Jamaica's experience with drug subsidization: examining access and adherence to prescription medicines through the National Health Fund among adults with diabetes or hypertension

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I declare that this thesis is my own work and has not been submitted for the award of a higher degree elsewhere

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GLOSSARY OF TERMS

ACE	Angiotensin-Converting Enzymes
ADA	American Diabetes Association
ARBs	Angiotensin II Receptor Blockers (ARBs)
BI	Bamako Initiative
CBA	Controlled Before and After
CCB	Calcium Channel Blockers
CVD	Cardiovascular Diseases
DPP-4 Inhibitors	Dipeptidyl peptidase 4 Inhibitors
ECA	Economic Commission for Africa
ECE	Economic Commission for Europe
ECLAC	Economic Commission for Latin America and the Caribbean
EPHPP	Effective Public Health Practice Project
ESCAP	Economic and Social Commission for Asia and the Pacific
ESCWA	Economic and Social Commission for Western Asia
IDF	International Diabetes Federation
ITS	Interrupted time series
JADEP	Jamaica Drug for the Elderly
LMICs	Low- and middle-income countries
MOHW	Jamaican Ministry of Health and Wellness
MPR	Medication Possession Ratio
NCD	Non-Communicable Diseases
NEML	National Essential Medicines List
NEMP	China's National Essential Medicines Policy
NHF	National Health Fund
NHI	Taiwan's National Health Insurance Scheme
NICE	National Institute for Health and Care Institute
NRCT	Non-Randomized Control Trial
OOP	Out-of-pocket expense/ the unsubsidized cost paid by the patient
PAHO	Pan American Health Organization
PICO	Population Intervention Comparator Outcome

PIOJ	Planning Institute of Jamaica
RCT	Randomized Control Trial
RM	Repeated Measures
SNTP	Brazil's 'Health Has no Price'
SP	Mexico's Seguro Popular
SPSS	Statistical Package for the Social Sciences
SUS	Brazil's National Medicine Policy under the Unified Health System
UCS	Thailand's Universal Coverage Scheme
UHC	China's Universal Health Coverage
UN/DESA	United Nations Department of Economic and Social Affairs
UNCTAD	United Nations Conference on Trade and Economic
WESP	World Economic Situation and Prospects
WHO	World Health Organization
WHO/HAI	World Health Organization/Health Action International
ZMDP	China's Zero-Markup Drug Policy

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ABSTRACT

Background: Cardiovascular diseases are responsible for a large proportion of deaths globally and disproportionately affects developing countries. Diabetes and hypertension are major contributors to the burden of cardiovascular diseases worldwide (WHO, 2017; IDF, 2017; WHO, 2013). In Jamaica, the prevalence of diabetes and hypertension was estimated at 12% and 22% respectively, and has been attributed to an ageing population, increased prevalence of obesity, sedentary living and unhealthy diet (MOHW, 2018; WHO, 2018; WHO Global Data Repository). Access and the appropriate use of essential chronic disease medicines is an effective public health strategy against the morbidity and mortality associated with diabetes and hypertension. The consequences of inappropriate drug therapy are poor health outcomes and increased health care costs to individuals and society. The National Health Fund (NHF), which was implemented in 2003, provides financial assistance for medicines to Jamaicans with one or more of 16 specific chronic diseases, including diabetes and hypertension. This benefit is available to all Jamaicans regardless of age, sex or socio-economic status. To be eligible, individuals are required to have their physician sign an enrollment application confirming their diagnosis (es). Although medicines can be accessed with no fee at point of service at public pharmacies, over 80% of the pharmacies in Jamaica are privately run and may be a more convenient and accessible option for many patients (PAHO, 2012). NHF enrollees have the option of accessing their medicines at a subsidized cost through this network of private pharmacies. Affordability of medicines was highlighted as a barrier to accessing chronic disease medicines, with approximately 25% of Jamaicans reporting not taking medicines due to unaffordability (PAHO, 2012). This study included a literature review, which highlighted multiple barriers

to accessing medicines in developing countries. The extent, to which these barriers affected access and use of the NHF, was explored in this study.

Objective: This study set out to answer three research questions related to access and use of the NHF in Jamaica among adults with diabetes or hypertension: 1) What are the factors predicting enrollment in the National Health Fund? 2) What is the drug utilization patterns and the factors associated with adherence to medicines among NHF enrollees with diabetes or hypertension? 3) What was the effect of a major health policy (the removal of user fees from primary health facilities in 2008) on access and use of the NHF?

Design and methods: The study population was community dwelling adults between the ages of 18 and 59 years with diabetes or hypertension. Data were derived from two disparate sources, the Jamaica Health and Lifestyle Survey (2008) and the NHF pharmacy claims data. Multiple quantitative methods were used to analyze the data. Multivariate logistic regression models were used to identify predisposing, enabling, need and contextual factors associated with enrollment in NHF (n=626), and to identify factors predicting adherence among the enrollees (2008, n=20, 264; 2017, n=77, 454). Interrupted Time Series (ITS) models were used to examine the impact of the removal of user fees from public health facilities on access and use of the NHF (n=49,599; n=74,520).

Results: Five years following the implementation of the NHF individualized drug benefits, only 25% of adults (18-59 years) with diabetes and/or hypertension were enrolled. Low enrollment was mainly seen among younger adults. While higher enrollment was observed

among those with comorbid hypertension and diabetes. Adherence levels among this population of enrollees was also low at just over 50% in 2017, which represents a decline from 2008 ($p<0.001$). Multiple factors were found to be predictive of adherence in both years examined. Howvever, out-of-pocket (OOP)/unsubsidized expense had the strongest effect on adherence when compared to the other predictors included in the model, with lower adherence consistenly observed among individuals with the lowest monthly out-of-pocket (OOP)/unsubsidized expense on medicines. Individuals who obtained multiple drug therapies; those with comorbid conditions; those who lived in the Southeast Health Region; females and those less than 45 years old were also significant predictors of medication adherence but with relatively small effects. Using independent sub-group analysis, the study found that the removal of user fees from public health facilities in 2008, increased NHF enrollment among specific sub-groups (females, urban residents, residents within the Southeast health region and adults ages 18 to 39 years and 45 to 54 years). However, the policy was not effective at increasing the rate of NHFCard users each month.

Conclusion: The results of this study suggests that adults between the ages of 18 and 59 years, with diabetes or hypertension had suboptimal access to essential chronic disease medicines through the NHF. Additionally, continued access measured by adherence to drug therapy was low and showed indications of geographic and socio-economic differences. The study also found that different factors are associated with different levels of access, for example need and predisposing factors were the primary drivers of NHF enrollment, while enabling factors were primary drivers of medication adherence among those already enrolled. These findings highlight the need for interventions in Jamaica to increase access

and use of the NHF. Considering the multiple factors predicting access and the limited effectiveness of the policy to remove user-fees from public health facilities, interventions must take a multidimensional approach and target those most in need.

CHAPTER 1 - BACKGROUND

1 Global overview

1.1 Burden of diabetes and hypertension

Chronic non-communicable diseases (NCDs) are a major cause of death and disability in the world with an estimated 41 million deaths per year globally. Developing countries are disproportionately affected and account for approximately 80% of NCDs (WHO, 2018). A large proportion of deaths from NCDs in developing countries are among people under 70 years old and are considered preventable (WHO, 2018). Of the estimated 15 million deaths annually between the ages of 30 to 69 years, 85% are in developing countries (WHO, 2018). The leading causes of NCD deaths are cardiovascular diseases (CVD) such as heart disease and stroke (WHO, 2018). Diabetes mellitus and hypertension are among the most important risk factors for CVDs and other NCDs (WHO, 2017). People with diabetes are 2 to 3 times more likely to suffer from CVDs and 10 times more likely to have end stage renal disease (IDF, 2017). Globally, hypertension is reported to be responsible for 45% of deaths due to heart disease and 51% of deaths due to stroke (WHO, 2013). The WHO reports that in 2005 chronic diseases were responsible for nearly one-half of the disease burden in developing countries (Wirtz et al, 2011). Moreover, the premature loss of life, morbidity and disability associated with these diseases are known to have a significant economic impact on developing countries.

Diabetes is a chronic disease that occurs when the body is unable to produce the insulin needed to regulate glucose, leading to elevated blood glucose levels or hyperglycemia (IDF, 2017). It is characterized by chronic hyperglycemia (Shah and Afzal, 2013). There are three main types of diabetes, type 1 diabetes, type 2 diabetes and gestational diabetes. However, 90% of all diabetes cases are type 2 diabetes (IDF, 2017). Global trends in diabetes have shown an increase in prevalence over time, with an estimated 8.8% of adults between the ages of 20-79 years affected (IDF, 2017). Eight (8) out of 10 adults with diabetes live in developing countries (IDF, 2017). If the current trends continue, the International Diabetes Federation (IDF) predicts that by 2045, 1 in 10 (628 million) adults will have diabetes mellitus. The majority of this increase is predicted to take place in developing countries (IDF, 2017).

Hypertension is a chronic disease, which is characterized by persistently elevated blood pressure. Elevated blood pressure is when the heart systolic blood pressure is equal to or greater than 140 mm Hg and a diastolic blood pressure equal to or greater than 90 mm Hg (WHO, 2013). Raised systolic and diastolic blood pressure affects the normal functioning of vital organs such as the heart, kidneys and brain (WHO, 2013). It is a global public health issue because of its high prevalence in many parts of the world, and because it significantly increases the risk of heart disease and stroke (WHO, 2013; Sarki et al 2015). The global prevalence of hypertension was estimated at 32.3% in 2015 and is predicted to increase by 2025 (Sarki et al, 2015). According to Sarki et al (2015), 1 in 3 adults in developing countries were diagnosed with hypertension. A projected 75% of the world's hypertensive population

will reside in developing countries in the next decade (Shah and Afzal, 2013; Sarki et al, 2015).

Diabetes and hypertension are considered metabolic diseases and typically occur together. When they co-exist, the risk of CVD increases by 75% (Shah and Afzal, 2013). A combination of lifestyle factors and an aging population are being blamed for the increased prevalence of these conditions in developing countries. Life-style risk factors include physical inactivity, poor diet and tobacco use. In public health, these are commonly known as 'modifiable' risk factors because they are amenable to health promotion and prevention interventions. Factors such as, age and genetics are referred to as 'non-modifiable' risk factors. Together, the modifiable and non-modifiable risk factors are driving the global diabetes and hypertension epidemic (WHO, 2005; IDF, 2017). Both are slow-progressing life-long diseases, which can generally be controlled but not cured. Because of this, they can have a significant impact on the quality of life of individuals and their family. In developing countries, the onset of diabetes and hypertension tend to occur at a younger age, which means people in those countries experience a longer duration of their disease or die at a younger age if not managed appropriately (WHO, 2005). Public health interventions, which include prevention programmes targeting key lifestyle factors such as diet, physical activity and tobacco use are considered the most cost-effective approach to manage the burden of diabetes and hypertension. Those strategies are reported to have had significant public health impact over time (WHO, 2013; WHO, 2016). However, primary prevention strategies which include detecting and managing diabetes and hypertension is also critical for preventing CVDs and other life-threatening complications resulting from them

(Hobbs, F, 2004; WHO, 2013; WHO, 2016). It is also important for maintaining quality of life for those affected and reducing the economic impact of NCDs in developing countries (WHO, 2013). However, detecting and managing these diseases is a known challenge for individuals, communities and health systems in developing countries. Largely because of their limited financial resources and a general lack of health system infrastructure at the community level. To deal with these challenges, countries have been encouraged to implement integrated NCD programmes through primary care, as a more affordable and sustainable way of managing diabetes and hypertension (WHO, 2013; WHO, 2016). The concept of integrated management involves managing diabetes, hypertension and other CVD risk factors in primary care, in which early detection and access to essential medicines play a key role (WHO, 2016).

1.2 Drug therapy in Chronic Disease Management

NCDs typically require life-long drug therapy, making access to essential medicines in primary care facilities a critical component of care (Ewen et al, 2017). In the management of diabetes and hypertension, cost-effective drug therapy has shown significant benefits at both the individual and societal levels (Wirtz et al, 2011; Grady & Gough, 2014). For individuals with hypertension, medicines can reduce the incidence of stroke and heart attack by as much as 40% and 25% respectively (Neal et al, 2000 in Wirtz et al, 2011). Likewise, glycemic control with anti-diabetes medicines have been shown to prevent complications and is associated with a significant reduction in major cardiovascular events (Younk et al, 2016; Hayward et al, 2016). As such, the WHO's global strategy for the prevention and

control of chronic diseases, considers access to essential medicines a key component for strengthening health systems in order to achieve optimal management of these diseases (Wirtz et al, 2011; Ewen et al, 2017). According to the WHO, “essential medicines are those that satisfy the priority health care needs of the population” and must be selected for each country with due regard to disease prevalence and public health relevance. These medicines are crucial for survival, preventing significant disability and morbidity and preventing inappropriate use of other healthcare services. It is the responsibility of governments and policy makers to ensure they are available in adequate quantities and be of good quality (Ewen, 2017). In developing countries where the burden of NCDs is increasing, the projected demand for essential medicines to treat them is expected to also increase (Wirtz et al, 2011). Sadly, these countries are likely to have the most challenges with access to essential medicines to treat NCDs, because of low availability and unaffordability (Ewen et al, 2017).

Another key component of effective drug therapy is medication adherence. Medication adherence reflects continued access to medicines overtime and is important for effective management of chronic diseases. Multiple factors including, drug, patient, provider and the health system are said to have an impact on adherence to drug therapy among chronic disease patients (WHO, 2003). Adherence improves when medicines are available and accessible within the health care system and when patients have a high level of commitment to taking them as prescribed by their physicians. Regardless of the reasons, when patients do not take their medicines as prescribed, the behaviour is known as medication non-adherence. In the US, medication non-adherence cost the healthcare system an estimated

290 billion dollars every year (Lemstra et al, 2018). A Canadian study found that 5.4% of all hospitalizations were due to medication non-adherence (Iskedjian et al, 2002 in Lemstra et al, 2018).

