence or absence of diabetes mellitus. Other important co-morbid diseases or complications in hypertensive patients are renal disease, congestive cardiac failure (CCF) and stroke. These conditions impact on the type of management that the patient will receive and in Bushbuckridge patients with these co-morbid diseases are treated by doctors at hospitals level. All other medical conditions that the patient was being treated for were grouped as 'other' as these did not impact on the manner in which the patient was managed. Examples of the conditions included under the "other" group were epilepsy, arthritis of any joint, psychiatric conditions, peptic ulcers, human immunodefiency virus (HIV) and gout.
Cardiovascular risk assessment done	Cardiovascular (CVD) risk assessment is done to determine how a patient should be managed and what treatment they should receive. Risk is expressed as a percentage (<10%, 10-20% and >20%). Although the guidelines specify that risk assessment should be done at diagnosis and every five years thereafter, the new PC101 guidelines that came into effect during the review period required that this be done in order to determine how the patient should be managed. Although this review did not look at when the patient was diagnosed, nor did the review period cover a five year period, it was expected that every patient would have had a risk assessment conducted at least once after the introduction of the new guidelines. The records were checked for a recorded CVD risk assessment that was performed at least once in the 22 month period. The principal investigator searched for the percentage of risk or words such as "low risk", "medium/moderate risk" and "high risk". One entry was accepted as evidence of CVD risk stratification having been performed.

Variable	Description
Anti-hypertensive drugs prescribed	The anti-hypertensive drugs prescribed at each visit were recorded. The anti-hypertensive drugs were grouped according to their mechanism of action into five drug classes in line with the groups used in the guidelines. The five drug classes were diuretics, ACE-Is, CCBs, beta blockers and centrally acting drugs. Although the centrally acting drugs were not part of the initial group of anti-hypertensive drugs that were to be analysed (not recommended for use by PHC nurses for the treatment of hypertension except in pregnancy), they were collected as some patients were still being given these drugs. The use of aspirin for the prevention of new or repeat stroke or myocardial infarction episodes in patients with diabetes and those with CVD risk greater than 10%, was captured as a separate variable from the drugs that were used for the primary control of hypertension. If a patient was on more than one drug within the class of drugs with the same pharmaceutical action, this was captured as a single drug class and not multiple drugs. Drugs that were in the form or a fixed dose pill that was composed of two or more drugs with different mechanisms of action were captured as separate drugs in the appropriate drug class.
Investigations done	Seven investigations that should be conducted annually are urinalysis, blood glucose, cholesterol, creatinine, potassium, microalbuminuria and electrocardiograph (ECG). It was expected that each investigation should have been performed at least once during the 22months. Evidence of any of these laboratory and point of care tests having been requested or collected at least once in the 22 month period was sought. Such evidence included a note of a blood sample having been collected and/or the laboratory results being recorded in the patient's file. The accepted blood glucose or cholesterol results were in the form of point of care finger prick tests or laboratory tests. Both the fasting and non-fasting blood glucose tests were accepted.
Clinical measurements done	Blood pressure, weight, abdominal circumference should be measured and body mass index (BMI) calculated at each visit. Height should only be measured once at the first visit as this is not expected to change in adults. The blood pressure (systolic and diastolic), weight, abdominal circumference and BMI recorded at each visit were captured as continuous variables. Each one of the five clinical measurements was a separate variable. In this review the height recorded at any of the visits within the 22 months was captured as this was not expected to be different from the height measured at the first visit.
Prescription completeness	At each visit, the anti-hypertensive drugs (excluding aspirin) that had been prescribed and recorded in the patients' records at the end of each visit were collected. If "out of stock" or "o/s" appeared near a drug, that drug was considered to have not been dispensed and thus the prescription incompletely filled. If there was a tick next to all the drugs or "out of stock" or "o/s" did not appear on the prescription the prescription was considered to be completely filled.

Table 2.3 Description of newly generated variables

Variable	Description
Hypertension control	A new variable called hypertension control was created using the following steps: • The average systolic blood pressure (SBP) was calculated by adding all the SBP readings for each patient and dividing the sum by the total number SBP measurements for each patient. • The average diastolic blood pressure (DBP) was calculated by adding all the DBP readings for each patient and dividing the sum by the total number DBP measurements for each patient. • The two average measurements were used as the patient's average blood pressure over 22 months. This average blood pressure over was used to calculate the 22month period prevalence of hypertension control. Hypertension control was defined using targets for hypertension control as defined by the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC7) (3). Hypertension was controlled if the mean SBP was ≤ 140 mmHg and the mean DBP was ≤90 mmHg in all patients except those with diabetes. For those with diabetes, hypertension was controlled if the mean SBP was ≤130 mmHg and the average DBP was ≤80 mmHg.
Frequency of normal blood pressure	This is the number of visits at which blood pressure was measured and found to be normal. A normal blood pressure is a SBP ≤140 mmHg and DBP ≤90 mmHg in all patients except those with diabetes, and a SBP ≤130 mmHg and a DBP ≤ 80 mmHg in diabetic patients. This was expressed as a percentage of the total number of blood pressure measurements taken. *No. of controlled blood pressures x100* *Total no. of blood pressure measurements*
Frequency of blood pressure measurement	This is the number of visits at which blood pressure was measured. This was expressed as a percentage of the total number of visits. *No. of blood pressure measurements x100* *Total number of visits*
Frequency of weight measurement	This is the number of visits at which weight was measured. This was expressed as a percentage of the total number of visits. *No. of weight measurements x100* *Total number of visits*
Frequency of abdominal circumference measurement	This is the number of visits at which abdominal circumference was measured, expressed as a percentage of the total number of visits. *No. of abdominal circumference measurements x100* *Total number of visits*
Frequency of calculation of BMI	This is the number of visits at which BMI was calculated, expressed as a percentage of the total number of visits. *No. of BMI calculations x100* *Total number of visits*
Frequency of prescription completeness	This is the number of visits at which the all the prescribed anti-hypertensive drugs were dispensed. *No. of complete prescriptionsx100* *Total number of visits*

2.6 Data management

The data from the paper based data collection tool was captured onto an electronic questionnaire created in the Epi Info™7.1.4 (2011 release) statistical program by two independent data capturers. The data capturers were trained prior to the data capturing process by the principal investigator on how to use the statistical programme and how to capture the data.

Checks and limits were set in the electronic questionnaire to ensure that incorrect was not captured. Double entry was performed on 200 records for quality control. At the end of each day, the principal investigator checked each copy of the data extraction tool and compared this to the data captured on the electronic dataset. The dataset was then cleaned by removing duplicates. The data was then exported onto a Microsoft® Excel 2013 (2012 release) spreadsheet. The responses were coded by the principal investigator before being imported into a Stata®13.1 (2013 release) database for analysis. All statistical analyses were performed by the principal investigator using both Microsoft® Excel 2013 and Stata®13.1.

2.7 Statistical analysis

2.7.1 Descriptive analysis

The descriptive analysis of the variables for Part A of the study was reported using frequencies and proportions. Availability of each item audited was dichotomised and coded 0='unavailable' and 1='available'. Functionality was dichotomised and coded 0='dysfunctional' and 1='functional'.

The descriptive analysis of the variables for Part B is described in Table 2.4. The distribution of continuous data was tested statistically for normality using the Shapiro-Wilk test and reported using the appropriate measure of central tendency and dispersion. Normally distributed continuous data was summarised using mean and standard deviation and skewed continuous data was summarised using median and interquartile range (IQR). Categorical data was reported as percentages.

Table 2.4 Variables used in the descriptive analysis of the record review

Variable	Unit of measurement or generation	Summary measure
Continuous variables		Mean (SD) or Median (IQR)
Age	Measured in years	
Number of visits	Count	
Categorical variables		Percentages
Gender	Dichotomised into 'male'=0 and 'female'=1	
CVD risk assessment	Dichotomised into 'not done'=0 and 'done'=1	
Blood pressure control	Dichotomised into 'uncontrolled'=0 and 'controlled'=1	
Prescription completeness	Dichotomised into 'incomplete'=0 and 'complete'=1	
Co-morbid diseases	Dichotomised into 'non-diabetic'=0 and 'diabetic'=1	
Investigations done	Five tests were analysed as individual variables. Each variable dichotomised into 'not done'=0 and 'done'=1.	
Number of anti-hypertensive drugs prescribed	Group variable with 5 groups coded 1 to 5 depending on the number of drug classes each patient was taking.	
Clinical measurements	Five clinical measurements were analysed as individual variables. Each variable dichotomised into 'not measured'=0 and 'measured'=1	
Frequency of blood pressure control	Grouped according to a 6 point frequency Likert scale (Table 5). 0= 'never', 1= 'very rarely', 2= 'rarely', 3= 'frequently', 4= 'very frequently' and 5= 'always'	
Frequency of blood pressure measurement	Grouped according to a 6 point frequency Likert scale (Table 5). 0= 'never', 1= 'very rarely', 2= 'rarely', 3= 'frequently', 4= 'very frequently' and 5= 'always'	
Frequency of weight measurement	Grouped according to a 6 point frequency Likert scale (Table 5). 0= 'never', 1= 'very rarely', 2= 'rarely', 3= 'frequently', 4= 'very frequently' and 5= 'always'	
Frequency of abdominal circumference measurement	Grouped according to a 6 point frequency Likert scale (Table 5). 0= 'never', 1= 'very rarely', 2= 'rarely', 3= 'frequently', 4= 'very frequently' and 5= 'always'	
Frequency of calculation of BMI	Grouped according to a 6 point frequency Likert scale (Table 5). 0= 'never', 1= 'very rarely', 2= 'rarely', 3= 'frequently', 4= 'very frequently' and 5= 'always'	
Frequency of prescription completeness	Grouped according to a 6 point frequency Likert scale (Table 5). 0= 'never', 1= 'very rarely', 2= 'rarely', 3= 'frequently', 4= 'very frequently' and 5= 'always'	

The new variables that were created were expressed as percentages using the formulae in Table 2.4. A six point frequency Likert scale was used to group the variable into categories (Table 2.5).

Table 2.5 Description of the Likert scales used in the assessment of the frequency of clinical measurements

Likert Scale	Percentage of visits where each measurement was recorded
0= Never	0%
1= Very rarely	1-24.9%
2= Rarely	25-49.9%
3= Frequently	50-74.9%
4= Very frequently	75-99.9%
5= Always	100%

The inputs, processes and outcome variables were then scored and facilities ranked according to the score. The maximum input score was 24.

- 1 point for each of the 9 functional equipment
- 1 point for each of the 5 consumables
- 1 point for each of the 7 anti-hypertensive drugs
- 1 point for the guidelines and educational material (total 3).

The facilities were then ranked according to the total inputs score from the highest to the lowest.

The processes were scored using a Likert scale in which the percentage of patients at each clinic who had had each clinical measurement, investigation and cardiovascular risk assessment done at the frequency recommended in the guidelines was scored. The following scale was used:

- 0-25% =1

- 26-50%=2,
- 51-75%=3 and
- 76-100% =4

Each of the 12 processes was scored from one to four using the scale above. The maximum score for the processes was 48. The facilities were ranked from the highest to the lowest. Similarly outcome was scored using the same Likert scale as above to score and rank the percentage of patients in each facility that had controlled hypertension. The total outcome score was 4.

A composite score was then used to score eight facilities on all the inputs, processes and outcomes. The total score was 76, and the facilities were ranked from the highest to the lowest.

2.7.2 Inferential statistics

Factors associated with uncontrolled hypertension were determined through inferential statistics. The outcome variable was hypertension control. The outcome of interest was 'uncontrolled hypertension' because this was a rare outcome in this study and therefore the odds ratio would approximate the risk ratio. The predictor variables were:

Patient related factors

i. Demographics (age and gender)
ii. Presence of co-morbid diseases
iii. Percentage CVD risk

Factors related to the management of hypertension

iv. Facility attended

v. Number of visits made to the facility for hypertension management

vi. Cardiovascular risk assessment done

vii. Number of anti-hypertensive drugs prescribed

viii. Number of investigations done in review period

ix. Frequency of weight measurement

x. Frequency of blood pressure measurement

xi. Frequency of abdominal circumference measurement

xii. Frequency of calculation of BMI

xiii. Frequency of prescription completeness

Associations between the predictor variables and the outcome were determined using Pearson's chi-squared test for categorical variables, Student t-test for normally distributed continuous variables and Mann-Whitney tests for non-normally distributed continuous variables. Associations were significant at the 5% level of significance ($p \leq 0.05$).