2 Introduction

2.1 Burden of Diabetes and Hypertension in Jamaica

Jamaica is in the Latin America and Caribbean Region and is classified by the World Bank as one of 55 Upper Middle-Income Countries in the world (World Bank Development Indicators, 2016). In 2018, the population was estimated to be 2.8 million (WHO, 2018). According to the Jamaica Survey of Living conditions (JSLC), approximately 20% of the population live in poverty (PIOJ, 2017). Poverty is more prevalent in the rural areas with signs of it increasing over time (PIOJ, 2017).

Over the past several decades, the country has made significant improvements on key population health indicators such as life expectancy, infant mortality and control of vaccine preventable diseases (Figueroa, JP, 2001; Gordon-Strachan et al, 2010). However, they struggle to have an impact on NCDs, which are now the leading cause of death and disability in the country. Jamaica has undergone an aging of its population, which saw a doubling of seniors (60+ years) from 1970 to 2000 (Bourne and McGrowder, 2009). As a result, the main causes of illness and mortality are chronic NCDs (Bourne and McGrowder, 2009). The PIOJ (2017) estimated the burden of NCDs in Jamaica to be 25%. In 2016, the age-adjusted

mortality rate from NCDs was estimated at 475 per 100,000 population and ranked 9th highest among the 28 Caribbean nations (PAHO, 2018). In addition, approximately 15% of NCD deaths were premature (PAHO, 2018). Diabetes and hypertension are major contributors to premature NCD deaths making those conditions high on the list of public health priorities. The WHO estimated that in 2014, the prevalence of diabetes in adults (18+ years) was 12% in Jamaica, this was an increase from the previous estimate of 10% in 2009 (WHO, 2018; WHO, 2016). While the prevalence of hypertension remained constant at approximately 22% over time, albeit above the global target (WHO, 2018). These increases are occurring concurrently with increasing prevalence of lifestyle risk factors such as obesity, tobacco use and physical inactivity (WHO, 2018). Despite national initiatives to promote healthy lifestyles over the past several decades.

The rise in diabetes and hypertension is due to an aging population and increased prevalence of obesity, sedentary living and unhealthy diet. However, there are marked variations in the burden of both diseases between males and females and among socio-economic groups (Scott & Theodore, 2013). Females of all age groups, adults above 35 years, persons with lower levels of education and persons in the lowest socio-economic category were the most affected by these conditions (Tulloch-Reid et al, 2013). These variations strongly suggest inequalities in the chronic disease burden in the country.

2.2 An overview of the Jamaican Health Care System

The Jamaican health care system consists of a mixture of public and private health sectors, with more than half the population accessing primary healthcare in the private sector (Commonwealth Health Online, 2017). Hospital services (secondary and tertiary care) are largely provided by the government who account for 95% of hospital beds (Theodore et al, 2001). The healthcare financing system can be characterized as segmented, with just over 60% financed by public funds, followed by 22% out-of-pocket and the other 18% by a combination of private health insurance and other private sources (WHO, 2016). Jamaica was ranked the lowest when it came to total health expenditure per capita, when compared to similar countries in and outside the region (MOHW, 2018).

In 1997, the National Health Service Act gave rise to the decentralization of delivery of public health care services in Jamaica. As a result, four geographically based health regions were established to deliver primary, secondary and tertiary healthcare services across the country. The four health regions are the; Southeast Regional Health Authority; Southern Regional Health Authority; Northeast Regional Health Authority and Western Regional Health Authority. Each Regional Health Authority is responsible for operational management of public health facilities in their respective geographies (MOHW, 2017).

Since 2008, all patients who use the public health sector pay no user fees for a primary care visit, due to a national health policy to remove the user-fees charged at public health facilities. User fees were health care costs borne by the patient at the point of care at public

health facilities. This policy also included the provision of essential medicines free of charge at all public health facilities (PAHO, 2012). The removal of user fees was largely in response to concerns that they act as a barrier to healthcare access, with the poor and rural residents facing the most challenges (Li et al, 2017). Although the cost barrier was removed from accessing primary care in the public sector, 6 out of 10 individuals were still using the private sector for primary care where they are required to pay at each visit (PAHO, 2012). The remainder of the population use the public sector and a small percentage use non-governmental organization at a reduced cost (PAHO, 2012). A primary care visit in the private sector was estimated to cost an average of J$2,575/US$25.00 (PIOJ, 2015). However, these fees do not include diagnostics and medicines, and can vary significantly from place to place. Mainly because fees charged within the private sector are not government regulated or monitored in any way.

The private health sector dominates primary healthcare services including pharmacy and diagnostic services, so patients who regularly use public health facilities are still likely to pay out-of-pocket for these services. For individuals with private health insurance, a portion of these costs is covered, but less than 20% of the population have private health insurance (PIOJ, 2015). Most private health insurance is employer provided, so the poor are less likely to have these policies, due to lower employment rates or employment in the informal sector (PIOJ, 2015). Rural residents also face greater challenges as there is a higher prevalence of poverty, so the physical barriers they often face in accessing healthcare is also compounded by financial barriers (PIOJ, 2017). Private versus public healthcare utilization in Jamaica is strongly influenced by socio-economic status (Bourne et al, 2010). It was found

that as income increased, individuals were more likely to use private health facilities in Jamaica due to their ability to pay and the likelihood of them having health insurance (Bourne et al, 2010). A recent report by the Ministry of Health and Wellness (MOHW, 2019), stated that utilization of public sector clinics was declining, due to multiple issues related to the financing, organization and delivery of primary healthcare services in the public sector (MOHW, 2019). This has shifted utilization at the primary health clinics to secondary care and has resulted in significant burden on public hospitals (MOHW, 2019). Unaffordability and inadequate use of primary care services in the country is likely to place a financial burden on Jamaicans.

In Jamaica there are 399 private pharmacies compared to only 83 operational public pharmacies (PAHO, 2012). As a result, 80% of medicines are purchased within the private sector. Medicines are regulated by the Pharmaceutical and Regulatory Affairs Division, who oversee licensing of manufacturers, importers, distributors, wholesalers and exporters of medicine. However, the country has very limited control on the retail price of medicines in the private sector and there is no medicine monitoring system in place to track these prices and their change over time (PAHO, 2012). Generic substitution is permitted by law in public and private pharmacies, but there are no incentives to dispense generics (PAHO, 2012). Medicine monitoring systems and generic substitution policies are typically implemented under a National Pharmaceutical Policy, but Jamaica has not officially adopted one (PAHO, 2012). The inability of the Jamaican government to monitor the retail price of medicines weakens their ability to regulate these prices, thus ensuring their affordability.

2.3 Access to chronic disease medicines in Jamaica

An assessment of the pharmaceutical sector found that essential medicines were generally available (93%) in both public and private pharmacies (PAHO, 2012). Availability of medicines in the public sector in Jamaica was better when compared to other countries in the upper middle-income categories, where medicine availability was critically lower in the public sector compared to the private sector (Ewen et al, 2017). Geographical accessibility to public and private pharmacies was rated as good, as only a small percentage of people had to travel more than an hour to fill their prescription. With respect to the cost of essential medicines, they are provided free of cost in the public sector. However, in the private sector it was estimated that it would cost 10% of a day's wage of the lowest paid government worker to purchase a 30-day supply of the lowest cost generic medicines for diabetes and 80% for hypertension (PAHO, 2012). The cost of originator brands for the same medicines was significantly more costly, for example it would take 5.2 days wages of the lowest paid government worker to purchase an originator brand of antihypertensive medicine (PAHO, 2012). Accessibility to public health facilities was reportedly adequate in most areas across the country, but access to medicines was hindered by affordability (PAHO, 2012). Relatively low utilization of public pharmacies where medicines are provided free of cost was a big contribution to the unaffordability of essential medicines in Jamaica (PAHO, 2012). In a household survey, more than one quarter of individuals with a chronic condition reported not taking medicines because they could not afford it (PAHO, 2012). This was after the implementation of the Jamaica Drug for the Elderly Programme (JADEP) in 1996 and the National Health Fund in 2003. These are two government initiatives intended to narrow the

gap in access to essential medicines for chronic diseases. The JADEP provides subsidy for medicines to the elderly (60+ years) and the NHF provides subsidy for medicines to all Jamaicans diagnosed with selected chronic diseases. Both programs were intended to reduce the out-of-pocket costs of essential medicines among patients with chronic diseases.

2.4 Medication Subsidy in Jamaica – The National Health Fund

According to the NHF Act (2003), all Jamaicans could realize health benefits through the National Health Fund whose principal objectives are to:

a) Provide prescribed health benefits to all residents regardless of age, gender, health or economic status;
b) Provide greater access to medical treatment and preventive care for specified diseases and specified medical conditions all residents (NHF Act, 2003);
c) secure improvement in the productivity of residents by reducing time lost on the job that is attributable to personal and family health care problems;
d) Reduce the island's disease burden through health promotion and protection programmes; and
e) Provide support to health services and promote and encourage the utilization of primary health care to improve the quality of life of the island's population.

Under the NHF Act (2003), increasing access to essential medicines for NCDs was a key objective of the National Health Fund by making "prescribed drugs and other benefits available to residents at government-owned and other facilities" (NHF ACT, 2003). This is

known as the NHF Individual Benefits. The NHF Individual Benefits programme was implemented in 2003. The programme provides financial assistance for medicines to Jamaicans with one or more of 16 chronic diseases, including diabetes and hypertension. This benefit is available to all Jamaicans regardless of age, sex or socio-economic status. To be eligible, individuals are required to have a physician confirmed diagnosis of one of the 16 chronic diseases covered. Although medicines can be accessed free through the NHF at public pharmacies, the majority of the pharmacies in Jamaica are privately run, where NHF enrollees can access their medicines at a subsidized cost.

To enroll, patients must complete an application form with their names, address, sex and their date of birth and have it signed by their physician confirming their diagnosis (es). The patient is also required to actively go to an NHF enrollment office to submit their application for an NHF beneficiary card (NHFCard) in order to access the subsidy. Almost all pharmacies within the private sector participate in the NHFCard programme. In 2017, the NHF subsidized chronic disease medications for over 240,000 Jamaicans, over one-third of whom received subsidies for hypertension and diabetes medicines (NHF, 2018). Majority of NHF beneficiaries are females (62%) over 45 years (84%) (NHF, 2018). The average number of illnesses covered per patient was 3 and the average subsidy paid was 44% of the drug retail price (NHF, 2018).

Subsidy rates varied by chronic disease and was higher for anti-diabetic (56%) compared to anti-hypertensive (42%) (NHF, 2016). Antihypertensive was among the medicines with the lowest subsidy rates (NHF, 2016). There was a 10% decrease in the overall subsidy rate

since 2012, which was attributed to an increase in the retail price of prescription drugs (NHF, 2016, 2018). This is largely because the price of medicines in Jamaica is strongly influenced by the devaluation of the Jamaican dollar (NHF, 2018). Therefore, overtime we are seeing a decreasing impact of the NHF Individuals Benefits on the out-of-pocket cost of chronic disease medicines to patients in Jamaica. The amount of subsidy received is not dependent on income and is the same for all individuals. Low-income families are therefore required to pay the same out-of-pocket when they use the subsidy. Those with private health insurance will have lower out-of-pocket expenditures.

2.5 Study Rationale

Access to essential medicines and adherence to these medicines are important for effectively managing life-long chronic diseases such as diabetes and hypertension in primary care. The Jamaican government has over the years endeavored to make healthcare more accessible. The removal of user fees from public health clinics in 2008, was implemented to increase access to primary care services for those who could not afford to pay. The Jamaica Drug for the Elderly Programme (JADEP, 1996) and the National Health Fund (NHF, 2003) were implemented to narrow the gap in access to essential medicines for chronic diseases and ensure quality treatment with medicines. Despite the implementation of these policies and programmes, disparities in healthcare utilization and health status in Jamaica was still a problem (Scott & Theodore, 2013). These disparities may be influencing access to the medicine subsidy through the NHF. Also, the high rate of utilization of the private sector for primary care services and medicine purchases may have a

disproportionate negative impact on low-income families. This is largely because the government has little control over the fees charged and price of medicines sold in the private sector. This may result in catastrophic health expenditures on chronic disease management for those families. It is well known that families exposed to catastrophic health expenditures have poorer outcomes. It also puts unnecessary burden on the already strained healthcare system.

In 2008, five years following implementation of the NHF, approximately 40,000 adults with diabetes and 270,000 adults with hypertension reported not taking prescription medicines for their condition (Wilks et al, 2008). The NHF Individual Benefit was designed specifically to reduce the gap between need and access to medicines. However, this data suggests that there was still a significant gap between the need for prescription medicines to treat these common chronic diseases and access to these medicines. It was previously highlighted that socio-economic and socio-cultural factors influence utilization of health services in Jamaica (Bourne et al, 2010). However, there is no empirical evidence of the effect that these factors have on access to the NHF. Considering the public health impact of diabetes and hypertension in Jamaica, and the importance of essential medicines in reducing the burden of those diseases, ensuring equitable access to the NHF medicine subsidy is important for Jamaicans, particularly the poor. To my knowledge, no research has been conducted to investigate the factors driving utilization of this important public health initiative. Medication adherence is key to the effective management of chronic diseases. Now that medications are made more affordable through the NHF, no studies have investigated the levels of adherence and the factors associated with medication adherence among the patients

enrolled in the programme. Additionally, although previous studies have examined levels of adherence to chronic disease medicines, no studies have used actual pharmacy utilization data to examine adherence to diabetes and hypertensive medications on a large cohort of the Jamaican population. The removal of user fees from public health facilities in 2008 was an important policy decision towards making primary care and by extension essential NCDs medicines more accessible. The impact of that policy on use of NHF among diabetics and hypertensives has not been investigated. The impetus for this research is to address some of these unanswered questions related to accessing the NHF.

3 Research aim

This research aims to use real world national data sources to understand access and utilization of the NHF Individual Benefits programme among adults with diabetes and hypertension.

3.1 Specific Research questions

The research will specifically address three questions related to accessing the NHF Individual Benefits programme among adults with diabetes and hypertension:

a) Is there differential access to this medication subsidy programme? Can those differences be attributed to patient needs or other non-need factors?

b) What are the utilization patterns and the factors predicting adherence among NHF enrollees with diabetes or hypertension?
c) What was the effect of the removal of user fees from public health facilities on use of the NHF subsidy?

The government has over the years made large investments in this medicine subsidy programme. It is important for policy makers to understand how the programme is being used and if the individuals most in need are benefiting.

CHAPTER 2 - LITERATURE REVIEW

1 Chapter introduction

This chapter comprises three sections. The first section discusses the definition of access within the context of healthcare and its relevance to research on access to medicines. This definition will be used as a framework to analyze the literature on access to medicines and to make recommendations about interventions to improve access to the NHF. The second section examines the literature on the factors associated with access to medicines in developing countries and will be used to guide the selection of study variables for this thesis. The third and final section is a systematic review, which focuses on describing the experience of developing countries with policies aimed at influencing access and use of chronic disease medicines. The systematic review is intended to highlight how developing countries have used policies or programmes like the NHF and the scope of these policies in addressing the broad range of issues related to access to medicines. The review is also intended to highlight some of the gaps in research related to these policies in developing countries.

2 Definition of access

According to Penchansky & Thomas (1981), access in healthcare is defined as “the degree of fit between clients and the system”, in other words, the extent to which the needs of patients are addressed by the healthcare system. They argued that access is a general

concept consisting of five distinct but related dimensions, accommodation, accessibility, availability, affordability and appropriateness. This multi-dimensional concept of access was later supported by Peters et al (2008), Bigdeli et al (2013) and Suarman et al (2016). According to the Penchansky & Thomas (1981), the five dimensions of access can be characterized as:

1. **Availability** – which can be characterized by the volume and types of services that exist within the healthcare system relative to the patients' need. With regards to access to medicines, this would be associated with health system factors, such as adequate drug supplies in pharmacies and the availability of essential medicines to meet the needs of the population.

2. **Accessibility** - This dimension of access has to do with the physical and geographical location of patients versus healthcare sites and takes into account distance, travel time and their associated costs. This dimension is associated with health system factors, such as location and distribution of primary care facilities, diagnostic facilities and pharmacies. This enables patients to be appropriately diagnosed, receive ongoing disease monitoring and fill prescriptions for chronic disease medicines.

3. **Accommodations** - These are the administrative services or operational components such as hours of operation, waiting time and whether they are appropriate for the patients being served. These are also associated with health

system factors that enable timely access to chronic disease management services. Government policies may have very little control over these factors in countries where the private sector is a major player within the healthcare system.

4. **Affordability** - This is the patient's perception of the cost of healthcare services versus its value, this takes into account insurance coverage, patients' income and the price of healthcare services. This is a combination of health system and patient factors. Financial barriers exist when patients are unable to receive needed healthcare services and medicines due to unaffordability, either because they are poor or the cost of healthcare accounts for a large proportion of their household expenditure. This is especially true in countries where primary care services and medicines are determined by the private sector without government oversight, as these services are for profit rather than needs driven.

5. **Acceptability** is concerned the relationships of the patients with the healthcare system and takes into account patients' characteristics such as education level, socio-cultural and religious beliefs. The informal healthcare system such as traditional healers and alternative medicine practitioners also plays a key role if they exist. Treatment factors, such as medicine side effects and provider factors are also associated with this domain. It characterizes the patients' perception of the need for services or the quality of healthcare services.

Access to health services is optimized when all the five dimensions are accounted for. Penchansky & Thomas (1981) demonstrated that multiple factors were influencing the different dimensions of access. These factors were a combination of health system and population characteristics such as, physician's office wait-times, travel time, length of relationship with physician, sex, persons with high health concerns and use of private physicians. Later, Saurman et al (2016) proposed a sixth dimension of access - awareness - which emphasized the importance of communication and information. Awareness has to do with service provider awareness as well as patient awareness. Based on these dimensions, access to health services can be summarized as consisting of multiple dimensions that can be linked to a broad range of inter-related health system and patient factors.

By considering all the dimensions of access, the literature review in section two is intended to identify the factors associated with access and adherence to chronic disease medicines in developing countries.

3 Literature review on access and adherence to medicines in developing countries

A review of the literature was conducted to identify factors associated with access and adherence to chronic disease medicines in developing countries. Ninety-three (93) studies were identified between 2010 and 2019 using the search terms in Appendix 2.1.

A review of the titles and abstracts identified 24 relevant studies. One (1) was a systematic review including fifteen (15) studies from developing countries across Africa, Asia, Europe, the Middle East, Latin America and the Caribbean (Christiani et al, 2016). Another systematic review included fourteen (14) studies from Iran on adherence (Sarayani et al, 2013). Ten (10) were studies involving multiple countries across Africa, Asia, Latin America, the Caribbean and the Middle East (Ewen et al, 2019; Barbar et al, 2019; Macquart de Terline et al, 2019; Chow et al, 2018; Attaei et al, 2017; Ewen et al 2017; Emmerick et al, 2015; Srivastava et al, 2015; Vialle-Vallentin et al, 2015; Wagner et al, 2011). Others were single country studies from Kenya (Rockers et al, 2019; Shannon et al, 2019; Rockers et al, 2018), Kyrgyzstan (Murphy et al, 2016), Indonesia (Rahmawati et al, 2018), India (Elias et al, 2017), Iran (Sarayani et al, 2014), Ghana (Marfo et al, 2017), Guatemala (Flood et al, 2017); Mozambique (Gama et al, 2013), Tanzania (Jande et al, 2017) and Pakistan (Shams et al, 2016).

Definitions and measurement of access and adherence varied between studies. Only three studies included a theoretical framework in their analysis, Vialle-Valentin et al (2015) and Elias et al (2017) used the Medicine Access framework developed by Bigdeli et al (2013) and Srivastava et al, 2015 used the Demand for Health Economic framework. A wide variation of patient, health system and contextual factors were examined in these studies. A summary of the access to medicine outcomes measured, and the factors examined can be found in Table 1 below.

Table 1: Summary of studies on access to medicines in developing countries

Authors, year	Country	Chronic disease	Outcomes measured	Factors examined and direction of effects
Attaei et al, 2017	22 LMICs and high-income countries	Hypertension	Use of at least one antihypertensive Use of combination therapy Blood pressure control	Number of blood pressure lowering drug classes at community pharmacies (+), cost of medicines at community pharmacies (+), rurality (+), countries economic development (+), number of therapies (+)
Babar et al, 2019	17 LMICs Countries	Diabetes	Medicine prices Medicine stock at legally permitted dispensing sites	countries economic development (+), generics (+), cost (-)
Chow et al, 2018	22 LMICs and high-income countries	Diabetes	Availability of medicine on the day the pharmacy is visited Cost of medicine (Metformin and Insulin)	Countries economic development (+)
*Christiani et al, 2016	Multiple LMICs	Diabetes	Access to anti-diabetes medicines	Rural (X/-), race/ethnicity (-), occupation (X), Female gender (+/X/-), education (+/X), socio-economic status/income (+), age (+/-), health insurance coverage (+), physical disability (-)
Elias et al, 2017	India	Diabetes and Hypertension	Access to medicines	Health system components defined by Bigdeli et al (2013) Access to Medicine Framework (+)
Emmerick et al, 2015	3 Latin American Countries	Multiple chronic diseases	obtaining all medicines sought for the chronic conditions reported.	Age 65+ years (+/X),age of household head (+),rural(X),gender (X),ethnicity (X),health insurance coverage (X),education (+/X),literacy (X), physical disability (X),health status (X),status in the household (X), seeking care in the formal health system (+) , proximity to public and private health facilities (X),medicine insurance (x),household economic level (+/X), seeking care in the private sector (+/X), obtaining medicine in the private sector (+/X), receiving free medicine (+/X)
Ewen et al, 2017	30 LMICs and high-income countries	Multiple chronic diseases	Medicine prices Medicine stock at legally permitted dispensing sites	Countries economic development (+); Private sector (+); generic medicines (+)
Ewen et al, 2019	13 Countries LMICs and	Diabetes	Medicine prices (generics vs originator brands)	Countries economic development (+); Income (+); Biosimilars (+)

	high-income countries		Medicine stock at legally permitted dispensing sites.	
Flood et al, 2017	Guatemala	Diabetes and Hypertension	Access to low-cost generics	Providers' positive perception (+)
Gama et al, 2013	Mozambique	Hypertension	Pharmacological treatment of hypertension	Female Gender (+), age (X), overweight/obesity, smoking (X), BMI (X), use of traditional medicine (X), rural (X), education (X), aware of hypertensive status (+)
Jande et al, 2017	Tanzania	Hypertension	Adherence	Patient's positive perception about medication (+)
Macquart de Terline et al, 2019	12 Sub-Saharan countries	Hypertension	Adherence	age (X), male gender (X), patient wealth index (+), countries income level (+), rural (X), duration of disease (X), CVD Risk Factors (X), use of traditional medicine (+), drug class (X), polypharmacy (X), Complications (X)
Marfo et al, 2017	Ghana	Hypertension	Blood pressure control and adherence	Pharmaceutical care model (Community level Intervention) (+)
Murphy et al, 2016	Kyrgyzstan	Hypertension	Adherence	Age (X), Male gender (X), rural (X), marital status (+), insurance coverage (X), income level (+), geographic region (+)
Rahmawati et al, 2018	Indonesia	Hypertension	How and where people in rural villages obtain their medicines	age (X), Female gender (X), education (+), employment status (X), proximity to clinic (+), health insurance coverage (+), physical activity (+), duration of chronic diseases (+), knowledge of disease (X)
Rockers et al, 2018	Kenya	Diabetes, hypertension or asthma	Medicine available in the home (location and cost).	Wealth (+), proximity to health facilities (+), Out-of-pocket cost (-)
Rockers et al, 2019	Kenya	Multiple chronic diseases	Availability and price of portfolio medicines at health facilities	Low-cost medicines (X)
			Availability of medicines at patient households	
*Sarayani et al, 2013	Iran	Diabetes	Adherence	Age (-), gender (X), education level (+/X), duration of pharmacotherapy (+/X), beliefs about medicine (+/X/-), knowledge of the disease (+), perception of disease severity (+), regular visits to physician (+), insurance coverage (+/X), polypharmacy (X)
Sarayani et al, 2014	Iran	Diabetes	Prevalence of diabetes medicine utilization	Time (+), drug class (+)

Shams et al, 2016	Pakistan	Diabetes	Adherence	Age (X), Gender (X), polypharmacy (-), alternative therapy (-), duration of disease (X), education/Illiteracy (+), poverty (-), dietary adherence (+), drug type (X), glycemic control (+)
Shannon et al, 2019	Kenya	Diabetes	Access	Stable and affordable insulin supply at dispensing sites (X)
Srivastava et al, 2015	35 LMICs	Multiple chronic diseases	Patient utilization as a measure of access	Age (x), Gender (+), marital status (-), health status (+), insurance coverage (+), rural (-), education (+), employment (+), household expenditure (+)
Vialle-Valentin et al, 2015	Uganda, Kenya, The Philippines, Jordan, Ghana	Chronic diseases	Regularly taking medicine for a diagnosed chronic disease and data collectors	Age (-/X), gender (X), education level (+/X), poverty (+/X/-), distance to health facilities (+/X), household size (+/X), Living in the capital (+/X), Free medicines (+/X), Insurance (+/X), positive attitude towards medicine (+/X), awareness of generic medicines (+/X), positive opinions about medicine availability (+/X/-), history of borrowing money to pay for medicines (-)
			Found a medicine indicated for that disease in their homes	
Wagner et al, 2011	70 LMICs and high-income countries	Multiple chronic diseases	Household respondent in need of treatment and medicines received care	Health Insurance (+), High public sector functioning (+)
			Household respondent with at least 1 chronic illness was treated or reported taking medicines for his/her condition in the past 2 weeks	
			Household respondent that usually requires treatment with medicines received all or most of the medicines needed	

Note: Covariate has a positive effect on one or more access to chronic disease measures (+); Covariate has a negative effect on one or more access to chronic disease medicines (-); Covariate was not significant on the access to chronic disease medicines (X)

The common theme from the identified studies over the last decade, was that affordability and availability of essential chronic disease medicines was still a barrier to access and adherence in developing countries (Ewen et al, 2019; Babar et al, 2019; Shannon et al,

2019; Rockers et al, 2018; Chow et al, 2018; Rahmawati et al, 2018; Attaei et al, 2017; Ewen et al, 2017; Flood et al 2017; Christiani et al, 2016; Murphy et al, 2016; Emmerick et al, 2015; Sarayani et al, 2014; Wagner et al, 2011). Availability was often measured by determining medicine stock or inventory in community pharmacies or at the household level (Rockers et al, 2019; Babar et al, 2019; Attaei et al, 2017; Chow et al, 2018). Affordability was measured by people's capacity to pay for medicines, or by the price of drugs at medicine dispensing sites (Rockers et al, 2019; Barbar et al, 2019; Chow et al, 2018, Ewen et al, 2017). Factors other than affordability and availability of medicines were also found to be significant in determining access to chronic disease medicines. For example, poor accommodations within primary care health clinics were considered a barrier, including gaps in the organization of care for diabetes and hypertension at primary health centres and availability of quality trained healthcare professionals (Shannon et al, 2019; Elias et al, 2016; Christiani et al, 2016). Underdiagnosis and poor disease management within the health sector were identified as barriers to accessing chronic disease medicines (Sarayani et al, 2014). Geographic accessibility also affected access to chronic disease medicines. For example, patients who lived in communities near a health centre and people living in urban areas had better access, while patients living in remote locations had poorer access (Emmerick et al, 2015; Srivastava et al, 2015; Christiani et al, 2016; Rahmawati et al, 2018). A range of patient characteristics such as age, sex, education, socio-economic status, insurance coverage, patient belief, marital status, knowledge of condition, seeking care or purchasing medicines in the private sector, treatment acceptability and use of alternative treatments were found to significantly influence access to chronic disease medicines in developing countries (Emmerick et al, 2015; Vialle-Vallentin et al, 2015; Shams et al, 2016;

Gama et al, 2013; Wagner et al, 2011; Jande et al, 2017; Macquart de Terline et al, 2019). Provider awareness and perceptions about medicine quality and safety were also found to have a significant impact on access in these settings (Marfo et al, 2017; Flood et al, 2017). Factors associated with the disease condition and drug therapy were also significant predictors of access and adherence, such as polypharmacy and the presence of comorbid disease conditions (Macquart de Terline et al, 2019; Gama et al, 2013; Shams et al, 2016).