Logistic regression was used to assess the associations between predictor variables and the outcome and reported as unadjusted odds ratios. Multivariate logistic regression was performed to assess the factors associated with uncontrolled hypertension and reported as adjusted odds ratios. Adjusted and unadjusted odds ratios were reported with the corresponding 95% confidence interval. Associations were significant at the 5% level of significance ($p \leq 0.05$).

Some of the group variables (Tables 2.4 and 2.5) that had very few observations were regrouped and analysed as new groups in order to investigate significant associations between the outcome and predictor variables. The new groups were created as detailed below:

i. Age: was divided by ten to enable the analysis to be reported for every 10 year increase in age rather than every one year increase.

ii. Percentage CVD risk: < 10% and 10% to 20% risk were grouped together to form a group named ≤20% risk. The two groups that were analysed were: ≤20% and >20% CVD risk.

iii. Number of anti-hypertensive drugs prescribed: those on three or more drugs were grouped together. The three groups that were analysed were: one, two and three or more drugs.

iv. Number of investigations done: those who had four or more investigations done were grouped into one group. The five groups that were analysed were: none, one, two, three and four or more investigations.

v. Frequency of blood pressure measurement: the groups 'rarely' and 'frequently' were grouped together. The three groups that were analysed were 'rarely to frequently', 'very frequently' and 'always'.

vi. Frequency of weight measurement: the groups 'never', 'very rarely' and 'rarely' were grouped together. The groups 'frequently' and 'very frequently' were grouped together. The three groups that were analysed were: 'never to rarely', 'frequently to very frequently' and 'always'.

vii. Frequency of abdominal circumference measurement: the groups 'very rarely' and 'rarely' were grouped together. The two groups that were analysed were 'never' and 'very rarely to rarely'.

viii. Frequency of calculation of BMI: the groups 'very rarely' and 'rarely' were grouped together. The two groups that were analysed were 'never' and 'very rarely to rarely'.

ix. Frequency of prescription completeness: the groups 'rarely', 'frequently' and 'very frequently' were grouped together. The two groups that were analysed were: 'rarely to very frequently' and 'always'.

Multivariate logistic regression model was built using a forward selection method. The process followed in building the model is described below:

i. Testing if age and gender were confounders in the model. These were explored by looking at the reduction in the deviance by adding each potential confounder to a

model with only the constant (outcome). None of these variables were confounders in the empty model.

ii. As a result 14 predictor variables were added one at a time to this baseline model to assess their significance by looking at a reduction in the deviance. The reduction in deviance was confirmed by nesting a model with the baseline model and selecting the model with the lowest Aikaikes Information Criterion (AIC) as the best model.

iii. The predictor variables were again added one at a time to the best model selected in (ii) above and these models were nested against the best fitting model selected in (ii) and the AIC of the new models with an added variable were compared to the model selected in (ii). The model with the lower AIC was selected.

iv. These steps were repeated until the best fitting model was selected with six predictor variables which were presence of co-morbid diseases, age, risk assessment done, number of anti-hypertensive prescribed, frequency of blood pressure measurement and frequency of abdominal circumference measurement.

The best model was then used for the multivariate analysis. Gender was not included in the model as it was found not to be a confounder nor did it improve the model.

2.8 Ethical considerations

Ethics approval was obtained from the Human Research Ethics Committee of the University of the Witwatersrand (protocol reference number: M131149) (Appendix D).

Permission to expand the study period was later granted from the same ethics committee (Appendix E).

Permission to conduct the study was received from the Mpumalanga Department of Health Research and Ethics Committee (Appendix E). Meetings were held with the Bushbuckridge sub-district manager and a presentation was made to all clinic supervisors and facility managers to explain the nature and purpose of the study, and to seek further permission to access the facilities on specific days. On the day before a visit was to be conducted to a facility, the facility manager was informed of the visit by the local area manager. The facility manager was then presented with a copy of the ethics approval from the University of the Witwatersrand and the letter from the Mpumalanga Department of Health granting permission for the study at the time of the visit.

No primary data was collected directly from patients and therefore informed consent was not obtained from individual patients for the record review. Confidentiality was maintained through the use of unique codes for all facility and personal identifiers. Patient and facility identifiers were kept in a separate book under lock and key, separate from the data collection forms. All electronic data was coded and stored in password protected files. Only the principal investigator had access to this information.

The final research report will be shared with the participating facilities through the Mpumalanga Department of Health and the Bushbuckridge sub-district Health Office.

Chapter 3 RESULTS

This chapter will present the findings of this study. The findings of the facility audit will be presented first, describing the available resources such as equipment, consumables and drugs. A brief summary of the resources available in the eight facilities selected for the record review will be presented. This will be followed by the descriptive results which will focus on the process of care in terms of the clinical assessments, measurements and investigations done. Finally, the prevalence of hypertension control and factors associated with uncontrolled hypertension will be presented.

3.1 Part A: Facility audit results

A total of 38 PHC facilities were audited. Four of these facilities were community health centres and 34 were clinics. At the time of the audit, all the facilities were using PC 101 treatment guidelines for the management of all chronic conditions including hypertension. Copies of the PC101 and 2008 Standard Treatment Guidelines and Essential Medicines List for Primary Health Care guidelines were available in all facilities. None of the facilities had a copy of the 2011 South African Hypertension guidelines. All 38 facilities were ranked according to the availability of the inputs necessary for the management of hypertension (see Appendix H).

Printed health education material about hypertension was not found in any of the facilities. Four (10.5%) facilities had posters on lifestyle modification and the control of risk factors for cardiovascular diseases (not specifically hypertension). These posters were all in English. None of the facilities had audio-visual material or pamphlets that patients could take home.

In all 38 facilities, health education messages on hypertension were given to patients by nurses during talks to groups of patients in the waiting area on an ad hoc basis. These talks were presented in the three languages spoken locally, namely XiTsonga, Siswati and SePulane (a local variant of SePedi).

3.1.1 Equipment

The number of facilities that had each equipment type available on the day of the audit is presented in Table 3.1. Five (13.2%) facilities had all the equipment available. All the facilities had at least one functional sphygmomanometer, weighing scale, stethoscope, blood glucose measuring device and a blood pressure cuff. Two (5.3%) facilities did not have a small cuff and 27 (71.1%) did not have a large cuff. Thirty three (86.8) facilities did not have a cholesterol measuring device, six (15.8%) did not have a measuring tape and one (2.6%) did not have a height stadiometer. Stethoscopes were available in all 38 facilities. Thirty two (84.2%) facilities had a measuring tape.

Table 3.1 Total number of available and functional equipment in 38 facilities in the Bushbuckridge sub-district in 2014

Equipment	Total	No. of facilities that had a minimum of one of each equipment (%)	No. of functional equipment (%)
Sphygmomanometers	114	38 (100)	98 (86.0)
Blood pressure cuffs	116	38 (100)	98 (84.5)
Weighing scales	103	38 (100)	81 (78.6)
Height stadiometers	58	37 (97.4)	54 (93.1)
Glucose measuring devices	85	38 (100)	73 (85.9)
Cholesterol measuring devices	5	5 (13.2)	3 (60.0)

Figure 3.1 indicates the types of sphygmomanometers available and Figure 3.2 illustrates the types of weighing scales.

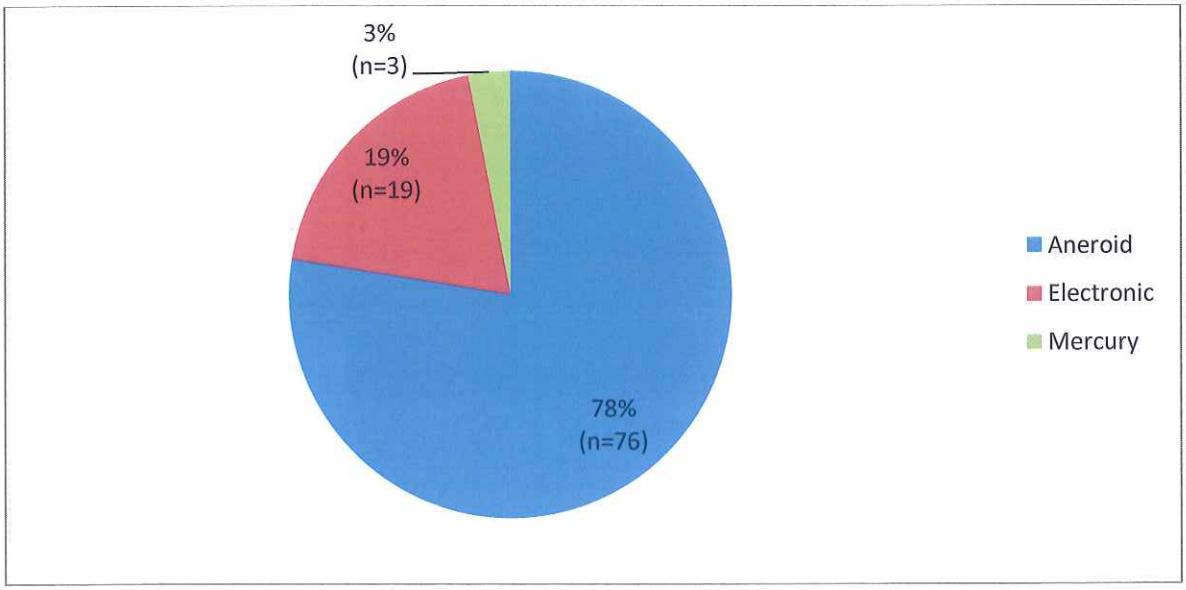


Figure 3.1 Functional sphygmomanometers by type in 38 facilities in the Bushbuckridge sub-district in 2014

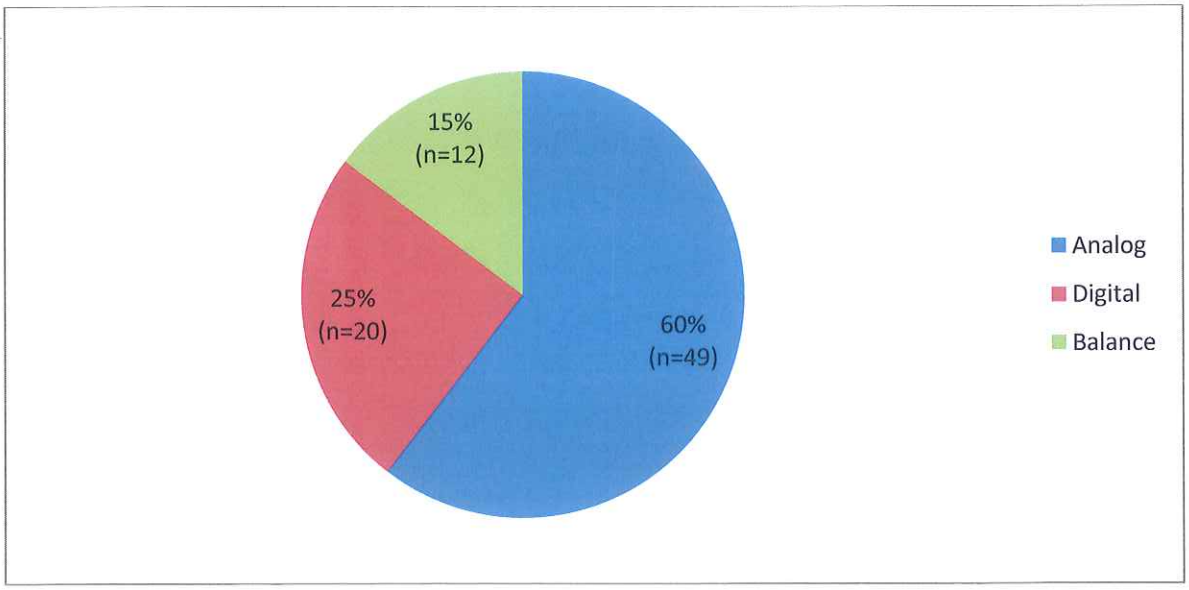


Figure 3.2 Functional weighing scales by type in 38 facilities in the Bushbuckridge sub-district in 2014

None of the sphygmomanometers, weighing scales or height stadiometers had been calibrated in the preceding 12 months. Sixteen (42.1%) facilities did not have extra sphygmomanometers, 36 (94.7%) did not have extra weighing scales, and none of the facilities had extra stadiometers to replace equipment that became dysfunctional.

3.1.2 Consumables

Table 3.2 provides a list of consumables that were audited and the number of facilities that had at least one unit of each type of consumable available and those that had none. None of the facilities had cholesterol test strips. None of the facilities had all the consumables available.

Table 3.2 Availability of consumables in 38 facilities in the Bushbuckridge sub-district in 2014

Consumables	Number of facilities that had the consumable (%)
Blood glucose test strips	36 (94.7)
Urinalysis test strips	37 (97.4)
Cholesterol test strips	0
Fluoride sample collection tubes	25 (65.8)
Serum sample collection tubes	35 (92.1)

3.1.3 Anti-hypertensive medication

Table 3.3 provides a list of anti-hypertensive drugs that were audited and the number of facilities that had at least one drug in each pharmacological group and those that had none.

Table 3.3 Availability of anti-hypertensive drugs in 38 facilities in the Bushbuckridge sub-district in 2014

Anti-hypertensive drug classes	Number of facilities that had at least one drug in this class (%).
Angiotensin converting enzyme inhibitor (ACE-I)	38 (100.0)
Calcium channel blocker (CCB)	37 (97.4)
Beta-blocker	37 (97.4)
Thiazide diuretic	38 (100.0)
Thiazide-like diuretic	38 (100.0)
Loop diuretic	34 (89.5)
Aspirin	27 (71.1)

Twenty four (63.2%) clinics had at least one packet of each of the anti-hypertensive drug classes available. Thiazide diuretics, thiazide-like diuretics and ACE-Is were available in all facilities. Eleven (28.9%) facilities did not have aspirin and four (10.5%) did not have loop diuretics. One facility did not have four of the drugs i.e. beta blockers, CCBs, loop diuretics and aspirin.

3.1.4 Summary of facility audit results in each of the eight facilities selected for the record review

A summary of the findings of the audit in the eight facilities selected for the record review is presented in the following Tables 3.4, 3.5 and 3.6. The number of functional equipment in each facility is shown in Table 3.4. The availability of consumables is shown in Table 3.5 and the availability of anti-hypertensive drugs are shown in Table 3.6. The 8 facilities were ranked according to the availability of inputs necessary for the management of hypertension (see Appendix I).

Table 3.4 Availability of functional equipment in 8 facilities in the Bushbuckridge sub-district in 2014

Equipment	Facility							
	A	B	C	D	E	F	G	H
Sphygmomanometers	3	3	5	1	2	2	2	2
Blood pressure cuffs								
Small (≤15cm)	3	2	2	1	2	2	3	2
Large (>15)	0	1	0	0	0	1	0	0
Weight scales	2	2	2	1	1	3	2	1
Height stadiometers	2	2	1	1	1	1	1	1
Measuring tapes	2	1	2	1	1	3	3	1
Stethoscopes	3	3	5	1	1	3	3	1
Blood glucose measuring device	1	3	1	1	1	1	2	2
Cholesterol measuring device	0	0	0	0	0	0	0	0

Table 3.5 Availability of consumables in 8 facilities in the Bushbuckridge sub-district in 2014

Consumables	Facility								%
	A	B	C	D	E	F	G	H	
Blood glucose test strips	Yes	Yes	Yes	Yes	Yes	Yes	**No**	Yes	87.5
Urinalysis test strips	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Cholesterol test strips	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	0
Fluoride sample collection tubes	Yes	Yes	**No**	**No**	Yes	Yes	Yes	**No**	37.5
Serum sample collection tubes	Yes	Yes	Yes	**No**	Yes	Yes	Yes	**No**	25

Table 3.6 Availability of anti-hypertensive drugs in 8 facilities in the Bushbuckridge sub-district in 2014

Anti-hypertensive drugs	Facility								%
	A	B	C	D	E	F	G	H	
Angiotensin converting enzyme inhibitor (ACE-I)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Calcium channel blocker (CCB)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Beta-blocker	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Thiazide diuretic	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Thiazide-like diuretic	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Loop diuretic	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Aspirin	**No**	Yes	Yes	**No**	**No**	Yes	Yes	**No**	50

3.2 Part B: Record review results

A total of 404 patients' records were reviewed in eight facilities. The majority of the patients were female (82.4%). The mean age was 66 years (SD ±11.8). The ages ranged from 30 to 96 years (Table 3.7). There was no difference in the mean ages of the males and females (p=0.487).

Table 3.7 Characteristics of hypertensive patients in Bushbuckridge sub-district in 2014

Variable	Males n (%)	Females n (%)	Total n (%)
	71 (17.6)	333 (82.4)	404 (100)
Age*			
Overall			
Mean	65.9 (SD±12.0)	67.0 (SD±10.8)	66.1 (SD±11.8)
Median	68 (IQR 59-74)	66 (IQR 58-75)	66 (IQR 58-74)
30-39	0	5 (1.5)	5 (1.3)
40-49	4 (5.6)	22 (6.7)	26 (6.5)
50-59	14 (19.7)	76 (23.0)	90 (22.4)
60-69	22 (31.0)	93 (28.2)	115 (28.7)
70-79	24 (33.8)	90 (27.3)	114 (28.4)
≥80	7 (9.9)	44 (13.3)	51 (12.7)

*Age was normally distributed

3.2.1 Number of visits made to the facility for the management of hypertension

The median number of visits to the facility was 17 (IQR 13-21) in the 22 month study period. The number of visits varied from facility to facility as the duration between appointments given was different at each of the clinics. Figure 3.3 shows the median number of visits at each facility.

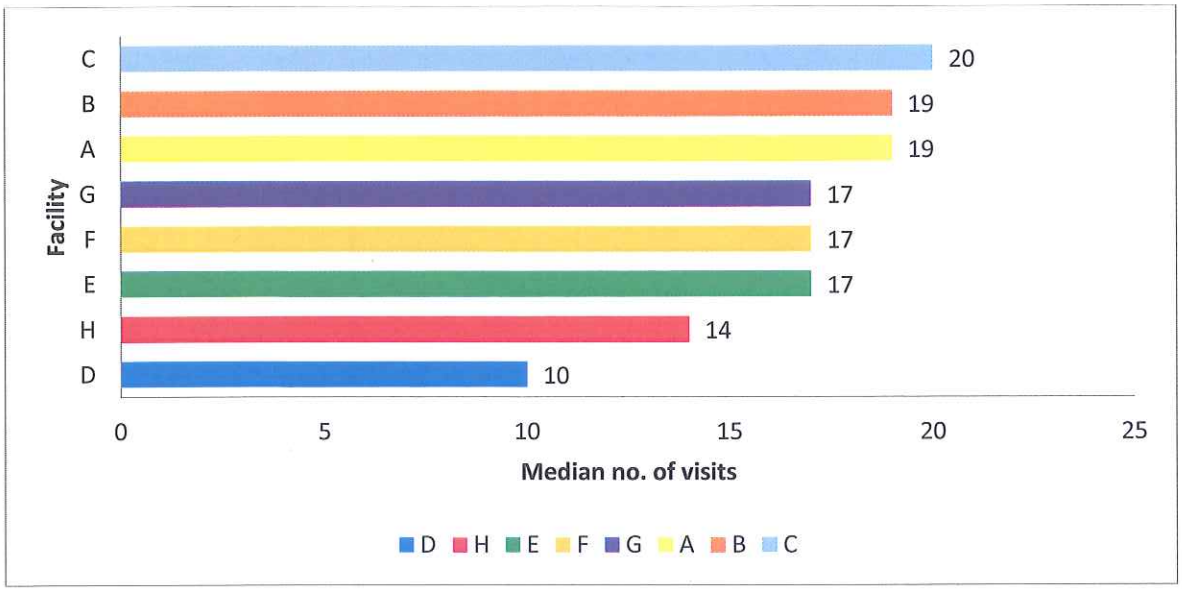


Figure 3.3 Median number of visits in 22 months at each facility in the Bushbuckridge sub-district from June 2012 to March 2014

3.2.2 Presence of co-morbid diseases and cardiovascular risk assessment

Seventy eight percent (n=315) of the patients did not have a co-morbid disease. Eighty nine (22%) patients had diabetes mellitus. None of the patients had other important co-morbid diseases such as kidney disease, congestive cardiac failure and stroke.

Forty four (10.9%) patients had at least one record of CVD risk assessment having been done during the 22 months. The level of risk was less than 10% for one patient, 10 to 20% for 26 patients, and greater than 20% for 17 patients.

Twenty eight (60.9%) of the 46 patients in whom cardiovascular risk assessment was recorded were in facility C and 13 (28.3) in facility E. None of the patients in facilities B, D or G had their cardiovascular risk assessment done.

3.2.3 Clinical measurements done

Blood pressure and weight measurements were recorded more frequently than abdominal circumference and body mass index (Table 3.8). Abdominal circumference was never measured in 329 (81.4%) patients and 277 (68.6) patients never had their BMI calculated. Two thirds of the patients (n=268) had their height measured at least once during the review period. The reason for not measuring blood pressure was not always recorded, but when it was, it was always dysfunctional sphygmomanometers or cuffs. This reason was given at 4.8% of the total visits in this review. No reason was given for the rest of the visits at which blood pressure was not measured.

Table 3.8 Frequency of clinical measurements done on hypertensive patients in the Bushbuckridge sub-district from June 2012 to March 2014

Frequency of measurements	Blood pressure	Weight	Abdominal circumference	Body mass index
Never	0	7 (1.7)	329 (81.4)	277 (68.5)
Very rarely	0	3 (0.7)	72 (17.8)	113 (28.0)
Rarely	3 (0.7)	5 (1.2)	3 ()0.7	14 (3.5)
Frequently	34 (8.4)	11 (2.7)	0	0
Very frequently	179 (44.3)	179 (44.3)	0	0
Always	188 (46.5)	199 (49.3)	0	0

Figure 3.4 shows the number of patients in each facility who had at least one record of abdominal circumference and BMI. Seventy of the 75 patients who had their abdominal circumference measured were in facilities C and D. None of the patients in facilities A, B, F and G had their abdominal circumference measured. Two thirds of the patients who had their BMI calculated were in facilities C and D. None of the patients in facility B had their BMI calculated throughout the review period.