Five studies specifically examined the factors associated with adherence to chronic disease medicines. Multiple factors were found to be associated with adherence, including poverty, socio-economic status, illiteracy, use of traditional medicines, poor knowledge of condition and medicines, patient beliefs about the medicine efficacy, dietary adherence, poly-pharmacy, duration of pharmacotherapy, perception of disease severity, regular visits to physician and medication side-effects (Macquart de Terline et al, 2019; Marfo et al, 2017; Jande et al, 2015; Shams et al, 2016; Sarayani et al, 2013).

The literature review on the factors associated with access and adherence to chronic disease medicines in developing countries supports Penchansky and Thomas' (1985) multidimensional concept of access. It also highlighted the problems faced by lower income countries and households in developing countries, concerning equitable access and adherence to chronic disease medicines (Babar et al, 2019; Ewen et al, 2019; Macquart de Terline et al, 2019; Chow et al, 2018; Attaei et al, 2017; Elias et al, 2017; Christiani et al, 2016; Murphy et al, 2016; Emmerick et al, 2015; Wagner et al, 2011). The next section

examines developing countries' use of government policies to improve access and adherence to medicines in developing countries.

4 A Systematic review of developing countries experience with policies aimed at influencing access to medicines

4.1 Introduction

WHO (2011) recommends that developing countries have policies as a basic intervention to promote access and quality use of essential medicines. As demonstrated earlier, there are many challenges to achieving the goal of equitable access to chronic disease medicines. A major challenge to achieving these goals is limited supply of low-cost essential medicines. This results in patients paying out-of-pocket or receiving poor quality treatment, particularly in the public sector. Vulnerable populations, such as the elderly and low-income families are more susceptible to the financial risks associated with the high cost of medicines. Patients with chronic diseases also face greater financial burdens, due to the complexity and longevity of these diseases (Viswanathan et al, 2012; Sum et al, 2018). However, while patient's risk profiles tend to be a big consideration in pharmaceutical policy designs, the country's economic status also plays a strong role (Maniadakis et al, 2017).

A search of systematic reviews databases in December 2018 (PDQ Evidence and Health Evidence) on the effects of pharmaceutical policies identified eighteen (18) systematic reviews completed in the last five years. The countries included in these reviews were

primarily developed countries in Europe and North America. The reviews highlighted that when policies do not offer sufficient financial protection from high out-of-pocket costs, patients are more likely to experience negative outcomes (Lee et al, 2013; Sinnott et al, 2013; Angela et al, 2014; Happe et al, 2014; Mann et al, 2014; Jia et al, 2014; Tang et al, 2014; Barnieh et al, 2014; Lee et al, 2015; Njie et al, 2015; Rashidian et al, 2015; Luiza et al, 2015; Kesselheim et al, 2015; Ogbechie & Hsu, 2015; Aziz et al, 2016; Kolasa & Kowalczyk, 2017; Park et al, 2017; Sum et al, 2018; Babar et al, 2018). Vulnerable populations, such as the elderly and low-income groups were at a greater risk of negative outcomes because of their limited financial resources (Jia et al, 2014; Sum et al, 2018). For patients with chronic diseases, when policies did not include sufficient pharmaceutical assistance or subsidy, access and adherence to essential medicines were negatively impacted and often lead to inappropriate use of health services (Mann et al, 2014; Tang et al, 2014; Njie et al, 2015; Luiza et al, 2015; Sum et al, 2018). On the other hand, some researchers argue that lowering or removing out-of-pocket expenses may cause overconsumption of unnecessary health services or irrational use of medicines (Jia et al, 2014; Luiza et al, 2015; Kolasa & Kowalczyk et al, 2017). There was also a general consensus from recent reviews that there was a lack of consistency in the findings pertaining to the effects of pharmaceutical policies on drug use outcomes, and that more research is needed in this area to inform effective policies.

4.2 Why do this review?

Ratanawijitrasin et al (2001) who conducted a systematic review almost twenty years ago concluded that there was a lack of reliable data in developing countries to answer questions about the effects of pharmaceutical policies on access to medicines. The authors also highlighted that most studies in developing countries used weak study designs. In the reviews examined more recently, except for Sum et al (2018), which included one study in India, systematic reviews on the effects of pharmaceutical policies, were based on high-income countries. This is consistent with a previous study, which concluded that there was a gap in evidence related to pharmaceutical policies in developing countries (Gray & Suleman, 2015). A number of limitations were highlighted in recent reviews, such as heterogeneity of populations studied, policy designs, study designs and outcomes measured outcomes (Lee et al, 2013; Sinnott et al, 2013; Angela et al, 2014; Happe et al, 2014; Mann et al, 2014; Jia et al, 2014; Tang et al, 2014; Barnieh et al, 2014; Lee et al, 2015; Njie et al, 2015; Rashidian et al, 2015; Luiza et al, 2015; Kesselheim et al, 2015; Ogbechie & Hsu, 2015; Aziz et al, 2016; Kolasa & Kowalczyk, 2017; Park et al, 2017; Sum et al, 2018; Babar et al, 2018). As a result, very few reviews included meta-analysis or pooled analysis of results. Those limitations plus the lack of inclusion of studies from developing countries, means that the existing evidence on this topic has limited transferability to policy makers in developing countries.

This review is intended to summarize existing research on the effects of pharmaceutical policies on drug utilization outcomes. By focusing on developing countries, it is adding to much needed evidence within this context.

4.3 Review objective

This review aims to examine the effects of government pharmaceutical policies on access and use of chronic disease medicines in developing countries.

4.4 Methods

Selection Criteria

The study selection criteria were based on the Population Intervention Comparator Outcome (PICO) framework. For this review, there were no set criteria for comparators.

Participants/population

Consumers of prescription medicines and healthcare providers who prescribe or dispense prescription medicines in developing countries. Only studies on community dwelling populations were included.

Developing countries were identified using the 2018 World Economic Situation and Prospects (WESP) report, produced jointly by the United Nations Department of Economic and Social Affairs (UN/DESA), the United Nations Conference on Trade and Economic (UNCTAD) and the five United Nations Regional Commissions (Economic Commission for

Africa (ECA), Economic Commission for Europe (ECE), Economic Commission for Latin America and the Caribbean (ECLAC), Economic and Social Commission for Asia and the Pacific (ESCAP) and Economic and Social Commission for Western Asia (ESCWA).

WESP classifies all countries into their basic economic condition. Based on that classification system, three broad groups were defined; developed economies; economies in transition and developing economies (WESP, 2018). Only studies pertaining to countries in the 'developing economies' group were included in the review.

Intervention

Government pharmaceutical policies aimed at influencing consumer or healthcare provider behaviour related to access and use of prescription medicines. For the purpose of this review, policies are defined as laws, regulations, policies and programs implemented at the national or regional level or in the public sector. This definition is consistent with previous reviews (Rashidian et al, 2015; Ratanawijitrasin et al, 2001).

Outcomes

- Medicine access and use
    - Access (availability, affordability)
    - Prescribing/dispensing patterns
    - Consumption patterns e.g. adherence or compliance

Although five dimensions of access was described earlier, the literature review in section two identified availability and affordability as the main concern in developing countries when

it comes to accessing chronic disease medicines. As such, the systematic review focused specifically on these two access dimensions along with other outcome which represent key steps in the medicine consumption life cycle in which government pharmaceutical policies can influence change. They are also key priorities for improving the quality of drug therapy.

Types of study to be included

Quantitative study designs, including randomized control trials (RCTs), repeated measures studies (RM), non-randomized control trials (NRCTs), cohort studies, interrupted time series designs (ITS), controlled before-and-after studies (CBA), cross-section designs and other quantitative designs found in the literature.

Search strategy

PRISMA Guidelines for conducting systematic reviews were followed. Major online health related, and multidisciplinary databases were searched to identify peer-reviewed articles published in English. The databases searched were Medline, Web of Science, CINAHL and EMBASE were searched. Finally, the reference lists of included studies and reviews from the online bibliographic search were reviewed to identify additional studies. Search terms were based on the PICO framework and were refined by a trained librarian at Lancaster University. The search strategy was executed between November 1, 2018 and December 31, 2018 (Appendix 2.2)

Data extraction and management

All titles included in the search criteria were screened for inclusion/exclusion. Abstracts were then screened, followed by a full text review of articles for final inclusion. The information

extracted from each included study can be found in Appendix 2.3. Other pertinent information, such as the study limitations, that might affect the interpretation of the study were also noted. Data extraction was completed between January 1 to 30, 2019.

Methodological quality assessment

As this review is intended to evaluate evidence regarding public policies related to pharmaceutical access and use, the Effective Public Health Practice Project (EPHPP) tool was used to assess the methodological quality of included studies. This tool was designed to assess all types of quantitative studies and evidence related to public health programs and policy. The EPHPP tool outlines six components for assessing the methodological quality of quantitative studies (Appendix 2.4).

Each component was assessed and rated individually as either ‘strong’, ‘moderate’ or ‘weak’, then a global rating was given based on the combined assessment outcomes of the individual components. For the global rating, studies were also placed into one of three methodological quality categories, ‘strong’, ‘moderate’ or ‘weak’. Studies with two or more ‘weak’ component ratings were assessed as having ‘weak’ methodological quality, studies with one ‘weak’ component rating were placed in the ‘moderate’ category and studies with no ‘weak’ component rating were placed in the ‘strong’ methodological quality category. Studies were not excluded from the review on the basis of their methodological quality.

Strategy for data synthesis

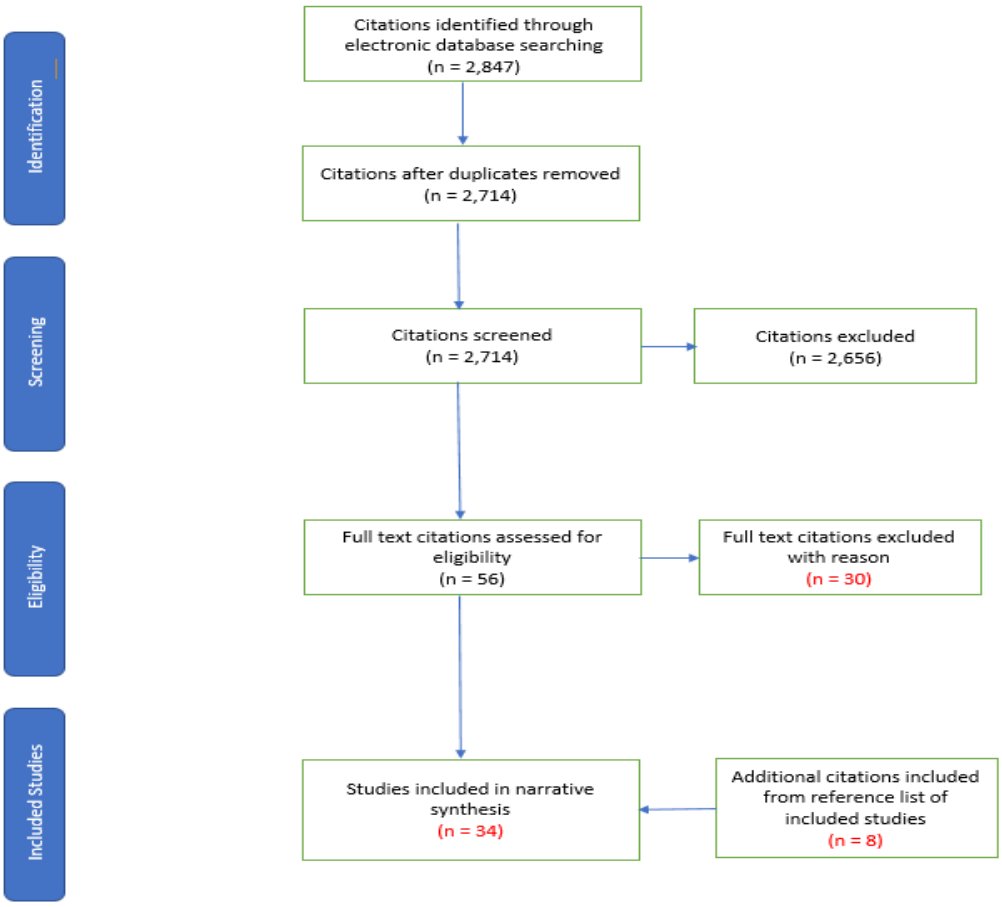
The findings from all included studies are presented in a descriptive summary table. Information includes country, authors, policy name/time period, and policy goal and policy intention.

A narrative approach was used to synthesize the findings of all included studies. This approach was chosen for two reasons. Firstly, because of the observed heterogeneity in population, study design, and policy designs. Secondly, because the objective of the review was to develop an understanding of the experience of developing countries with respect to their National Pharmaceutical policies. The narrative summary was organized and presented by the primary outcomes evaluated.

4.5 Results

The search yielded 2,714 citations. Upon screening of titles and review of abstracts, 2,656 records were excluded. The full text of the remaining 56 articles were retrieved and assessed for eligibility. Twenty-six (26) articles were eligible from the search. The reference list of all eligible studies was reviewed for additional articles not found in the search, which yielded eight (8) additional articles. A total of thirty-six (34) studies were included in the review. See figure 1 below for the PRISMA flow diagram of the study inclusion process.

Figure 1: Prisma Chart Outlining Process for Study Inclusion



Description of included studies

A total of thirty-four (34 studies) related to policies in ten developing countries were included in this review. Over half (52%) were related to policies in the East Asian region (China and Taiwan); One-fifth (21%) to policies in the Latin American Region (Brazil and Mexico); 9% of included studies were related to countries on the African Continent and one (3%) each from three countries across Asia and the Middle East (Turkey, Nepal, Thailand). A description of policies examined by included countries is provided in table 2 below.

Table 2: Description of policies and policy intervention evaluated in included studies

Country	Authors	Policy/time period	Policy intention	Policy component evaluated
China	He at al, 2018; Xi et al, 2018; Guo et al, 2017; Ding et al, 2017; Yi et al, 2015; Zhou et al, 2015; Yao et al, 2015; Chen et al, 2014; Song et al 2014a; Song et al 2014b; Zhang et al, 2014; Yang et al 2013	National Essential Medicine Policy (NEMP) and Zero-Markup Drug Policy (ZMDP) and Centralized Procurement Policy (2009)	Increase availability of essential medicines Improve affordability of essential medicines Reduce irrational prescribing Reduce the burden of pharmaceutical expenditure on the healthcare system	Multiple component policy: Reimbursement for medicines on Essential Medicines list Only; Zero profit on Essential Medicines; Centralized procurement of essential medicines
China	Huang et al, 2018; Zhang et al, 2017; Sun et al, 2009	China's 3 main health insurance schemes (Urban Employee Basic Medical Insurance was established in 1998; National Cooperative Medical Scheme established in 2003; Urban Resident Basic Medical Insurance Scheme established in 2008)	Improve affordability of primary care including medicines	Universal Health Coverage (UHC)
Brazil	Mengue et al, 2016; Monteiro et al, 2016; Bertoldi et al, 2012; Bertoldi et al, 2011; Paniz et al 2010; Bertoldi et al, 2009	Brazilian Unified Health System (SUS) - National Medicine Policy and National Policy on Pharmaceutical Services (1998-2004)	Improve availability of essential medicines Improve affordability of essential medicines Reduce irrational prescribing	Free access to medicines in the public sector since 1998 AND Access to low-cost medicines in selected private pharmacies for selected medicines (2004)

			Ensure equitable access	
Brazil	Arauja et el, 2014	Health Has no Price (SNTP) (2011)	Improve availability of essential medicines for patients with hypertension Improve affordability of essential medicines for patients with hypertension	Free access to selected anti-hypertensive in the private sector medicines
Mexico	Moye-Holtze et al 2018; Rivera-Hernandez et al 2016	Seguro Popular (SP) (2003)	Improve access to essential medicines Ensure equitable access	Multi-component health policy which includes access to range of health interventions including medicines
Mali	Maiga et al, 2003	National Drug Policy (1990) - Bamako Initiative	Improve availability of essential medicines Improve affordability of essential medicines Reduce irrational prescribing	Cost recovery mechanism for low-cost generic drugs
South Africa	Gray et al (2016)	National Drug Policy (2003)	Reduce irrational prescribing Reduce burden of pharmaceutical expenditure on the health system	Mandatory generic substitution
Nigeria	Uzochukwu et al, 2002	Bamako Initiative (1988)	Improve availability of essential medicines Improve affordability of essential medicines Reduce irrational prescribing	Cost recovery mechanism for low-cost generic drugs

Taiwan	Liu et al, 2003	The National Health Insurance Scheme (NHI) - Outpatient Prescription Drug Cost-Sharing Program (1999)	Reduce irrational prescribing Reduce burden of pharmaceutical expenditure on the health system	Drug co-payments
Taiwan	Chu et al, 2011; Chu et al, 2008	The National Health Insurance Scheme (NHI) - Reimbursement rate reduction policy (2000)	Reduce burden of pharmaceutical expenditure on the health system	Reimbursement rate reduction
Thailand	Garabedian et al, 2012	Universal Coverage Scheme (2001)	Reduce irrational prescribing Reduce burden of pharmaceutical expenditure on the health system	Payment caps on utilization of medicine
Turkey	Gur Ali et al, 2011	National Drug Policy (2006)	Reduce burden of pharmaceutical expenditure on the health system	Switching reimbursable prescription drugs to non-reimbursable over the counter (OTC) status
Nepal	Holloway et 2001a; Holloway et al 2001b	Bamako Initiative – Fee per item at public health facility (1992)	Improve availability of essential medicines Reduce irrational prescribing	Cost recovery mechanism for low-cost generic drugs

Thirteen studies evaluated the National Essential Medicine Policy (NEMP), which was introduced in China in 2009 (Huang et al, 2018; He at al, 2018; Xi et al, 2018; Guo et al, 2017; Ding et al, 2017; Yi et al, 2015; Zhou et al, 2015; Yao et al, 2015; Chen et al, 2014; Song et al 2014a; Song et al 2014b; Zhang et al, 2014; Yang et al 2013). The NEMP contained three key components, the National Essential Medicines List (NEML), Zero Mark-up Drug Policy and Centralized Procurement Policy. The NEMP was implemented as part

of China's healthcare reform and was intended to increase access to essential medicines and curb irrational prescribing in primary health centres. Two additional studies evaluated China's three government health insurance schemes, the Urban Employee Basic Medical Insurance established in 1998; National Cooperative Medical Scheme established in 2003; Urban Resident Basic Medical Insurance Scheme established in 2008 (Zhang et al, 2017; Sun et al, 2009). These policies were introduced in China at various points over time to increase equitable access to primary health care services, including access to medicines.

Six studies evaluated Brazil's National Medicine Policy under the Unified Health System (SUS) (Mengue et al, 2016; Monteiro et al, 2016; Bertoldi et al, 2012; Bertoldi et al, 2011; Paniz et al 2010; Bertoldi et al, 2009). Key policy components evaluated were, free access to medicines in the public sector and access to low-cost medicines in the private sector under the 'Popular Pharmacy Program". Aruaja et al (2014) evaluated the "Health Has No Price Program", which was introduced in 2011 to allow for free access to selected anti-hypertensive medicines in the private sector.

Two studies investigated Mexico's Seguro Popular (SP) policy, which was introduced in 2003 to improve access and availability of healthcare services, particularly the portion of the population without access to employer provided health insurance (Moye-Holtze et al 2018; Rivera-Hernandez et al 2016).

Three studies evaluated Taiwan's National Health Insurance Scheme (NHI). One study evaluated the Out-Patient Prescription Drug Cost-Sharing Program, which was introduced

in 1999 (Liu et al, 2003) to address irrational physician prescribing. The other two studies evaluated the Reimbursement Rate Reduction Policy which followed in 2000 (Chu et al, 2008; Chu et al, 2011) with a goal of reducing pharmaceutical expenditure.

National Drug Policies tied to the Bamako Initiative was evaluated in four studies from three separate countries, Nigeria (Uzochukwu et al, 2002), Mali (Maiga et al, 2003) and Nepal (Holloway et al, 2001a; Holloway et al 2001b). The Bamako Initiative was formulated in 1987, as a cost-recovery mechanism where low-cost generics are sold at a profit and user-fees are charged to the patient. This was to ensure financing for the continued supply of essential medicines in public health centres and improve access and quality of care in the public health sector.

One study evaluated South Africa's National Drug Policy which was introduced in 1996. In 2003, the policy was updated to include mandatory generic substitution (Gray et al, 2016). It allowed for pharmacists had to offer a generic substitute, but patients could choose to accept or refuse the offer. Additionally, prescribers could write 'no substitution' on the prescription and pharmacists were disallowed from offering the generic substitute. The intent of this policy was to achieve generic prescribing in the public and private sectors in an effort to lower the burden of drug expenditure on the healthcare system.

One study evaluated Thailand's Universal Health Scheme (UCS), which was introduced in 2001 to ensure universal access to healthcare, including essential medicines. The policy

includes a payment capitation for outpatient services and essential medicines for each enrolled member (Garabedian et al, 2012).

Turkey's National Drug Policy (2006) was evaluated in one study. The main component of this policy is the removal of reimbursable prescription medicines to non-reimbursable over the counter status. This policy initiative was prompted by the government's ever-increasing expenditure on prescription medicines (Gur Ali et al, 2011).

A summary of the outcomes examined, and study designs of included studies is included in table 3 below.

Table 3: Outcomes examined in relation to National Pharmaceutical Policies

Intervention	Outcomes	Authors	Study design
Cost-recovery	availability; affordability; prescribing behavior	Maiga et al, 2003; Uzochukwu et al, 2002, Holloway et al, 2001a; Holloway et al 2001b	NRCT; CBA; Cross-sectional
Financial incentives (higher reimbursement for generics or essential medicines; no cost/low-cost medicines; health insurance)	Availability; affordability; prescribing behavior; utilization of outpatient clinics	He at al, 2018; Xi et al, 2018; Guo et al, 2017; Ding et al, 2017; Yi et al, 2015; Zhou et al, 2015; Yao et al, 2015; Chen et al, 2014a; Song et al 2014a; Song et al 2014b; Zhang et al, 2014; Yang et al 2013; Huang et al, 2018; Zhang et al, 2017; Sun et al, 2009; Mengue et al, 2016; Monteiro et al, 2016; Bertoldi et al, 2012; Bertoldi et al, 2011; Paniz et al 2010; Bertoldi et al, 2009; Arauja et el. 2014; Moye-Holtze et al 2018; Rivera-Hernandez et al 2016	ITS; CBA; Cross-sectional; NRCT
Financial disincentives (drug cost-sharing; reimbursement rate reduction; payment caps)	Prescribing behaviour	Garabedian et al, 2012; Chu et al, 2011; Liu et al, 2003; Chu et al, 2008	ITS; NRCT; CBA; Cohort (pre-post)
Generic substitution	Prescribing behaviour	Gray et al (2016)	ITS

Removing medicines from reimbursable list	Prescribing behaviour	Gur Ali et al, 2011	CBA

Methodological quality of included studies

Of the thirty-four included studies, thirty (31) were assessed as having 'weak' methodological quality, two (2) had 'moderate' and one (1) had 'strong' methodological quality. With respect to study designs, sixteen studies had various cohort analytic designs i.e. Cohort (multiple groups) or Cohort (pre-post) and were rated as having a 'moderate' study design (Holloway et al, 2001a; Holloway et al, 2001b, Uzochukwu et al, 2002; Liu et al, 2003; Chu et al, 2008; Sun et al, 2009; Gur Ali, 2011; Chu et al, 2011; Yang et al, 2013; Song et al, 2014a; Song et al, 2014b; Chen et al, 2014; Zhang et al, 2014; Yao et al, 2015; Zhou et al, 2015; Ding et al, 2017; Moye-Holz et al, 2018). Three (3) used an interrupted time series (ITS) design and were also rated as having a 'moderate' study design (Garabedian et al, 2012; Gray et al, 2016; He et al, 2018). All other studies used various cross-sectional study designs and were rated as having a 'weak' study design (Maiga et al, 2003; Bertoldi et al, 2009; Paniz et al, 2010; Bertoldi et al, 2011; Bertoldi et al, 2012; Araujo et al, 2014; Yi et al, 2015; Mengue et al, 2016, Monteiro et al, 2016; Rivera-Hernandez, 2016; Guo et al, 2017; Zhang et al, 2017; Huang et al, 2018; Xi et al, 2018). Confounding, data collection methods and blinding of investigators were rated as 'weak' in a large proportion of included studies (Appendix 2.5).

4.6 Narrative synthesis

Access (Availability and Affordability) – Essential Medicine

According to the WHO (2011), “essential medicines are those that satisfy the priority health care needs of the population” and must be selected for each country with due regard to disease prevalence and public health relevance. Access to essential medicines is a basic measure of the quality of a healthcare system. Availability and affordability of medicines are basic requirements to ensure equitable access. However, poor availability and affordability of medicines continue to challenge governments in developing countries. Governments use various mechanisms, such as cost-recovery and financial incentives, to ensure the availability and affordability of essential medicines.

Cost recovery mechanisms were used to ensure a steady supply of medicines in the public health sector. This involved the sale of low-cost generics in order to finance the purchase of essential medicines in primary health centres. The Bamako Initiative (BI) Model, which was adopted in a number of developing countries in Africa and Asia, was evaluated in Nigeria, Mali and Nepal (Holloway et al, 2001a; Holloway et al, 2001b; Uzochukwu et al, 2002; Maiga et al, 2003). They reported that cost-recovery mechanisms, based on the sale of drugs, had the intended effect of greatly increasing the availability and affordability of essential medicines (Uzochukwu et al, 2002; Maiga et al, 2003). The initiative also showed a positive impact on the availability of low-cost generics in the private sector in Mali, due to an increase in the demand for these drugs created in the public-sector (Maiga et al, 2003). However, there was a concern that while the BI Model was effective at improving access, it may have had an unintended consequence of over prescribing or irrational prescribing.

Financial incentives to ensure access to essential medicines were used as mechanisms in drug policies in a number of developing countries. This typically involved the government creating a list of medicines for which they were willing to partially or fully reimburse. In China, an important goal of the NEMP was to increase the use of primary health centres where patients would be able to access essential medicines at low-cost (Zhang et al, 2014; Yao et al, 2015; Yi et al, 2015; Zhou et al, 2015; Ding et al, 2017; Gou et al, 2017; Xi et al, 2018; Huang et al, 2018). Key components of the policy were higher reimbursement rate for essential medicines; a restriction on physicians prescribing non-essential medicines and prohibiting primary health clinics from profiting off the sales of essential medicines. Majority of studies reported a lack of effectiveness of the NEMP in achieving its goals. Rather than increasing outpatient visits, where patients can access low-cost essential medicines, there was evidence that patients shifted utilization behavior from primary health centres in favor of secondary and tertiary facilities (Ding et al, 2017; Guo et al, 2017; He at al, 2018). One explanation given for this change was because the EML restriction did not apply to secondary care facilities (Ding et al, 2017; He at al, 2018). Other studies reported no change in outpatient utilization behaviour as a result of the NEMP (Zhang et al, 2014; Yi et al, 2015). These conflicting results may be due to a number of factors including, differences in study design and population studied. There was also evidence that out-of-pocket payments after reimbursement did not decline after the policy was implemented (Ding et al, 2017). Furthermore, Huang et al (2018) and Zhang et al (2017) evaluated the three National Health Insurance schemes, which had a goal of improving access to essential medicines. They found that the health insurance schemes have not been effective in making medicines affordable in outpatient clinics. Huang et al (2018), Xi et al (2018) and Yao et al (2015)

identified systematic barriers in China, such as, disparity in socioeconomic development, rural vs urban setting and the organizational structure of National Policies in China, that have confounded their effectiveness.

Brazil's constitution guarantees free access to essential medicines in public clinics. Due to the limited availability of medicines in these clinics, the government also implemented various programs in private pharmacies to increase access to medicines for chronic diseases. Two such programs are, the "Popular Pharmacy Program" and the "Health has No Price Program". In public clinics where medicines are provided free, Bertoldi et al (2009, 2012) reported that even the poorest segment of the population had to pay out-of-pocket for their medicines. It was also reported that upper income families spent more money on medicines compared to lower income families (Monteiro et al, 2016; Bertoldi et al, 2011). Likely because people in the upper income brackets can afford to pay for their medicines in private pharmacies, where there is better supply and fewer restrictions. Free access to chronic disease medicines was reported to have improved as a result of Brazil's pharmaceutical policies (Paniz et al, 2010; Bertoldi et al, 2011; Arauja et al, 2014). This is important because of the financial burden that long-term medicines can place on households. Disparities in access was evident. For example, some cities and regions reportedly had better access to medicines and utilization patterns were different among the rich versus the poor, and persons with health insurance (Bertoldi et al, 2009; Bertoldi et al, 2011; Bertoldi et al, 2012; Mengue et al, 2016). Although access to medicines improved in Brazil, the limited supply of low-cost medicines in public clinics was still a barrier. This likely

created socio-economic inequities in access, because the poor may be forced to purchase medicines in private pharmacies or forego treatment if they cannot pay.