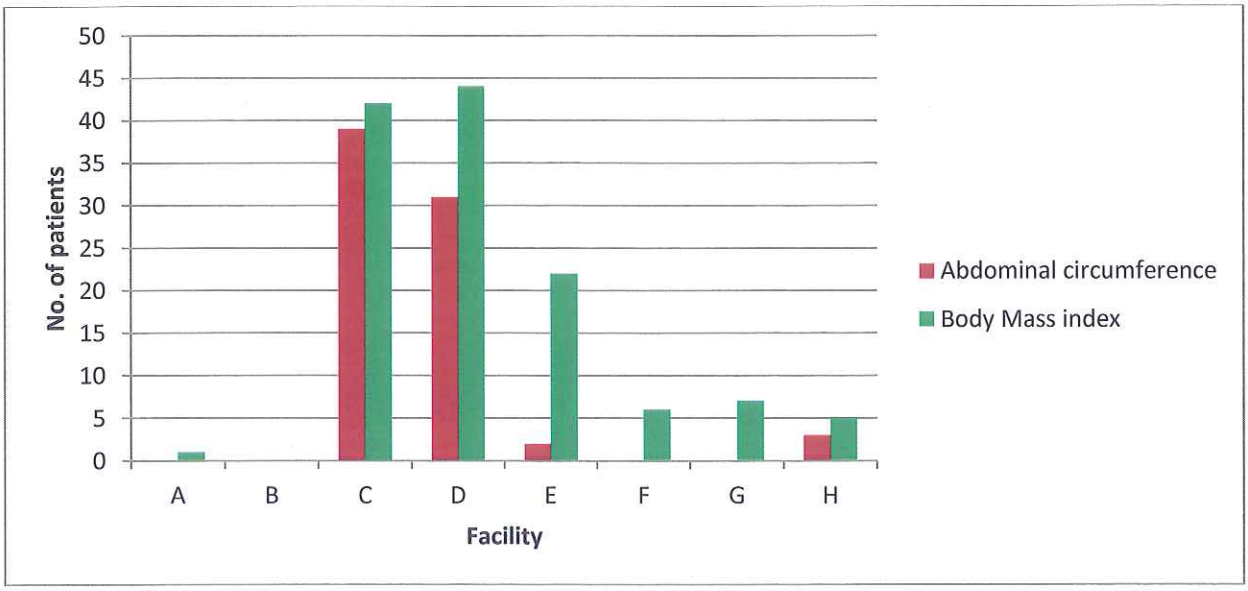


Figure 3.4 Number of hypertensive patients in each facility in the Bushbuckridge sub-district that had at least one abdominal circumference and body mass index recorded from June 2012 to March 2014

3.2.4 Investigations done

Out of the seven tests that should have been performed at least once in the 22 months, only five were done at all in the clinics. None of the patients in any of the eight facilities had a micro-albuminuria test or an electrocardiograph (ECG) done and there was no evidence of the patients having been referred to hospital for these tests.

Table 3.9 list the five tests and the number of patients who had each test done at least once in the review period. Figure 3.5 shows the percentage of patients who had a specific number of the recommended tests during the review period. Twenty five (6.2%) patients had none of the tests done. Three (3.4%) of the diabetic patients did not have their blood glucose levels measured at any point during the 22 months.

Table 3.9 Laboratory and point of care investigations done at least once on hypertensive patients in the Bushbuckridge sub-district from June 2012 to March 2014

Laboratory and point of care test	Number of patients (%) (n=404)
Urinalysis	352 (87.1)
Blood glucose	302 (74.7)
Creatinine	77 (19.0)
Cholesterol	61 (15.1)
Potassium	8 (2.0)

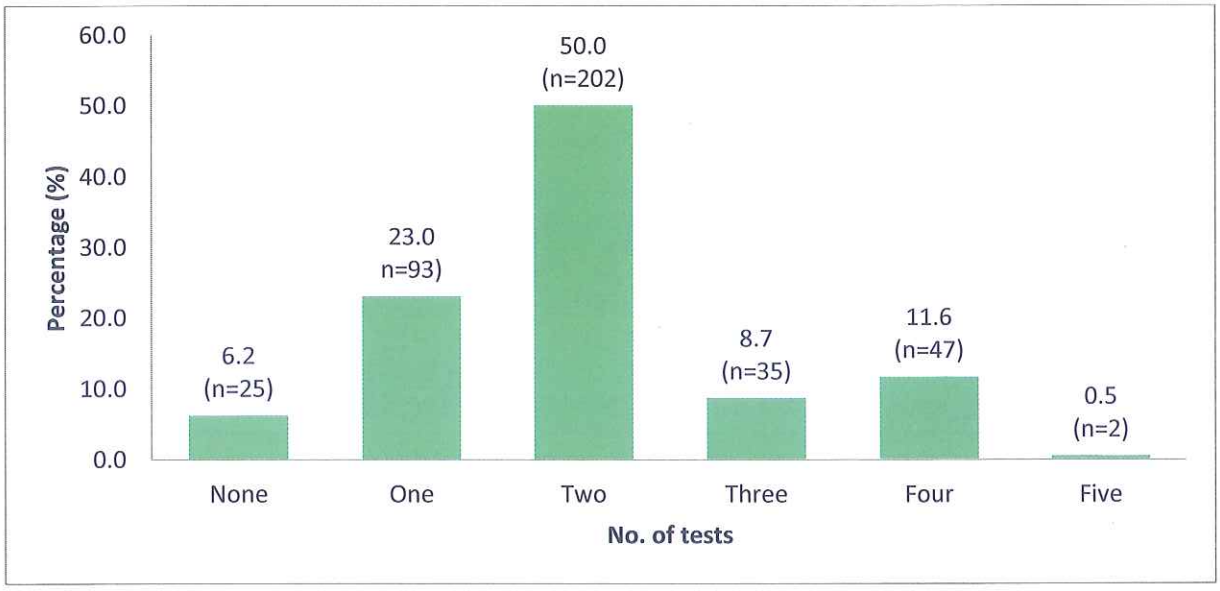


Figure 3.5 Percentage of hypertensive patients who had a number of investigations from June 2012 to March 2014

Whether or not a patient would have a test done depended on the facility in which the patient was being treated (Figure 3.6). None of the patients in facilities A, E or G had a creatinine tests done, while 69 (89.6%) of the 77 patients who had a creatinine test were in facilities C and D. Of the 61 patients who had at least one cholesterol test done, 46 (75.4%) were in facility D. None of the patients in facilities B or E had a cholesterol test done.

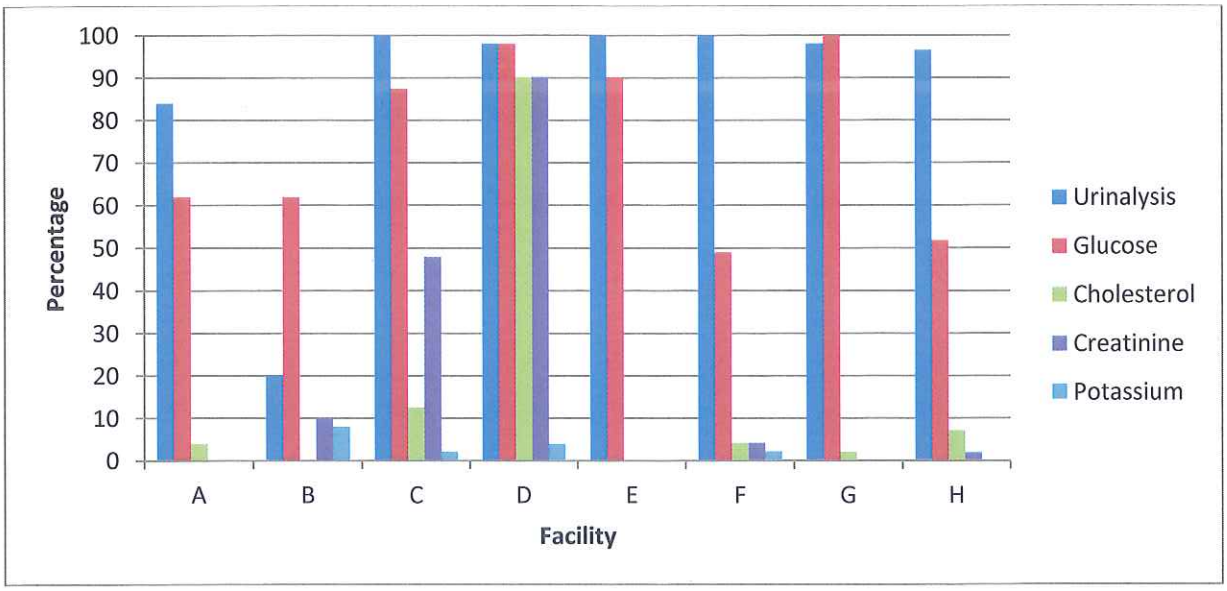


Figure 3.6 Investigations done on hypertensive patients in each facility in the Bushbuckridge sub-district from June 2012 to March 2014

3.2.5 Anti-hypertensive drugs prescribed and frequency of prescription completeness

According to the guidelines, the three important first line anti-hypertensive drugs for uncomplicated essential hypertension are diuretics, ACE-Is and CCBs. Table 3.10 shows the number of patients on each drug. Seventy nine percent of the patients were on two or more different anti-hypertensive drug classes either as single drugs or as fixed dose combination. Four patients were on a fourth line centrally acting drug.

Table 3.10 Number of patients on each anti-hypertensive drug class in the Bushbuckridge sub-district from June 2012 to March 2014

Drug class	Number of patients (%) n=404
Diuretic	386 (95.5)
Angiotensin converting enzyme inhibitor (ACE-I)	256 (63.3)
Calcium channel blocker (CCB)	132 (32.6)
Beta-blocker	78 (19.3)

According to the guidelines, aspirin should be prescribed as adjuvant therapy for patients with CVD risk of more than ten percent and those with diabetes, once their blood pressure is well controlled. Of the 89 patients who were diabetic, 57 (64%) were on aspirin although only 14 (24.6%) of these had a controlled blood pressure. Of the 43 patients who had a CVD risk of more than ten percent, 14 were on aspirin, although only nine had a controlled blood pressure.

Table 3.11 shows the frequency of visits at which the patients received all the prescribed anti-hypertensive drugs. Seventy percent of the patients received all the prescribed anti-hypertensive drugs at all their visits. However, the number of patients who received all the prescribed drugs at all their visits drops to 48.3% if the adjuvant therapy, aspirin, was prescribed and not dispensed.

Table 3.11 Frequency of prescription completeness from June 2012 to March 2014

Frequency of prescription completeness	Number of patients (%) who received all the prescribed anti-hypertensive drugs	Number of patients (%) who received all the prescribed drugs (both antihypertensive plus adjuvant therapy)
Never	0	0
Very rarely	0	0
Rarely	1 (0.3)	1 (0.3)
Occasionally	2 (0.5)	25 (6.2)
Very frequently	117 (29.0)	183 (45.3)
Always	284 (70.3)	195 (48.3)

The drugs that were most often out of stock were aspirin, CCBs, diuretics and ACE-Is respectively.

The eight facilities were ranked according to a score on all process variables (see Appendix J).

3.2.5 Hypertension control

The period prevalence of controlled hypertension over the 22 months was 61.4% (n=248; 95% CI 56.4-66.2). However, the period prevalence of controlled hypertension was lower in those who were diabetic compared to those who did not have diabetes (Table 3.12).

Table 3.12 Percentage of patients with controlled hypertension in the Bushbuckridge sub-district in 2014

	Total	Controlled hypertension n (%)	95% confidence Interval
All patients	404	248 (61.4)	56.4-66.2
Males	71	37 (52.1)	39.9-64.1
Females	333	211 (63.4)	57.9-68.5
Diabetic patients	89	25 (28.1)	19.1-38.6
Non-diabetic patients	315	223 (70.8)	65.4-75.8

Seventy one percent of the patients had a normal blood pressure at the last visit. Table 3.13 shows the frequency of normal blood pressure. This is the percentage of visits at which the patients' blood pressure was found to be normal. Thirty five (8.7%) patients had a normal blood pressure at every visit and two (0.5%) patients never had a normal blood pressure at any of their visits during the review period. These two patients had visited the facility 17 and 24 times respectively and had their blood pressure measured on 100% and 92% of the visits respectively.