Mexico's Seguro Popular (SP) was implemented with a goal of achieving access and equity to universal healthcare and required no fees for accessing medicines. Rivera-Hernandez et al (2016) evaluated the effect of Mexico's Segura Popular (SP) on access to diabetes and hypertension treatment and found that it only had a marginal effect on access to medicines for diabetes and no effect on access to medicines for hypertension. Moye-Holtze et al (2018) reported that innovative cancer medicines for beneficiaries of SP were less accessible compared to patients enrolled in work-based health insurance schemes. Considering that SP was primarily designed to cover the poorer population, this evidence suggests that it has not been effective reducing inequities. One explanation for the observed inequity is that larger cities were able to implement the policy more fully, because they had better infrastructure (Rivera-Hernandez et al, 2016; Moye-Holtze et al, 2018).

Prescribing behavior

Policies aimed at influencing prescribing behaviour tended to have two main goals: 1) to reduce the burden of medicine expenditure on the health system and 2) to improve the quality of treatment with prescription medicines. Irrational prescribing is a major cause of over expenditure on medicine and poor-quality treatment in developing countries. Sun et al (2009) showed that the National Cooperative Medical Scheme (NCMS) designed to increase access to primary care in rural China, inadvertently resulted in irrational prescribing among village doctors. In an attempt to address irrational prescribing, China's NEMP policy included the Zero Markup Drug Policy, which removed the financial incentive for healthcare

providers to prescribe irrationally. However, this policy was not found to be effective in curbing their behaviour, as providers sought new and inappropriate ways to increase revenue from the sale of medicines (Yang et al, 2013; Chen et al, 2014; Song et al, 2014; Yi et al, 2015; He et al, 2018). In Taiwan, the National Health Insurance (NHI) reimbursement rate reduction and the drug cost-sharing policies did not have the intended effect of containing government expenditure on medicines, because physicians changed their prescribing behaviour in order to increase revenue in other ways (Chu et al, 2011; Liu et al, 2003). The Bamako initiative (BI) model was also associated with inappropriate prescribing behaviour, such as, a tendency towards prescribing brand name and higher number of medicines per prescription (Uzochukwu et al, 2002; Maiga et al, 2003). Gray et al (2016), examined the mandatory generic substitution policy in South Africa, and found that it had very little effect on prescribing behaviour in South Africa. Turkey's policy of removing prescription drugs to over the counter (OTC) status, in order to reduce national drug expenditures, resulted in inappropriate prescribing, where there was a reduction in the use of medicines removed from the list (Gur Ali et al, 2011). Similar concerns of over-prescribing and irrational use of medicines was highlighted in systematic reviews of high-income setting (Jia et al, 2014; Luiza et al, 2015; Kolasa & Kowalczyk et al, 2017).

Consumption Patterns (adherence/compliance)

Studies on the effects of National Drug Policies on adherence or compliance to chronic disease medicines were not found, which is a gap in the literature for developing countries.

4.7 Discussion

Access to medicines is the first step towards achieving quality use of medicines. Developing countries often face significant resource challenges when it comes to financing medicines, which may ultimately affect the design and effectiveness of drug policies. A major consideration in their policy design is to control costs related to inappropriate use of medicines. As a result, these policies have had varying impacts on access and use of chronic disease medicines.

A range of policies have been implemented by developing countries to improve access to medicines. Financial mechanisms to influence patients' or providers' behavior, was a common tool used to achieve these goals. They included cost recovery and financial incentives tied to essential medicines policies. Cost-recovery was in the form of user-fees, while financial incentives included reimbursement and subsidies for low-cost medicines. However, these policies did not always have the intended effects and sometimes led to undesirable outcomes. Some unintended effects were an increase in irrational prescribing, inappropriate use of healthcare services, and increase in out-of-pocket payments for medicines. These findings are consistent with previous systematic reviews that evaluated policies in high-income countries (Jia et al, 2014; Luiza et al, 2015; Kolasa & Kowalczyk et al, 2017).

Drug policies were also strongly motivated by the government's goal of reducing the burden of pharmaceutical expenditure on the health system and ensuring a sustainable supply of

essential medicines. To achieve this, government policies targeted provider prescribing behaviour, including removing drugs from the reimbursement list or reducing the rate of reimbursement for non-essential medicines, removing profit from the sale of medicines, and encouraging prescription of generic medicines. None of these strategies proved to be effective at engendering the intended prescribing behaviour. The underlying reasons for some of these observed behaviours may need further exploration in order to find more sophisticated ways of addressing prescriber and patient behavior around inappropriate use medicines.

Additionally, health system infrastructure, such as, supply of medicines and organization and implementation of drug policies, were key determinants of access to medicines. Oftentimes these infrastructures were poorly developed and were not properly factored into drug policies in developing countries. As a result, inequities in access to medicines was still a problem and had a greater impact on the socio-economically disadvantaged. For example, in China, access to medicines was poorer among rural populations because of challenges with drug supply logistics in rural areas (Yao, 2015). As a result, urban residents paid less for medicines because those facilities benefit from lower logistics costs (Yao, 2015). Although this study was rated as having weak methodological quality, it highlights the accessibility dimension of access, where physical barriers such as geographical location are key determinants of access to medicines.

4.8 Limitations of the systematic review

Due to observed heterogeneity in population, context and study designs, analysis of pooled results was not possible in this review. Majority of studies included in this review had weak methodological quality. Notably, confounding, data collection and blinding were rated as having 'weak' quality, which limits the application and validity of this review to other settings. This finding is consistent with a previous systematic review by Ratanawijitrasin et al (2001), who concluded that poor study designs in developing countries makes it difficult to evaluate the effectiveness of pharmaceutical policies in those settings. Considering Ratanawijitrasin et al (2001) was done almost 20 years ago, there has been little change in the past two decades when it comes to the quality of research on this subject in developing countries. This is likely due to the difficulty in designing studies to measure drug use outcomes and lack of information systems in developing countries to reliably collect data on drug use on a population scale.

The inclusion of qualitative research may have enhanced the findings and or interpretation of the findings of this review, however due to several documented challenges with searching for qualitative studies (e.g. variation in of qualitative methods, non-standardized terminology, and absence of research methods from abstracts) (Booth, A., 2016), a decision was made to exclude them.

5 Summary of the literature review

5.1 Factors associated with access and adherence to chronic disease medicines in developing countries

Access to medicines is a multidimensional concept, which is not defined consistently in the literature in developing countries. There is a paucity of high-quality studies examining what factors are associated with access to chronic diseases medicines in developing countries. Studies published in the last decade tended to focus on affordability and availability of essential medicines, which are factors controlled at the global or health system level. However, the literature review identified multiple factors outside of the health system that are also affecting access to chronic disease medicines, such as patient, socio-economic, drug therapy, cultural, patient and provider awareness, geography and other contextual factors. These factors varied across countries and regions and highlights the need for country-specific research on access to medicines to inform effective policies and programmes.

5.2 A Systematic review of developing countries experience with policies aimed at influencing access to medicines

Developing countries often face significant resource challenges when it comes to financing medicines, which may ultimately affect the design and effectiveness of drug policies. A major consideration in their policy design is to control costs related to inappropriate use of

medicines. As a result, these policies have had varying impacts on access to medicines. The systematic review highlights the challenges developing countries face to design effective policies in order to reduce inequities in access to chronic disease medicines (Huang et al, 2018; Xi et al, 2018, Yao et al, 2015; Bertoldi et al, 2009; Bertoldi et al, 2011; Bertoldi et al, 2012; Mengue et al, 2016; Rivera-Hernandez et al, 2016; Moye-Holtze et al, 2018). This is likely because policies tended to use financial mechanisms with a goal of reducing national pharmaceutical expenditure, without due consideration given to the multiple dimensionalities of access. The review also highlights several gaps in the literature related to developing countries that have implemented policies to improve access to medicines. Firstly, while studies were found in different geographic regions, they were concentrated in specific countries; the majority were located in Asia. Only a small number of studies were found in the Latin American and Caribbean region, and they were all related to policies in Brazil and Mexico. Secondly, even within these countries, there was a paucity of literature related to the effect of policies on access and use of medicines. Thirdly, there is also a gap in research on the effect of these policies on adherence to medicines (which is an important quality outcome related to access and use of medicines). Finally, the majority of studies examining the effect of government policies on access to chronic disease medicines had poor methodological quality, highlighting the need for high quality country-specific research to evaluate and inform government policies.

CHAPTER 3 - CONCEPTUAL FRAMEWORK

1 Chapter introduction

The goal of this chapter is to describe the research approach and the conceptual frameworks that will be used to guide the research project and to formulate testable hypotheses for the three research objectives below:

1) Research objective one aims to understand factors associated with enrollment in the NHF Drug Benefit among adults with diabetes or hypertension.
2) Research objective two aims to understand drug utilization patterns and factors associated with adherence among diabetic and hypertensive adults who were enrolled in NHF Drug Benefit programme.
3) Research objective three will examine whether the national health policy to remove user fees from public health facilities in 2008, had an impact on utilization of the NHF Drug Benefit programme among adults with diabetes or hypertension.

The chapter begins by discussing the research approach and metatheory, followed by an exploration of theories of health seeking behaviour, which lays the groundwork for how health services utilization can be perceived and evaluated. Finally, the two conceptual frameworks that will be used in this study are discussed - the Andersen-Newman Behavioural Model and the Quasi-Experimental Approach. The conceptual frameworks will be used in this research to help with the analysis, interpretation and translation of the research findings (Paradies & Stevens, 2005). This is to ensure that the research findings have relevance to health policy makers in Jamaica.

2 Research approach

The research project will use multiple secondary data sources and quantitative research methods to achieve the overall goal of the study. With this approach it is possible to assess varying outcomes related to access to the NHF Drug Subsidy among diabetics and hypertensives. Quantitative research is deductive and takes a positivist epistemological and ontological philosophical position (Bryman A., 2001, p.62). Positivism advocates for objectivism in scientific investigation, and the use of natural science methods to the study of social phenomena (Bryman, A., 2001, p.12). Positivist theories in health research tend to be concerned with causal inference, thus its purpose is to generate hypotheses that can be tested (Bryman, A., 2001, p.12). Positivism has been widely criticized for its claims of objectivity, due to inherent limitations in applying natural science methods to social phenomena (Goldenberg, 2006). While these are valid criticisms, it is the dominant philosophy underlying quantitative scientific methods (Bowling, A., 2009, p. 129). The present study will therefore be conducted with the assumption that the outcomes investigated reflect human behaviour which were externally observed and measured using the principles of natural sciences (Bowling, A., p. 129). Recognizing that access to medicines is a complex and a multidimensional concept, the study also assumes that multiple explanatory factors are related to access to medicines, and these factors can be externally observed and measured (Bowling, A., p.129). Although it is difficult to claim the same level of value-free research as in the natural sciences, the use of secondary data supports the position of objectivity in the design phase of the research. There is also an awareness that social, political and cultural values may influence interpretations and

precautions will be taken against such influences. Based on these assumptions, the next section focuses on defining a roadmap (conceptual framework) to characterize the relationship between the explanatory and outcome variables in this study.

3 Theories of health seeking behaviour

Early theories revealed that health-seeking behaviour is a central concept to the understanding of health services utilization. It is important to study these behaviours, because they help to identify gaps in services, target appropriate patients and understand patterns of health practice and adherence with medical advice (Mechanic, 1995).

Khoso et al (2016) defined health-seeking behaviours as, “people’s response to symptoms of a disease within their socio-cultural environment”. A number of theoretical frameworks have evolved to explain the factors that influence health-seeking behaviour. These theories have been grounded in multiple disciplines including sociology, psychology and economics (Young, JT, 2004; Khoso, 2016). Health seeking behaviour is also referred to as Illness behavior and has been distinguished in the literature from health behaviour (Khoso et al, 2016). This distinction is important, as it is conceivable that behaviours of ill individuals are quite different from that of healthy individuals. Whereas health seeking/illness behaviour has to do with behaviours of people who know themselves to be ill and take certain actions to get well, health behaviours relates to people who want to maintain good health and aligns more with health promotion, prevention and protection (Khoso et al, 2016). Predominant theoretical explanations of health behaviour such as the Health Belief Model (HBM), Theory

of Reasoned Action (TRA), Theory of Planned Behaviour (TPB) and Health Locus of Control (HLC) are associated with health behaviours and thus commonly used to examine disease prevention programs. Therefore, they were not considered appropriate models for analyzing patients diagnosed with chronic diseases or who may require long-term medical treatment, and excluded from further discussion (Khoso et al, 2016).

The concept of health seeking behaviour was proposed in the early 1950's by Talcott Parsons who wrote about health seeking behaviour in terms of the 'sick role' (Khoso et al, 2016; Young JT., 2004). Later the concept of 'illness behaviour' was proposed in the 1960s by Mechanic and Volkart who were interested in understanding the behaviour of patients who were sick (Khoso, et al 2016). The early theories of health seeking behavior have guided much of the present-day research around health services use (Young, JT, 2004).

3.1 Early Theories

Parsons' sick role theory (1951) dates back to the early 1950's and is one the first theories to explain factors associated with health services use (Varul, MZ, 2010, Heidarnia, MA, 2016). It is a sociological theory, based on the assumption that all individuals have specific roles within the society. Parsons saw illness as more than a biological condition, but also a social phenomenon. He postulated that illness was an undesirable state causing the individual to assume a 'sick role', which precluded them from normal daily activities (Heidarnia, MA, 2016). In an effort to return to 'normal' functioning, the individual is motivated to seek out healthcare services (Heidarnia, MA, 2016). From Parsons' (1951)

perspective, the patient's decision to seek care was so they could return from their temporary 'sick role' to their institutional roles for which they were socialized. This theory was widely criticized by researchers for a number of reasons, including inadequately explaining observed differences in health seeking behaviour (McKinlay, J.B., 1972; Segall, A., 1976; Young JT, 2014; Yang & Hwang, 2016). Additionally, the 'sick role', which appeared to have been conceptualized as a temporary state, was a poor fit for the experience of individuals with chronic illnesses (McKinlay, JB, 1972; Segall, A., 1976).