Table 3.13 Frequency of normal blood pressure in hypertensive patients in the Bushbuckridge sub-district from June 2012 to March 2014

Percentage visits where blood pressure was normal	Number of patients (%)
Never	2 (0.5)
Very rarely	32 (7.9)
Rarely	90 (22.3)
Frequently	132 (32.7)
Very frequently	113 (28.0)
Always	35 (8.7)

The percentage of patients with controlled hypertension ranged from 43.8% to 84% across the eight facilities (Figure 3.7)

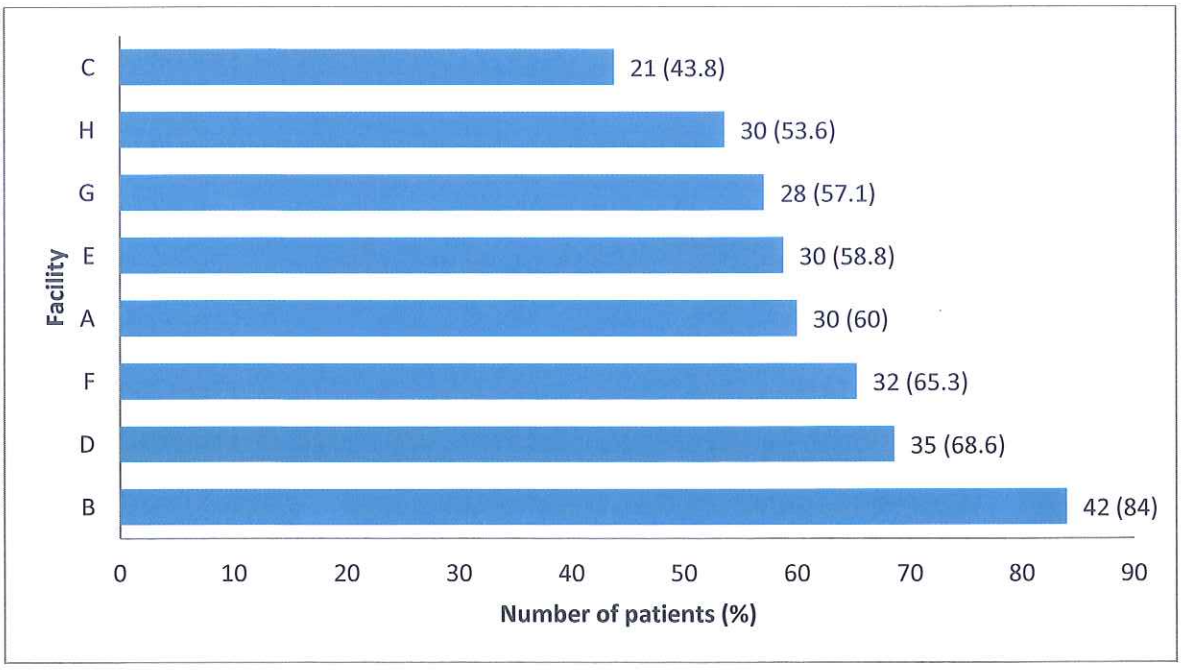


Figure 3.7 Number of patients with controlled hypertension in 8 PHC facilities in the Bushbuckridge sub-district in 2014

Table 3.14 shows the eight facilities ranked according to a score on the inputs, processes and outcomes. Facilities C and D scored the highest overall, and facility A and H scored the lowest.

Table 3.14 Facilities in the Bushbuckridge sub-district ranked according to inputs, processes and outcome score

Facility	Inputs score (24)	Processes score (48)	Outcome score (4)	Total (76)
C	18	31	2	**51**
D	17	31	3	**51**
B	20	25	4	**49**
F	20	24	3	**47**
G	18	26	3	**47**
E	18	22	3	**43**
A	18	21	3	**42**
H	16	23	3	**42**

3.2.6 Factors associated with uncontrolled hypertension

The results of the bivariate analysis (Pearson Chi, Mann Whitney and Student t-tests) are shown in Table 3.15. The factors that were found to be significantly associated with uncontrolled hypertension were:

- Presence of co-morbid diseases
- Number of visits made to the facility for the management of hypertension
- Number of investigations done
- Number of anti-hypertensive drug prescribed
- Facility attended
- Frequency of blood pressure measurement
- Frequency of weight measurement and
- Frequency of prescription completeness

Age, gender, cardiovascular risk assessment being done or not done, percentage CVD risk, frequency of calculation of BMI and frequency of abdominal circumference measurement were not significantly associated with uncontrolled hypertension.

Table 3.15 Bivariate analysis of factors associated with uncontrolled hypertension in hypertensive patients in the Bushbuckridge sub-district in 2014

Variable		Controlled n (%)	Total	p-value
Age[$]		246 (61.4)	401	p=0.324
Gender				p=0.077
	Male	37 (14.9)	71	
	Female	211 (85.1)	333	
Number of visits made to the facility for the management of hypertension		248 (61.4)	404	p<0.001*
Presence of co-morbid diseases				p<0.001*
	Diabetic	25 (10.1)	89	
	Non-diabetic	223 (89.9)	315	
Cardiovascular risk assessment done				p=0.173
	Not done	224 (90.3)	360	
	Done	24 (9.7)	44	
Percentage CVD risk (n=44)				p=0.583
	≤20%	15 (65.2)	27	
	>20%	8 (34.8)	17	
Number of investigations done				p<0.001*
	0	22 (8.9)	25	
	1	72 (29.0)	93	
	2	106 (42.7)	202	
	3	14 (5.7)	35	
	4 and more	34 (13.7)	49	
Number of anti-hypertensive drugs prescribed				p<0.001*
	1	71 (28.6)	85	
	2	126 (50.8)	193	
	3 and more	51 (20.6)	125	
Facility attended				p=0.005*
	A	30 (12.1)	50	
	B	42 (16.9)	50	
	C	21 (8.5)	48	
	D	35 (14.1)	51	
	E	30 (12.1)	51	
	F	32 (12.9)	49	
	G	28 (11.3)	49	
	H	30 (12.1)	56	
Frequency of blood pressure measurement				p=0.013*
	Rarely to frequently	27 (10.9)	37	
	Very frequently	96 (38.7)	179	
	Always	125 (50.4)	188	
Frequency of weight measurement				p=0.015*
	Never to rarely	6 (2.4)	15	
	Frequently to very frequently	107 (43.2)	190	
	Always	135 (54.4)	199	
Frequency of abdominal circumference measurement				p=0.288
	Never	206 (83.1)	329	
	Very rarely to rarely	42 (16.9)	75	
Frequency of calculation of body mass index				p=0.993
	Never	170 (68.6)	277	
	Very rarely to rarely	78 (31.5)	127	
Frequency of prescription completeness				p=0.009*
	Rarely to very frequently	62 (25.0)	120	
	Always	186 (75.0)	284	

n equals 404 unless otherwise specified
*Statistically significant at the 5% level

Table 3.16 shows the unadjusted and adjusted odds ratios of factors associated with uncontrolled hypertension. Diabetic patients were six times more likely to have uncontrolled hypertension than non-diabetics and this was statistically significant (unadjusted OR 6.2; 95% CI 3.7-10.5; p<0.001). Patients who had their blood pressure measured 'very frequently' were twice as likely to have uncontrolled hypertension (unadjusted OR 2.3; 95% CI 1.1-5.1; p=0.034).

Patients in facility B were 71% less likely to have uncontrolled hypertension compared to patients in facility A, and this was statistically significant (unadjusted OR 0.3; 95% CI 0.1-0.7; p=0.009). Patients who always had their prescription completed fully were 44% less likely to have uncontrolled hypertension than those who did not (unadjusted OR 0.6; 95% CI 0.4-0.9; p=0.009).Patients who always had their weight measured were 68% less likely to have uncontrolled hypertension than those who rarely or never had their weight measured (unadjusted OR 0.3; 95% CI 0.1-0.9; p=0.036).

Factors that were significantly associated with uncontrolled hypertension on multivariate analysis were the presence of co-morbid diseases and the number of anti-hypertensive drugs prescribed. Diabetic patients were ten times more likely to have uncontrolled hypertension than non-diabetics and this was statistically significant (adjusted OR 9.6; 95% CI 5.1-17.8, p-value <0.001). Patients who were on two or three and more anti-hypertensive drug classes were five and 13 times (respectively) more likely to have uncontrolled hypertension compared to those on one anti-hypertensive drug and this was statistically significant (adjusted OR 4.5; 95% CI 2.1-9.8; p<0.001) (adjusted OR 12.8; 95% CI 5.7-29.0; p<0.001).

Age, whether CVD risk assessment had been done, the frequency of blood pressure measurement and the frequency of abdominal circumference measurement were not found to be significantly associated with uncontrolled hypertension in the adjusted model. Gender was found not to be a confounder (results not shown).

Table 3.16 Univariate and multivariate analysis of factors associated with uncontrolled hypertension in hypertensive patients in the Bushbuckridge sub-district in 2014

Variable	Unadjusted odds ratios		Adjusted odds ratios	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Age[#]	1.1 (0.9-1.3)	0.323	1.1(0.9-1.3)	0.473
Number of visits made to the facility for the management of hypertension	1.1 (1.1-1.2)	<0.001*		
Gender				
Male	1			
Female	0.6 (0.4-1.1)	0.079		
Presence of co-morbid disease				
Non-diabetic	1		1	
Diabetic	6.2 (3.7-10.5)	<0.001*	9.6 (5.1-17.8)	<0.001*
Cardiovascular risk assessment done				
Not done	1		1.2 (0.5-2.9)	0.637
Done	1.5 (0.8-2.8)	0.175		
Percentage CVD risk*				
≤20%	1			
>20%	1.4 (0.4-4.8)	0.583		
Facility attended				
A	1			
B	0.3 (0.1-0.7)	0.009*		
C	1.9 (0.8-4.3)	0.109		
D	0.7 (0.3-1.6)	0.366		
E	1.1 (0.5-2.3)	0.904		
F	0.8 (0.4-1.8)	0.586		
G	1.1 (0.5-2.5)	0.773		
H	1.3 (0.6-2.8)	0.505		
Number of anti-hypertensive drugs prescribed				
1	1		1	
2	2.7 (1.4-5.1)	0.003*	4.5 (2.1-9.8)	<0.001*
3 and more	7.4 (3.7-14.5)	<0.001*	12.8 (5.7-29.0)	<0.001*
Number of investigations done				
0	1			
1	2.1 (0.6-7.9)	0.252		
2	6.6 (1.9-22.9)	0.003*		
3	11.0 (2.8-43.9)	0.001*		
4 and more	3.2 (0.8-12.5)	0.088		
Frequency of weight measurement				
Never to rarely	1			
Frequently to very frequently	0.5 (0.2-1.5)	0.228		
Always	0.3 (0.1-0.9)	0.036*		
Frequency of blood pressure measurement				
Rarely to frequently	1		1	
Very frequently	2.3 (1.1-5.1)	0.034*	2.1 (0.8-5.6)	0.148
Always	1.4 (0.6-3.0)	0.442	1.2 (0.5-3.3)	0.675
Frequency of abdominal circumference measurement				
Never	1		1	
Very rarely to rarely	1.3(0.8-2.2)	0.289	1.8 (0.9-3.9)	0.126
Frequency of calculation of body mass index				
Never	1			
Very rarely to rarely	1.0 (0.7-1.5)	0.993		
Frequency of prescription completeness				
Rarely to very frequently	1			
Always	0.6 (0.4-0.9)	0.009*		

[#] Every ten year increase in age
*Statistically significant at the 5% level

Chapter 4 DISCUSSION

The discussion will focus on linking the inputs, processes and outcome. Findings will be discussed in light of other published studies. Finally the chapter will end with a discussion of some of the limitations of this study.

4.1 Discussion

The aim of this study was to evaluate the clinical management of hypertension in PHC facilities in the Bushbuckridge sub-district. This study found that the facilities in Bushbuckridge were well equipped with the minimum equipment, consumables and drugs required to manage hypertension. Although all facilities had treatment guidelines for the management of hypertension, nurses' management of patients was not always in line with these guidelines. Nurses in different facilities were selective in terms of which elements of the guidelines they followed and which ones they did not follow. This study found a period prevalence of controlled hypertension of 61.4% (95% CI 56.4-66.2) over 22 months, however, the period prevalence in those with co-morbid diabetes was much lower at 28.1% (95% CI 19.1-38.6) over the same period. Co-morbid diabetes and being on more than one antihypertensive drug are factors that were found to be significantly associated with uncontrolled hypertension.

4.1.1 Part A: Facility audit

The first part of the study was designed to look at the inputs required for the management of hypertension. At the time of audit, none of the facilities had a copy of the 2011 South African Hypertension Guidelines. However, all the facilities had a copy of the PC101

guidelines. The PC101 guidelines for the management of hypertension do not differ from the 2011 South African Hypertension Guidelines.

There was a notable scarcity of patient education material in the facilities. Posters that provided information about risk factors for cardiovascular disease were found in only ten percent of the facilities and none of these posters provided information on hypertension. Facility managers did say that the reason for the absence of posters was that, during the roll out of ICDM, they were instructed to remove posters from the walls because they posed an infection control risk. Some facilities had notice boards mounted on the walls in the consulting rooms and the waiting areas but these were only used to display letters from the district office and other notices. The few posters that were available were all on lifestyle modification and risk factor control and they all written in English. This presents a potential language barrier to the message reaching the intended audience because the majority of the people in the community speak XiTsonga, SePulane (a variant of SePedi) and Siswati (43). Similar findings were described by Daniels et al. who found that, in CHCs in the Western Cape, education material was not appropriate for the cultures and communities being served by those facilities (38). In Bushbuckridge, health education was provided by nurses, in locally spoken languages to groups of patients in the waiting areas in the mornings on an ad hoc basis. Nurses reported giving counselling on specific lifestyle modification strategies to individual patients during their consultation. This could not be verified as the principal investigator did not observe individual consultations and the individual patient risk factors such as whether they smoked, were obese, had a family history of early onset of cardiovascular disease etc. were not recorded in the patients' files.

All eight facilities had the equipment required to measure blood pressure. Although all facilities had at least one sphygmomanometer, more than 70% of the facilities did not have blood pressure cuffs large enough to accurately measure blood pressure in overweight and obese patients and two facilities only had large cuffs. The shortage of large cuffs in PHC facilities in the Bushbuckridge sub-district is not a new problem. In 2006, Connor et al. found that only one of the six facilities they audited had a large cuff (37). This has implications for the accuracy of the measurements of blood pressure because the use of inappropriately sized cuffs has been reported to result in the over or underestimation of blood pressure (3,17,44).

Equipment and consumables necessary for diagnosing co-morbid diseases and monitoring complications of hypertension were available in almost all facilities. Inexpensive equipment, such as measuring tapes, were unavailable in some facilities. The unavailability of cholesterol measuring devices and tests strips possibly explains why cholesterol levels were not measured.

On the whole, the equipment that was available was functional. None of the equipment had, however, been calibrated and this raises questions about the accuracy of the functional equipment. There was a lack of extra equipment that could serve as a backup for equipment that became dysfunctional. In 2006, Connor et al found that dysfunctional equipment and unavailability of extra equipment in facilities was common (37). In facilities that had only one of each type of equipment, the lack of back up equipment could lead to delays in getting equipment delivered to the facility from the district office or neighbouring clinics because of the great distances between facilities in Bushbuckridge

and the poor road infrastructure. This study highlighted that a number of patients in this study left the facility without having their blood pressure measured due to problems with equipment. This has an impact on the quality of care.

The lack of certain consumables and equipment might explain why some clinical measurements and investigations were not performed by the nurses. Therefore, the possibility that a proportion of patients with co-morbid diseases and early complications may have presented to the facility and gone undiagnosed or undetected cannot be excluded.

Antihypertensive medication was available in the facilities with two thirds of the facilities having at least one drug in each anti-hypertensive drug class. . The one drug that was found to be out of stock in almost 30% of the facilities was aspirin. Although the lack of aspirin would not have affected the control of blood pressure, the prevention of complications such as strokes was likely to have been compromised.

The findings of the audit revealed that the facilities in Bushbuckridge were well equipped to manage hypertension. However, because the period covered by the facility audit and the record review are different, the availability of the resources as shown by the findings of the facility audit are not reflective of the availability of the resources for the most part of the 22 month review period. In fact, all the facilities in Bushbuckridge were supplied with new sphygmomanometers and glucose measuring devices when ICDM was rolled out in August 2013. The introduction of ICDM and PC 101 did not significantly change the drugs used in the management of hypertension or the clinical measurements and investigations that

should be done as part of routine care. Therefore, there is no reason why the availability of equipment should have been any different in the 22 months of this review.

Given that the facility audit and the record review were done at different times, and the audit only covered a portion of the review period, the availability of resources was therefore not included as predictor for hypertension control in the logistic regression.

4.1.2 Part B: Record review

Women made up a large proportion of the sample in this study. However, there was no difference between men and women with regards to the prevalence of hypertension control. Some studies have found that hypertension is more common in women, and this would explain why a large proportion of patients in this study were women (10,11,28–30). Previous studies have found gender differences in the prevalence of control (10,21,29,45,46).

In this study the prevalence of hypertension control was measured using the mean blood pressure over the review period. The overall prevalence of controlled hypertension in this study was high at 61.4%. Other studies have used the blood pressure at only one sitting and not over time. In this study, if only one blood pressure measurement is assessed, i.e. the blood pressure at the last visit, the 2014 point prevalence of hypertension control is 71.5% (95% CI 66.9-75.9). Therefore, using both methods of calculating hypertension control (i.e. point and period prevalence), the prevalence found in this study is higher than that which has been reported in both national population surveys and facility based studies (22–

24,28–30,45,46). The high prevalence in this study is similar to the 61.2% prevalence that was reported by Rayner et al. in patients who were treated in private practices (11).

The difference in the prevalence depending on how hypertension control is measured raises questions about the accuracy of how the prevalence of hypertension control is measured in different studies. The mean blood pressure over time was used to determine hypertension control because it was expected that blood pressure would vary from visit to visit and thus the mean would be a better estimate of blood pressure control rather than just using the average of two or three blood pressure readings at one sitting as has been done in other studies (10,28,30). The assumption that there would be variations in blood pressure over time was supported by the finding that only 8.7% of the patients had a normal blood pressure at every visit during the 22 months.

This study did not further investigate the visit to visit variability in blood pressure measurement, which might have been a better indication of hypertension control. Evidence does suggest that what is important in the management of hypertension is the short term (day to day) and long term (visit to visit) variability of blood pressure as this is an important prognostic factor for the development of cardiovascular complications (47–49). Measuring blood pressure at one sitting to determine prevalence of hypertension control is inadequate.

There are a number of reasons why the prevalence of hypertension control may be higher than in other studies. The first reason could be that the introduction of ICDM resulted in improved control of hypertension. The aim of ICDM was to integrate the management of

chronic diseases (both NCDs and communicable diseases such as HIV and Tuberculosis), and thus improve health outcomes. ICDM was piloted in Bushbuckridge and the nurses may have been supervised well during this pilot phase which resulted in improved control of hypertension. However, the much lower prevalence of control in patients with diabetes does not really suggest that the integration of services translated into an integrated approach to the management of co-morbid diseases and improved outcomes.

Although not the purpose of this study, establishing whether or not the blood glucose in patients who had both diabetes and hypertension was well controlled or if both conditions were poorly controlled would have confirmed if the approach used by nurses in the management of chronic patients was an integrated approach and whether or not it had positive outcomes for both hypertension and diabetes.

The second reason for the high prevalence of controlled hypertension could be related to the treatment guidelines. Although it was anticipated that the simpler, colour coded algorithms in the new PC101 guidelines would have improved the management of hypertension and thus control, this study has shown that in fact nurses did not follow all of the components of the guidelines consistently. The introduction of the new guidelines is therefore unlikely to be the reason for the high prevalence of controlled hypertension in this study.

Lastly, the manner in which the nurses measured blood pressure could have been the reason for the high prevalence found in this study. Although it was not the purpose of this study to observe how blood pressure measurements were taken, opportunistic observations

during visits to the facilities were made, and it was noted that the method of measuring blood pressure was often incorrect. Nurses did not wait for patients to rest for a few minutes before taking blood pressure measurements, the cuff was placed over clothing, the arm from which the reading was taken was allowed to hang loosely rather than rest on a table and only one reading was taken instead of using the recommended average of multiple readings as recommended by the South African Hypertension Guidelines (17). Other studies have reported similar errors in the manner in which nurses measured blood pressure (25).

On closer scrutiny of the blood pressure recordings in this study, it was noticed that, in facilities that did not use electronic sphygmomanometers both the SBP and DBP were rounded off to the nearest ten. This practice raises questions on the accuracy of the blood pressure measurements and the implications that this had on the prevalence of hypertension control in these facilities. A study by Rayner et al. in the Western Cape found a similar trend and raised similar questions (28).

The problems with the measurement and recording of blood pressure has implications on the findings of this study because the cut-off value for normal blood pressure was strictly adhered to and thus any rounding off of values to the nearest ten might have resulted in the misclassification of patients' blood pressure as normal or elevated. The reliance on the accuracy of available data is a limitation of record reviews. In this study, the principal investigator could not verify the accuracy of the blood pressure measurements as these measurements had already been taken. Therefore, the high prevalence of hypertension control in this study should be interpreted with caution as it is possible that the reason for

the good control of hypertension could be due to the incorrect diagnosis of people with normal blood pressure as hypertensive as a result of poor blood pressure measuring technique, the overestimation of blood pressure due to the use of small cuffs or inaccurate equipment.

One of the recommendations of the treatment guidelines is that patients be managed according to their CVD risk in terms of the medication that is prescribed, the type and frequency of investigations and the target for blood pressure control. The assessment of CVD risk in this sample was low with only 11.4% of the patients having had their CVD risk assessed during the review period.

Although the guidelines recommend that a cardiovascular assessment be conducted every five years, it was reasonably expected that all the patients in this study would have had a CVD risk assessment conducted after the introduction of the new guidelines in August 2013 in order to determine the appropriate treatment for individual patients. Rayner et al. found similar short comings in the management of hypertension in that patients' CVD risk was not assessed nor was target organ damage assessed (28).

A little more than a fifth of the patients in this study had co-morbid diabetes. This is in keeping with the findings of other studies that have found that diabetes is the commonest co-morbid condition in hypertensive patients (11,24–26,28). There was no evidence in the records of any of the patients having any other comorbid condition such as CCF, stroke and renal disease. The presence of these co-morbid conditions could not be established from results of tests as very few patients had the necessary biochemical tests results in their

files. The low prevalence of co-morbid conditions is surprising. Earlier studies in the Bushbuckridge sub-district have found a high prevalence of stroke in hypertensive patients and the general population (50,51). In light of previous evidence, the absence of these other co-morbid diseases in this study should be interpreted with caution as it is possible that either these patients were referred to hospital to be managed by doctors or these co-morbid conditions remained undiagnosed and hence untreated. Steyn et al. found that often co-morbid conditions were undetected in CHCs in the Western Cape in 2008 (29).

The prevalence of hypertension control in those with co-morbid diabetes was lower than in non-diabetics. Being diabetic was significantly associated with uncontrolled hypertension, with diabetics being ten times more likely than non-diabetics to have uncontrolled hypertension. This finding is consistent with other studies that have found that blood pressure control is poor in diabetic patients in PHC facilities (11,29). Previous studies have found a similar pattern when the level of control was stratified according to the presence of co-morbid conditions such as diabetes (11,29). The lower levels of hypertension control in diabetic patients have been attributed to the nurses' and doctors' practice of indiscriminately treating all hypertensive patients, regardless of CVD risk and the presence of co-morbid conditions, to achieve the same target level (11). Therefore, the low prevalence of hypertension control in this study is not unexpected because almost ninety percent of the patients did not have their CVD risk assessed and thus it cannot be assumed that their treatment goals were towards the correct target level. This emphasises the importance of determining CVD risk and treating patients accordingly in order to reach the appropriate blood pressure levels.

The two measurements that nurses did most often were blood pressure and weight. Sometimes when patients did not have their blood pressure measured, notes were made in the patients' records stating that the sphygmomanometers and/or blood pressure cuffs were dysfunctional or unavailable. One particular facility had a high percentage of visits wherein blood pressure was not measured, and this was a facility that was found during the audit to have only one sphygmomanometer.