Mechanic (1968) argued that the bio-physiological approach to illness used in medicine was inadequate to describe the complexities of illness behaviour and the factors contributing to the use of formal and informal care (Young, JT., 2004). He initially postulated that psychological factors which were largely based on the patient's illness experience and perceived need for care was driving health seeking behaviour. Later, consideration was given to non-psychological factors outside the control of the individual patient, such as affordability and patient awareness. Mechanic's theory of illness behaviour was initially criticized for emphasizing the socio-psychological factors over the institutional factors that can act as barriers to access. However, it introduced the notion of patient need as a significant predictor of health seeking behaviour.

Suchman's Stages of illness and medical care (1965) builds on Parsons' Sick Role theory. He proposed that when a person becomes ill, they go through five (5) stages of critical decision-making points which will ultimately determine whether they will seek healthcare services (Suchman, EA, 1965). In his analysis of these five stages, he noted that there was

a natural tendency for individuals to under-emphasize symptoms of chronic diseases in their early stages, because they are not incapacitated (Suchman, EA, 1965). He also found significant variability in how severity of illnesses was perceived by age and sex and the decision to seek care (Young, JT, 2004). Suchman's model has been used to examine access to physicians among low-income individuals with chronic diseases (Young, JT, 2004, Newacheck & Butler, 1983). Newacheck & Butler (1983) highlighted significant differences between the poor and non-poor in healthcare utilization patterns and also supported Suchman's argument that incapacitation had a significant influence on healthcare utilization. Like Parsons' Sick Role Theory, Suchman's model has also been criticized for not accounting for socio-economic and cultural influences on health seeking behaviour (Young, JT, 2004). However, he highlighted the important role of the patient's characteristics on illness perception by demonstrating variations among patients from different demographic and social profiles.

Economic theories of health seeking behaviour have also been widely discussed in the literature (Young et al, 2004). Young JT (2004) examined several economic theories that have been used to study health services use and argued that economic theories are based on the assumptions that health seeking behaviour is largely driven by economic factors (Young, JT, 2004). These factors include income, cost of living, insurance, governmental assistance and self-payment/out of pocket costs. Young (2004) highlighted that while several authors have in the past reported the relationship between economic factors and use of health services, others have disputed these theories by showing that multiple factors

such as social, political and cultural factors, and not purely economics are driving utilization of health services (Young, JT, 2004).

4 Evaluating access to medicines

The theory of access described by Penchansky and Thomas (1981) and considerations for evaluating it described by Donabedian (1972), underscores the complexities with defining and evaluating access to health services. However, Donabedian (1972) stated that the actual utilization of health services was proof of access to healthcare. He highlighted the importance of measuring the quantity as well as the distribution of health, noting that the distribution of health by social class was an important criterion for evaluating healthcare access (Donabedian, 1972). Geographic and demographic distribution was seen as correlated to social class and were also considered important when evaluating healthcare access (Donabedian, 1972). Therefore, inequities can be identified by observing patterns of health service utilization which is a reflection of health seeking behaviour. It is well known that the poorer social class face greater access barriers. According to Tudor Hart's Inverse Care Law, the availability of medical care services is inversely related to patient needs (Hart, T., 1971 in Dalrymple, T., 2012). This suggests that there may be inherent inequities built into healthcare systems. Based on the above arguments, when evaluating healthcare access consideration must be given to equity in order to identify barriers.

To account for the multiple complex relations affecting access to medicines, Bigdeli et al (2013) proposed a framework for evaluating access to medicines, which takes a holistic

health system approach. Two (2) studies included in the literature review used this framework to examine the factors associated with access to chronic disease medicines in developing countries (Elias et al, 2017; Vialle-Valentin et al, 2015). However, the practical application of this framework for research purposes had many identified challenges, which the authors acknowledged could not easily be overcome (Bigdeli et al, 2013). That being said, important criteria for selection of a framework for this study were theoretical as well as practical applicability.

5 Conceptual framework: Andersen-Newman Behavioural Model of Health Service Utilization (Research Objectives 1 and 2)

Andersen & Newman (2005) stated that access and use of health services can be considered a type of individual behaviour. Andersen's model builds on previous work done by Mechanic (1968) and Suchman (1965) and predominantly reflects a sociological approach to health seeking behaviour. This framework, known as the 'behavioural model of health service utilization', was developed primarily to understand health service utilization patterns of the family unit; and to promote equitable access to services across population groups (Andersen, 1968). The framework conceptualizes health services utilization as behaviour influenced by micro and macro-level factors (Shaikh & Hatcher, 2004). The micro-level factors are patient and family characteristics, and macro-level factors represent the context in which patients seek health care. It aligns with Penchansky and Thomas (1981) theory of access, who noted similarities with their theory and the Andersen-Newman Model. The initial model explained health service utilization as a function of predisposing, enabling

and need factors and hypothesized that equitable access exists when utilization is largely determined by predisposing and need factors and less so by enabling factors such as income (Andersen, 1968). Since then, the model has gone through several iterations to account for inputs such as the health care system and the external environment as well as to include measures such as perceived and evaluated health status as outcomes related to health services use (Aday & Andersen, 2005; Phillips et al, 1998; Aday & Andersen, 1974; Andersen & Newman, 1973). Over time, the focus of analysis has shifted from the family to the individual as the unit of analysis to account for heterogeneity among family members (Andersen, 1995). Contextual or environmental variables were also highlighted by Phillips et al (1998) and Andersen (2008) as important determinants of health services use and to help understand the barriers that exist within the health system or communities. The most recent model has retained most of its initial tenets of predisposing, enabling and need factors but also emphasizes contextual or environmental factors influencing health service use (Phillips et al, 1998; Evans and Stoddart, 1990 in Andersen, 1995; Andersen, 2008).

Predisposing factors include biological factors such as age and sex, socio-structural factors such as education and ethnicity, and cultural factors such as health beliefs (Andersen & Newman, 2005). According to Andersen & Newman (2005), these are individual characteristics which exist prior to illness and represent the propensity of individuals to use health services more than others. Enabling factors or resources include income, insurance coverage, physical access to services such as transportation and distance to care and community resources such as availability and region of the country (Andersen & Newman, 2005). These variables include family and community characteristics and represent the

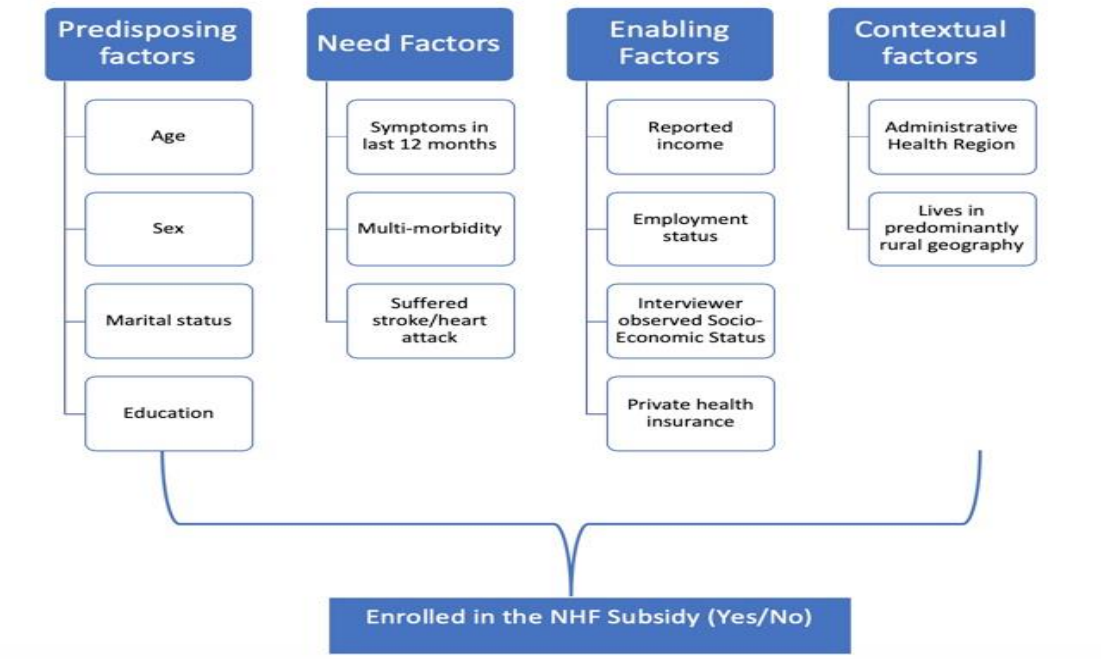
conditions that make health services resources available (Andersen & Newman). Perceived need refers to an individual's perception about their illness or level of need for care (Andersen & Newman, 2005). Perceived need includes factors related to the individual's attitudes, knowledge or values towards their illness and represent the most immediate cause of health service use (Lo and Fulda, 2008). While assessed need is based on clinical evaluation of the individual's level of impairment (Andersen & Newman, 2005; Cohen-Mansfield & Frank, 2008). Assessed needs are more objective measures and include factors such as actual illness experience of the individual and illness severity (Andersen & Newman, 2005). Predisposing, enabling and need factors are measures of individual characteristics. Contextual factors include health organization, provider-related factors and community characteristics. According to Andersen (2008), contextual factors can be measured at an aggregate level and can include measures such as, age-structure, healthcare resources, mortality and disability rates and community health resources and area level health planning (Andersen R, 2008; Morgan et al, 2010).

The final component of the model is the use of health services, which is the measured outcome related to health seeking behaviour. Equitable access to healthcare services was defined by Andersen (2008) as occurring when need and predisposing characteristics are responsible for most of the variation in utilization.

5.1 Hypotheses (Research Objective one)

Research objective one will examine the factors associated with enrollment in the NHF among adults diagnosed with diabetes or hypertension in Jamaica. The NHF Subsidy was established to ensure equal access to all Jamaicans with specific chronic diseases, regardless of age, sex or socio-economic status. Therefore, it will be important to examine the extent to which this occurs from the point of initial access. The Andersen-Newman Behavioural model of Health Services Utilization will allow for the examination of multiple individual and contextual factors to determine if enrollment reflects equitable access to the NHF drug benefits program (figure 2). As NHF enrollment is dependent on access to primary care, it relates to all six (6) dimensions of access - awareness, acceptability, availability, accommodation, acceptability, affordability and accessibility.

Figure 2: Conceptual framework for enrollment in the NHF Drug Subsidy



Accordingly, the following hypotheses were proposed for research objective one:

1) H_0: Initial access to the NHF subsidy is equitable among adult Jamaicans (18 to 59 years) with diabetes or hypertension i.e., need, and predisposing factors were the strongest predictors of enrollment in the NHF Subsidy.

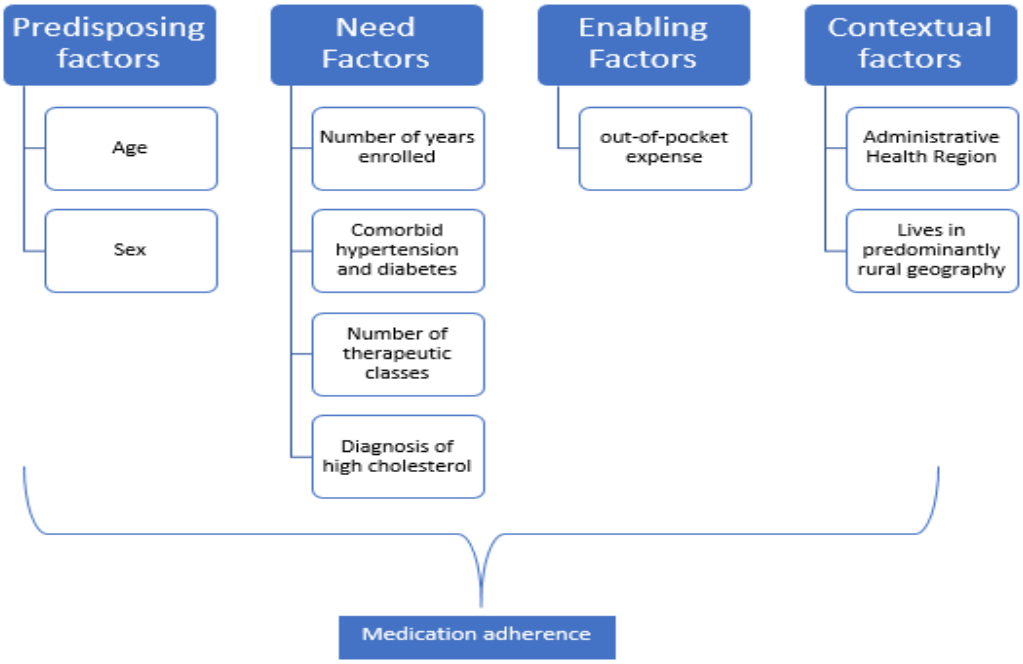
   H_a: Initial access to the NHF Subsidy among adult Jamaicans (18 to 59 years) with diabetes and hypertension, was mostly predicted by contextual and enabling factors.

5.2 Hypotheses (Research Objective two)

For individuals with chronic diseases, continuous access to medicines over time is necessary to ensure medication adherence and quality of care. Research objective two will examine patterns of drug utilization, the level of adherence and the factors associated with medication non-adherence among adults enrolled in the NHF subsidy. Medication adherence is indicative of continued access to medicines, which is necessary for the treatment of chronic disease like diabetes and hypertension. The extent to which the NHF is ensuring continuous access to medicines for adults with diabetes or hypertension needs to be examined. The factors being investigated will be organized according to the Andersen-Newman Behavioural Model into predisposing, enabling, need and contextual factors (figure 3). This will allow for the identification of barriers to medication adherence and to determine whether those barriers were predominantly related to predisposing and need factors such

as age and condition severity versus enabling and contextual factors such as out-of-pocket cost and geography. By using the Andersen-Newman Behavioural Model, it will be possible to identify medication non-adherence barriers that are potentially inequitable. Adherence was viewed from the perspective of continued access to medicines and relates to all six dimensions of access, affordability, accessibility, acceptability, accommodation, awareness and availability.