The frequency of blood pressure measurements was found to be significantly associated with better control of blood pressure, although this was not found to be significant in the adjusted model. However, this does reinforce the importance of measuring patients' blood pressure at every visit as this would allow the nurse to make the necessary adjustments to the treatment, to feed back the results to the patients and reinforce health education if the blood pressure is high. It is possible that there was reverse causality and those with controlled hypertension had their blood pressure measured more frequently than those whose blood pressure was uncontrolled.

Very few patients had their waist circumference measured at all. Although weight was measured frequently, and height was measured in 268 patients, BMI was rarely calculated. For the few patients who had both height and weight measured at different visits during the 22 months, the two measurements were not used to calculate BMI. Similar findings were reported by Mungati et al. who found that patients were weighed, very few had their height measured and although measuring tapes were available, they were not used to measure abdominal circumference (25). Abdominal circumference and BMI are measures of obesity which increases cardiovascular risk in hypertensive patients (17). Studies have found a

high prevalence of obesity amongst hypertensive patients (10,24,25,28,30,32). Few patients had their abdominal circumference or BMI recorded and thus it was not possible to ascertain if they were overweight or obese. Therefore it was not possible to determine whether there was an association between these measures of obesity and uncontrolled hypertension in this study.

Blood glucose and urinalysis tests were the two tests that the majority of patients had at least once during the review period. Fewer cholesterol, potassium and creatinine tests were conducted. Urinalysis and blood glucose tests were conducted as point of care tests and it was clear that those investigations that could be conducted at the point of care fared better than those that had to be sent off for testing. Cholesterol can be measured using a point of care device, however, the lack of cholesterol measuring devices and cholesterol tests strips in the facilities in Bushbuckridge contributed to the low uptake of this test. The majority of the patients that did have a cholesterol test done were in one facility, and those who had a creatinine test were in two facilities. None of the patients in this study had a microalbuminuria test. Devices for the point of care testing of microalbuminuria are available in South Africa but not in the facilities in the Bushbuckridge sub-district. Although the guidelines recommend that patients have an ECG test annually, none of the patients had this test. None of the PHC facilities had an ECG machine although patients' should have been referred to hospital annually to have this test performed and interpreted by a doctor.

Patients who were taking more than one anti-hypertensive drug were more likely to be uncontrolled than those who were taking only one drug. There are a number of possible

explanations for this. Perhaps it was because patients had uncontrolled hypertension that resulted in the addition of a second or third drug in an attempt to improve control in the first instance. The uncontrolled hypertension could have also been due to non-compliance to treatment because of polypharmacy. There is evidence that compliance to medication decreases with an increase in the number of drugs prescribed, unless these are prescribed as fixed dose combinations (35,52,53). This might partly explain the low levels of hypertension control in patients with co-morbid diabetes as they have to take medication for both hypertension and diabetes. A third reason might be due to inadequate treatment doses. Patients in some facilities were taking two or three drugs and all were prescribed at the minimum dose. This is contrary to the recommendations that patients first be placed on the maximum allowable dose before another drug is added (3). However, other studies have found that uncontrolled hypertension was associated with monotherapy. In these studies, a huge proportion of those who had uncontrolled hypertension were taking only one drug because doctors and nurses were reluctant to add extra drugs when patients were not reaching blood pressure control targets (11,26).

Patients who received all their prescribed drugs each time they came to the clinic were less likely to have uncontrolled hypertension (although this was not found to be significant in the adjusted model). This finding is important because shortages in medication have been reported as a reason for the poor control of hypertension(23,25,26). At least thirty percent of the patients in this study did not receive all their treatment and had to go home without one or more of their antihypertensive drugs at least once during the review period because of drug shortages. Aspirin was the drug that was most often out of stock. Although aspirin will not affect the level of control, there was a risk of patients developing complications

such as strokes. The anti-hypertensive drugs that were often recorded to be out of stock were CCBs, ACE-Is and diuretics. These are the first line anti-hypertensive drugs that the majority of patients were taking. Interestingly, all these drugs were available at all eight facilities during the audit. This of course was not a reflection of what had occurred in the preceding months as already discussed.

In Bushbuckridge, the drug shortages were experienced with both the cheaper diuretics and the more expensive drugs such as CCBs and ACEIs. In contrast, other studies found that it was the more expensive drugs that were often out of stock (25,26,37). Goverwa et al. found that those who did not get a certain drug when they went to the clinic defaulted because they could not afford to buy the drugs and thus waited until the drugs were available again in the clinic to continue taking them (26). The patients in this study were not given an alternative drug in the same pharmacological class when a drug was out of stock. This was done in line with the guidelines which discourage switching between different drugs within the same pharmacological class (17). However, the possibility that these patients did not default for an entire month and did return a few days later to collect the treatment cannot be excluded.

One of the important determinants of control is compliance with treatment (28). However, Steyn et al. suggest that the reason for uncontrolled hypertension in the public sector is largely due to the poor delivery of health services rather than patients' non-compliance to medication (10). Nothing can be said about whether or not patients were compliant with medication as it was not within the scope of this study to assess patients' compliance with medication. This study did not assess whether the patients were receiving the correct

combination of drugs because the decision to use a certain combination of drugs is influenced by CVD risk, previous side-effect experiences and a number of other patient related factors which were not within the scope of this study.

Despite the fact that all eight facilities included in the record review had the minimum resources and guidelines necessary for the management of hypertension, the nurses' management of patients was not always in line with these guidelines. In each facility, there were elements of the guidelines that were followed and others that were not. It was clear that, whether or not one had certain measurements and investigations done, depended on the facility one attended. Nurses in a facility tend to do similar things and follow similar recommendations of the guidelines and this might possibly explain the differences between the facilities. This implies that differences in access to quality care exist within the same sub-district, which has the same resources and is under the same management. The differences in the management of patients were an unexpected finding. Perhaps differences in the availability of resources and skills could have explained these differences if some of the facilities were bigger CHC's, however, all eight facilities included in the record review were clinics and were not found to differ greatly in terms of the availability of resources. This then raises the question of whether the differences were as a result of differences in the supervision provided by the different local area manager or the training that nurses in different facilities received. This study did not investigate these reasons as it was not within its scope to do so. The ranking of the facilities on the input, process and outcomes score will provide managers with the opportunity to identify priority areas that require immediate attention.

A number of studies have tried to explain why the guidelines are not followed by health workers. Daniels et al. looked at health worker's attitudes towards treatment guidelines for the management of hypertension and found that nurses were more receptive to the use of guidelines than doctors. This study found that some of the recommendations could not be realistically implemented in the CHCs in the Western Cape and therefore they lost their credibility and were not adhered to (38). This can be true with regards to these guidelines in terms of the recommendations about some investigations that should be performed annually which require equipment that is not available in the facilities.

Many other studies have studied the reasons for non-compliance with guidelines in doctors. Poor supervision, lack of awareness of the contents of guidelines and a lack of skills to do the procedures recommended by the guidelines were reasons why guidelines were not followed (39,41).

There is a lag time between the introduction of guidelines and their full adoption into practice, which could take a number of years (54). This is important to note because the new PC 101 guidelines were introduced very recently and the nurses might not have had enough time to familiarise themselves with them.

Guidelines that are very different from current practice or require a change in the manner in which things are done are not readily adopted (40,55). Daniels et al. found that some of the recommendations in the guidelines were in conflict with current practice especially with regards to what anti-hypertensive drugs to prescribe (38). However, this reason would

be most unlikely in this study because the nurses were not expected to do anything new after the introduction of the PC101 guidelines.

Guidelines in the form of algorithms that are simple, clear and short are readily accepted and applied in practice (55–57). However, although the PC101 guidelines are simple algorithms, this does not seem to be the case.

Most of the factors that were significantly associated with uncontrolled hypertension in the univariate logistic regression were not found to be significantly associated with hypertension in the multivariate logistic regression model. This raises questions about whether or not the multiple measurements and investigations that nurses are expected to do as recommended by the guidelines have any impact on the control of hypertension? Another reason might be that because the number of observations was too small, statistically significant associations could not be found in the model.

4.2 Limitations

There were a number of limitations to this study and the findings of this study are discussed in light of these limitations. Only facilities that kept patient records in the facility were included. The findings, therefore, cannot be generalised to the facilities that did not keep patient records. However, the sampling of patient records was conducted through systematic sampling.

The patients included in this sample are only those who came to the facility. Therefore findings of this study can be applied to the study population which attended the facilities that were selected for this study.

There was potential misclassification bias as it was possible that some patients may have been classified as uncontrolled or controlled due to the poor technique used in the measurement of blood pressure and the use of inappropriately sized cuffs and non-calibrated equipment. The poor technique used to measure blood pressure may have affected the internal validity of this study.

This study was a record review and therefore the quality and completeness of the data was dependent on what was written in the patients' records. Overall, the records were available and comprehensive. Most of the information that was sought was available in the records especially after the introduction of the chronic patient record forms that were introduced with ICDM. These forms served as a template and possibly prompted nurses to record information that they otherwise would have omitted.

One of the variables collected was the date of the next appointment. The intention was to use this appointment date to determine whether patients were encouraged to come back at the appropriate interval and whether they came back at all. This would then have indicated a level of compliance with follow up visits. Although the data was collected, it was not, in the end, possible to analyse the data meaningfully. Appointment dates were given but it was not clear whether the date was for the collection of medication or a consultation. It was therefore not possible to assess the appropriateness of intervals between consultations

especially once the patient's hypertension was controlled and the patients needed to only come to the facility every three to six months rather than on a monthly basis. Another challenge with the assessment of patients' compliance with appointment dates was that the patients sometimes sent a relative to come to the facility when they were unable to make the visit themselves and drugs were dispensed. Other limitations have been highlighted in the discussion.

Chapter 5 CONCLUSION AND RECOMMENDATIONS

In this chapter a conclusion will be presented in light of the findings and discussion presented above. Possible recommendations will be made.

5.1 Conclusion

The evaluation of the management of hypertension in the Bushbuckridge sub-district has shown overall that there is no clear link between the inputs, processes and the outcome. The inputs were available, processes were not consistently followed but hypertension control was found to be high.

This study raises two critical questions:

1. What is the best method of measuring hypertension control over a period of time? There is evidence that what is important is the variability of blood pressure measurements and not just a once off measurement.

2. How do we ensure that guidelines add value to the quality of care? If hypertension control is high despite the inconsistent compliance with guidelines, what value do they add in the management of hypertension?

5.2 Recommendations

In light of the findings of this study, the following recommendations are made in order to improve the management of hypertension in PHC facilities in the Bushbuckridge sub-district.

1. Regular facility audits should be conducted to ensure that equipment, consumables and drugs are available in all PHC facilities. The facilities should be provided with extra equipment that would serve as a backup if and when equipment became dysfunctional. The available equipment should be serviced and calibrated regularly. Drug shortages should be minimized through improved stock control measures and supply chain management to ensure that patients receive all their prescribed medication at every visit.

2. Further research should be conducted to identify the reasons why nurses do not follow certain recommendations in the guidelines. This secondary study should establish what the nurses' attitudes and perceptions about treatment guidelines are and identify the barriers that prevent nurses from complying with the guidelines.

3. Cardiovascular risk factors should be identified and steps should be taken to manage and control these through lifestyle modification strategies. Patients should be weighed, their abdominal circumference should be measured and BMI calculated. The patients' progress in reducing these measures of obesity should be monitored and recorded.

4. The methods used in the measurement of blood pressure should be improved through further training of nurses on the correct methods of measuring blood pressure as recommended by the guidelines. The use of electronic sphygmomanometers should be considered in all PHC facilities. These sphygmomanometers should be serviced and calibrated regularly.

5. Further research should be conducted to

    a. Validate the way the nurses in these PHC facilities measure blood pressure.

    b. Determine the best method of measuring the prevalence of hypertension control over a period of time. Such a method should not only be appropriate for statistical purposes but should be clinically relevant.

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APPENDICES

Appendix A: List of primary health care facilities in the Bushbuckridge sub-district

Chapter 6 Facility name	Type of facility	Local area
Casteel	Clinic	Dwaarsloop
Dwaarsloop	CHC	Dwaarsloop
Shatale	Clinic	Dwaarsloop
Zoeknog	Clinic	Dwaarsloop
Orinocco	Clinic	Dwaarsloop
Buffelshoek	Clinic	Cottondale
Arthurseat	Clinic	Cottondale
Moreipuso	Clinic	Cottondale
Cottondale	Clinic	Cottondale
Brooklyn	Clinic	Cottondale
Murhotso	Clinic	Cottondale
Islington	Clinic	Hluvukani
Utah	Clinic	Hluvukani
Gottenburg	Clinic	Hluvukani
Welverdiend	Clinic	Hluvukani
Ludlow	Clinic	Hluvukani
Hluvukani	CHC	Hluvukani
Dingledale	Clinic	Thulamashe
Arthurstone	Clinic	Thulamashe
Thulamashe	CHC	Thulamashe
Edinburg	Clinic	Thulamashe
Rolle	Clinic	Thulamashe
Mkuhlu	Clinic	Belfast
Culcutta	Clinic	Belfast
Cork	Clinic	Belfast
Belfast	Clinic	Belfast
Justicia	Clinic	Belfast
Thokozane	Clinic	Marite
Jim Brown	Clinic	Marite
Maviljan	Clinic	Marite
Oakley	Clinic	Marite
Marite	Clinic	Marite
Madras	Clinic	Marite
Agincourt	CHC	Agincourt
Xanthia	Clinic	Agincourt
Cunningmore	Clinic	Agincourt
Lillydale	Clinic	Agincourt
Kildare	Clinic	Agincourt

Appendix B: Facility audit tool

Date:_____ **Facility unique code:**_____

Total number of hypertensive patients:_____

Average no. of new hypertension patients per month:_____

1. **Consumables**

	Available Yes/No	Number	Functional Yes/No
Blood glucose measuring device			
Blood glucose test strips		-	-
Urinalysis test strips		-	-
Cholesterol measuring device			
Cholesterol test strips		-	-
Blood sample test tube		-	-
Grey top		-	-
Red/Yellow top		-	-

2. **Drugs**

	Available Yes/No	Stock –out in 3 last months Yes/No
Thiazide-diuretic		
Thiazide like diuretic		
Loop diuretic		
Angiotensin Converting Enzyme (ACE-I)		
Calcium Channel Blocker (CCB)		
Beta- Blocker (BB)		
Aspirin		

3. **Guidelines**

i. Are there written hypertension guidelines or protocols in the consultation room? (walls or desk cupboard)

Yes No

ii. Are these the 2011 South African Hypertension guidelines?

Yes No

iii. If no, what guidelines are they ?

_____

4. **Life-style modification strategies resources**

	Available Yes/No	In local language Yes/No	Readily accessible by patients Yes/No
Posters			
Pamphlets			
Televised videos			
Health promotion classes			
Other_____			

5. **Equipment**

	Sphygmomanometer	Functionality			Accuracy		General Condition							Leakage		Calibration date
	Type	Inf	Def	On/off	Clinic BPMD	Control BPMD	Glass Tube	Gauge	Mercury	Pointer	Control valve	Rubber tubes	Pump bulb	Rubber tubes	Pump bulb	
1																
2																
3...																

	Cuff Size	Bladder size	Leakage >10mmHg		General condition	
			Yes	No	Wear& Tear	Velcro sticks
1						
2						

	Type	Functional Y/N	Accuracy		Calibration date
Weight scale			**Clinic**	**Control**	
1					
2					
3					
Height Stadiometer					N/A
1					
2					
Measuring tape			N/A	N/A	N/A
1					
2					
Stethoscope			N/A	N/A	N/A
1					
2					

Are there extra batteries available for all battery operated devices?
Sphygmomanometers Y/N Weight scales Y/N Height Stadiometers Y/N

Appendix C: Record review data extraction tool

Age:_____ Gender: M F Patient unique code:_____ Facility unique code:_____

Date of diagnosis:_____ Risk stratification:_____ Co-morbid condition: DM/ CCF/ renal disease/other_____

_____

Date of initiation of treatment:_____

Visit	Date of visit	SBP mmHg	DBP mmHg	Wt Kg	Ht m	AC cm	BMI Kg/m^2	Drugs	UA	BG	Cho	Cr	K^+	ECG	MA	Appointment date	Script filled Y/N	Comments
1								A/B/C/D/a										
2								A/B/C/D/a										
3								A/B/C/D/a										
4								A/B/C/D/a										
5								A/B/C/D/a										
6…								A/B/C/D/a										

Key:

DM= Diabetes mellitus; CCF= Congestive cardiac failure; SBP= systolic blood pressure; DBP= diastolic blood pressure; Wt= Weight; Ht= Height; AC= abdominal circumference; BMI= body mass index; UA= urine analysis; BG=blood glucose; Cho= cholesterol; Cr=Creatinine; K^+= potassium; ECG=electrocardiograph; MA= microalbuminuria

A= Angiotensin converting enzyme inhibitor (ACE-I); B= Beta-blocker; C=Calcium channel blocker (CCB); D= diuretic; a= aspirin

Appendix D: Ethics clearance certificate

R14/49 Dr Makoma Charlotte Mlangheni

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M131149

NAME: (Principal Investigator)	Dr Makoma Charlotte Mlangheni
DEPARTMENT:	Community Health School of Public Health Primary Health Care Clinic and Community Health Centres, Bushbuckridge Sub-district, Mpumalanga
PROJECT TITLE:	An Evaluation of the Clinical Management of Hypertension in Primary Health Care Facilities in the Bushbuckridge Sub-district
DATE CONSIDERED:	29/11/2013
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Dr Julia Moorman
APPROVED BY:	Professor PE Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	06/01/2014

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**.

Principal Investigator Signature Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix E: Letter of permission to extend study period

Human Research Ethics Committee (Medical)

Research Office Secretariat: Senate House Room SH 10005, 10th floor. Tel +27 (0)11-717-1252
Medical School Secretariat: Medical School Room 10M07, 10th Floor. Tel +27 (0)11-717-2700/1234
Private Bag 3, Wits 2050, www.wits.ac.za. Fax +27 (0)11-717-1265

12 May 2014

Dr Makoma C Mlangheni
School of Public Health
University

Sent by email to: cmlangheni@yahoo.com

Dear Dr Mlangheni

RE: **Protocol M131149: "An Evaluation of the Clinical Management of Hypertension in Primary Healthcare Facilities in Bushbuck Ridge**
Protocol Amendment

This letter serves to confirm that the Chairman of the Human Research Ethics Committee (Medical) has reviewed and approved your request to **"extend study data collection period –June 2012 – March 2014"** on the abovementioned protocol as detailed in your letter dated 23 April 2014.

Thank you for keeping us informed and updated.

Yours sincerely.

Anisa Keshav
Administrator
Human Research Ethics Committee (Medical)

Appendix F: Letter of permission from Mpumalanga Department of Health

MPUMALANGA PROVINCIAL GOVERNMENT

Building No.3
No. 7 Government Boulevard
Riverside Park Extension 2
Nelspruit
1200
Republic of South Africa

Private Bag X 11285
Nelspruit, 1200
Tel: 013 766 3429
int: +27 13 766 3429
Fax: 013 766 3458
int: +27 13 766 3458

Department of Health

Litiko Letemphilo | Umnyango WezaMaphilo | Departement van Gesondheid

Enquiries: Themba Mulungo (013) 766 3511

17 January 2014

Dr. Charlotte Mlagheni
P O Box 966
Kwa-Mhlanga
1022

Dear Dr. Charlotte Mlagheni

APPLICATION FOR RESEARCH & ETHICS APPROVAL: AN EVALUATION OF THE CLINICAL MANAGEMENT OF HYPERTENSION IN PRIMARY HEALTH CARE FACILITIES IN THE BUSHBUCKRIDGE SUB-DISTRICT

The Provincial Research and Ethics Committee has approved your research proposal in the latest format that you sent.

Kindly ensure that you provide us with the soft and hard copies of the report once your research project has been completed.

MPUMALANGA PROVINCE
DEPARTMENT OF HEALTH
PLANNING & INFORMATION
2014 -01- 17
PRIVATE BAG X 11285
NELSPRUIT 1200

Kind regards

DR. WILLIAM MAPHANGA
CHAIRPERSON: PHREC

DATE

We care. Do you?
Siyanakekela

MPUMALANGA
A Pioneering Spirit

Appendix G: Plagiarism declaration

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG | FACULTY OF HEALTH SCIENCES

PLAGIARISM DECLARATION TO BE SIGNED BY ALL HIGHER DEGREE STUDENTS

SENATE PLAGIARISM POLICY: APPENDIX ONE

I Makoma Charlotte Mlangheni (Student number: 0300939V) am a student

registered for the degree of Master of Medicine in the branch of Community Health in the academic year 2015.

I hereby declare the following:

- I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- I confirm that the work submitted for assessment for the above degree is my own unaided work except where I have explicitly indicated otherwise.
- I have followed the required conventions in referencing the thoughts and ideas of others.
- I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.

Signature: _____ Date: 23 July 2015

Appendix H: Facilities ranked according to the input score

Facility	Equipment (9)	Consumables (5)	Anti-hypertensive drugs (7)	Guidelines and educational material (3)	Total score (24)
B	8	4	7	1	**20**
F	8	4	7	1	**20**
P	8	4	7	1	**20**
V	8	4	6	2	**20**
W	8	4	7	1	**20**
AC	8	4	7	1	**20**
AE	8	4	7	1	**20**
I	7	4	7	1	**19**
M	7	4	7	1	**19**
O	7	4	7	1	**19**
R	7	4	7	1	**19**
T	7	4	6	2	**19**
U	7	3	7	2	**19**
Y	7	4	7	1	**19**
AA	7	4	7	1	**19**
AH	9	3	6	1	**19**
AJ	8	4	6	1	**19**
AK	8	3	7	1	**19**
AL	8	3	7	1	**19**
A	7	4	6	1	**18**
C	7	3	7	1	**18**
E	7	4	6	1	**18**
G	7	3	7	1	**18**
K	7	3	7	1	**18**
L	7	4	6	1	**18**
N	6	4	7	1	**18**
S	7	3	7	1	**18**
X	7	3	7	1	**18**
Z	6	4	7	1	**18**
AB	7	4	6	1	**18**
AD	6	4	7	1	**18**
AG	7	4	6	1	**18**
AI	7	4	6	1	**18**
D	7	2	6	2	**17**
H	7	2	6	1	**16**
J	6	2	7	1	**16**
Q	6	3	6	1	**16**
AF	7	1	3	1	**12**

Appendix I: Facilities ranked according to the input score

Facility	Equipment (9)	Consumables (5)	Anti-hypertensive drugs(7)	Guidelines and educational material (3)	Total score (24)
B	8	4	7	1	**20**
F	8	4	7	1	**20**
A	7	4	6	1	**18**
C	7	3	7	1	**18**
E	7	4	6	1	**18**
G	7	3	7	1	**18**
D	7	2	6	2	**17**
H	7	2	6	1	**16**

Appendix J: Facilities ranked according the process score

Facility	CVD risk assessment (4)	Blood pressure (4)	Weight (4)	Height (4)	Abdominal circumference (4)	Body mass index (4)	Urinalysis (4)	Blood glucose (4)	Creatinine (4)	Cholesterol (4)	Potassium (4)	Prescription completeness (4)	Total (48)
C	3	3	3	4	1	1	4	4	2	1	1	4	**31**
D	1	1	2	4	1	1	4	4	4	4	1	4	**31**
G	1	2	3	4	1	1	4	4	1	1	1	3	**26**
B	1	4	4	3	1	1	1	3	1	1	1	4	**25**
F	1	4	3	2	1	1	4	2	1	1	1	3	**24**
H	1	2	3	2	1	1	4	3	1	1	1	3	**23**
E	1	1	2	3	1	1	4	4	1	1	1	2	**22**
A	1	2	1	2	1	1	4	3	1	1	1	3	**21**