Figure 3: Conceptual framework for medication adherence among patients enrolled in the NHF Drug Subsidy with diabetes or hypertension



Accordingly, the following hypotheses were proposed for research objective two:

1) H_0: Adherence/continued access to medicines among adult Jamaicans (18 to 59 years) enrolled in the NHF Drug Subsidy in Jamaica was equitable i.e. need and predisposing factors were the strongest predictors.

   H_a: Adherence/continued access to medicines among adult Jamaicans (18 to 59 years) enrolled in the NHF Drug Subsidy in Jamaica, was mostly predicted by enabling and contextual factors.

6 Conceptual framework: Quasi-experiments (Research objective three)

Quasi-experiments are quantitative methods that test causal hypotheses by using experimental designs, but do not use random assignment to create treatment and control groups, from which the treatment effect can be inferred (Cook & Campbell, 1979, p. 7). These types of experiments are characterized as one where the exposure to the intervention of interest has not been manipulated by the investigator and are considered observational studies (Craig et al, 2017; Craig et al, 2012; Dunning, T., 2008). The Randomized Controlled Trial (RCT) is considered the gold standard research design for determining cause and effect relationships in health care interventions. However, when the objective of the research is to understand the impact of large-scale interventions on an entire population, RCTs may be neither practical nor feasible (Craig et al, 2012; Craig et al, 2017). In such circumstances, quasi-experiments can be used to understand the impact of a population-level intervention such a change in national policy (Craig et al, 2012). They are very useful

for examining real life interventions in real world settings. The specific type of quasi-experiment that can be used in these circumstances is known as a natural experiment (Bryman et al al, 2001, p.39). An important feature of this design is, the exogenous variation induced by the public health intervention or change in policy mimics that of a laboratory experiment and identify treatment and control groups (Meyer, D., 1995). As such, causal inference can be established, because assignment of treatment and control subjects are presumed to be random (Dunning T., 2008). There are many advantages to using this approach over planned experiments, such as, it allows for the analysis of the intervention on entire populations, and they tend to be logistically and economically more feasible than planned experiments (Craig et al, 2012). They have the potential to evaluate a wide range of public health interventions that could not realistically be evaluated using an RCT (Craig et al, 2012). As a result, policymakers and researchers have advocated for their use to evaluate the impact of national policies or legislation (Craig et al, 2012). In health services research, the data used in natural experiments are collected in real world settings, during the course of actual patient care and in the context of their social and political environment (Dunning, T., 2008). Another terminology used to describe the type of data used in natural experiments is real world data (RWD). With the development of the quasi-experimental approach, RWD are being recognized more and more as valuable sources of data within health services research. However, this approach is not without limitations and criticisms, which impacts their ability to make valid causal inference. Some of the key limitations are, they are more susceptible to bias and confounding which ultimately affects internal validity (Craig et al, 2012; Sekhon & Titiunik, 2012). To overcome some of the inherent methodological challenges, a number of statistical approaches are recommended to

evaluate quasi-experiments. The interrupted time series is one such approach. This is a model built on continuous sequence of observations on a population overtime (Bernal et al, 2017). It is used to evaluate trends in the outcome in the pre-intervention and post-intervention period (Craig et al, 2017). A comparison is then made between the observed trend in the pre-intervention and post-intervention periods, assuming that the trends in the outcome would be the same if not for the intervention between those two time periods (Craig et al, 2017; Kontopantelis et al, 2015). The model is known as a single group pre-post design when used on a single population without a comparison group. This particular design is useful for evaluating policies using time-series data.

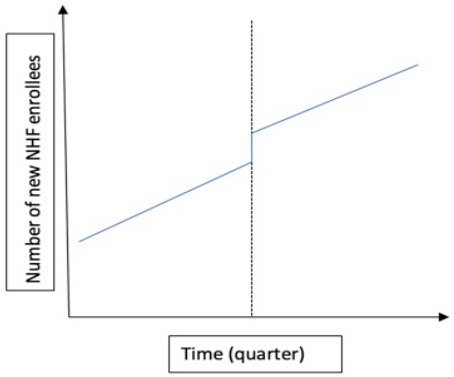
6.1 Hypotheses (Research Objective 3)

The Jamaican Ministry of Health's policy to remove user-fees from publicly funded primary care clinics, was intended to improve access to primary care, secondary care and medicines. This was a large-scale national policy to alleviate the financial barrier to accessing primary care services in the public sector. It has been reported that the removal of user fees made primary care visits more affordable thus improving access (Campbell A., 2013). Using a mixed-methods approach Campbell (2013) reported that patient utilization of the public health system increased immediately following the removal of user fees and remained above the pre-policy levels. Since primary care is the gateway to accessing the NHF, it can be assumed *apriori* that access to chronic disease medicines through NHF would also increase following the removal of user fees from primary care. The extent to which this policy increased access to chronic disease medicines among adults with diabetes

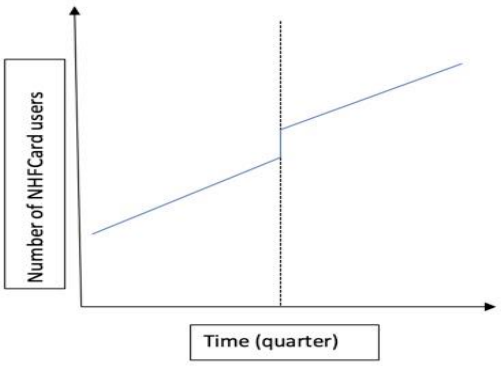
or hypertension will be investigated using an interrupted time series model (figure 4). A single group pre-post ITS model allows for the comparison of longitudinal trends in measures of access to the NHF among diabetics and hypertensives, before and after the removal of user fees in Jamaica. Based on the assumption that the trend in NHF access would remain the same if not for this policy, the impact of the policy on NHF access can be investigated. Access to the NHF will be assessed using two outcomes, new enrollment to the NHF Programme and NHFCard utilization among individuals with diabetes and hypertension. An ITS model also allows sub-group analysis, therefore equitable access will be assessed using demographic (age, sex) and geographical location (administrative health region, rurality) which are important indicators of the accessibility dimension. To use this model, data are collected over several incremental data points before and after the removal of user fees, as well as knowledge of the exact timing and details of the intervention (Jandoc et al, 2015; Hudson et al, 2019).

Figure 4: Conceptual framework for analyzing the effect of the removal of user-fees at primary health centres in 2008 on access to the NHF Subsidy

Model A: Number of new NHF enrollments



Model B: Number of NHFCard users



The hypotheses proposed for research objective 3 are as follows:

1) H_0: The health policy to remove user-fees from public health facilities in 2008 increased access (new enrollment and pharmacy visits) to medicines through NHF Individual Drug Benefit Programme, among adults with diabetes and hypertension in Jamaica.

   H_a: There was no difference in access (new enrollment and NHFCard use) to medicines through the NHF Individual Drug Benefit Programme among adults with diabetes and hypertension, following the health policy to remove user-fees from public health facilities in 2008.

7 Justification for selection of models

The first two research objectives aim to understand the range of factors influencing utilization of a healthcare benefit – The NHF Individual Benefit Programme. The Andersen-Newman Behavioural Model of Health Services Utilization was selected because it allows investigation of the individual and contextual factors that may be influencing the use of the NHF Programme. This model is also very flexible in handling data from multiple data sources. It's been applied in studies using survey data, where the researcher has a high level of control over the variables being collected as well in studies utilizing secondary administrative data, where the researcher has no control over the data being collected (Clewley et al, 2018; Morgan et al 2010; Andersen RM, 2008; Blalock et al, 2005). Thirdly, the model has been applied in similar research examining drug utilization patterns in a variety of settings and has been shown to facilitate ease of translation of study findings into health policy (Morgan et al, 2010; Blalock et al, 2005). This model is also said to be useful for exploratory analysis when there is not a lot of previous research in the area (Kim et al, 2016). Finally, the Andersen-Newman Behavioural Model of Health Services Utilization was recognized as being the most influential model used to guide much of health services research on access and utilization of health care services (Khoso et al, 2016).

The third research objective is to determine if the National Policy to remove user fees from primary health centres in 2008, had an impact on enrollment of the NHF subsidy. The interrupted time series (ITS) approach is the most common method used to evaluate policy interventions in drug utilization research (Jandoc et al, 2015). This model is also commonly

used to evaluate policies when using observational data from administrative sources (Jandoc et al, 2015). Biglan et al (2000) highlights the value of these designs in evaluating population interventions in multiple disciplines such as education and healthcare. Since the data and nature of the policy implementation is known, the ITS model is considered appropriate for evaluating this policy (Bernal et al, 2017). Another strength of the ITS model, is that the confounding effects of socio-economic status and other population characteristics are accounted for, as these are expected to change relatively slowly over time (Bernal et al, 2017). From the literature review in the previous chapter, which examined the effect of government policies on access to chronic disease medicines, three studies also used ITS models to evaluate their policies (Garabedian et al, 2012; Gray et al, 2016; He et al, 2018). Additionally, Li et al (2017) demonstrated the usefulness of an ITS model to evaluate and quantify the impact of the removal of user fees in Jamaica on healthcare utilization among children < 18 years old.

CHAPTER 4 - METHODOLOGY

1 Chapter Introduction

The study aimed to understand the factors contributing to or impeding access and utilization of the NHF among adults with diabetes or hypertension in Jamaica. In order to achieve this study aim, three research objectives were proposed. This chapter outlines the details of the study design, study population and statistical approach used to achieve the proposed study objectives.

2 Study design and setting

This study used a retrospective observational study design that combined self-reported cross-sectional survey data from the Jamaica Health and Lifestyle Survey II (JHLS II), and pharmacy claims administrative data from the National Health Fund (NHF). The study was based on community-dwelling adults (18-59 years) with diabetes or hypertension, who were eligible to use the NHF Drug Benefit Programme for prescription medication. The samples included individuals from all 14 parishes.

3 Data sources

The research involved the use of two secondary data sources. The Jamaica Health and Lifestyle Survey II (JHLS II), and pharmacy claims data from the National Health Fund (NHF). Both datasets are rich sources of data on medication use among patients with diabetes and hypertension within the Jamaican population.

3.1 The Jamaica Health and Lifestyle Survey II (2008)

Cross-sectional surveys are frequently used for conducting social and healthcare research (Bowling, A., 2005). The JHLS II is a national population-based cross-sectional survey which was coordinated by the Epidemiology Research Unit at the University of the West Indies in Kingston, Jamaica. Administration of the survey began in 2007 and was completed in 2008. The primary purpose of this survey was to determine the health and nutritional status, health seeking and lifestyle behaviour, and burden of risk factors of Jamaicans (Wilks et al, 2008). The survey is also a rich source of data on a range of social, cultural and environmental factors (Wilks et al, 2008). This was the second national health survey of its kind in Jamaica, and the only population survey which included data on the use of the NHF Drug Benefit Programme along with several other measured demographic, socio-economic and biomedical factors. To ensure national representation, participants were recruited using a random selection of clusters proportionate to the population of the 14 geographic regions (parishes) of Jamaica. Clusters were based on enumeration districts (EDs), which are lower-level geographic areas within each parish consisting of up to four hundred households (Wilks

et al, 2008). EDs are grouped within parishes to form sampling regions, within which primary sampling units were created to form clusters for random sampling (Wilks et al, 2008). The survey sample consisted of 2,914 individuals 15-74 years, of which 2,848 completed the survey, giving a low non-response rate of 1.7% (n=50). The survey was completed by experienced and trained interviewers using a face-to-face mode of data collection (Wilks et al, 2008). Face-to-face interviewer administered surveys are known to yield high response and item/questionnaire completion rates when compared to self-administered and telephone interviews (Bowling, A., 2005). Additionally, respondents tend to prefer this mode of administration compared to telephone interviews or self-administered because they are less burdensome (Bowling, A., 2005). However, face-to-face interviewer administered survey questionnaires can lead to other biases such as social desirability bias, 'yes-saying' bias and interviewer bias which can have serious implications on the validity and reliability of the survey (Bowling, A., 2005). However, a number of quality control checks were done to ensure quality and reliability of the data collected on the JHLS II. These measures included, checking for errors or omissions on completed questionnaires and partially re-interviewing 10% of respondents (Wilks et al, 2008). The survey was approved by the Jamaican Ministry of Health and the University of West Indies Ethics Committees. All participants provided written informed consent. Full details of the survey methods can be found in Chapters 2 and 3 of the survey report by Wilks et al (2008).

The JHLS II has supported a large number of health research projects and health policy decisions in the country. More specifically for the purposes of this research, it contained the necessary explanatory variables and the outcome variable of interest to examine equitable

access to the NHF Individual Benefit Programme among Jamaicans with diabetes and hypertension.

The JHLS II household survey was used to test the hypothesis related to research objective one:

1) Research hypothesis one:

H_0: Initial access to the NHF subsidy is equitable among adult Jamaicans (18 to 59 years) with diabetes or hypertension i.e. need, and predisposing factors were the strongest predictors of enrollment in the NHF Subsidy.

H_a: Initial access to the NHF Subsidy among adult Jamaicans (18 to 59 years) with diabetes and hypertension, is mostly predicted by contextual and enabling factors.

3.2 NHF Pharmacy Claims Database

The data used in the study was extracted from the NHF pharmacy claims database. The NHF is a government agency that administers the NHF Individual Benefit Programme across the island. They maintain an electronic population-based administrative database, which contains basic patient demographic data as well as the prescription history of medicines purchased using the NHFCard. The patient data is collected at the time of enrollment. Enrollment is necessary for all patients who wish to receive medicines free at public pharmacies or at a subsidized cost at private pharmacies, for any of the 16 eligible chronic

conditions. To enroll, patients must complete an application form with their names, address, sex and their date of birth and have it signed by their physician confirming the diagnosis(es). Once enrolled, individuals receive a NHFCard with a unique identifier, which they present to the pharmacy at each visit. The purchase is then linked back to the patient record using the unique identifier tied to the NHFCard. The enrollment and disease information for which the patient sought subsidization is captured in the NHF database, along with their drug claim history. Drug information is also coded using a unique identifier called the Generic Product Identifier (GPI). The GPI is a standard coding system consisting of a 14-digit code used to identify critical information about the medicine, such as the drug class, drug name, dosage form and strength. At the time the drug is dispensed, the quantity and number of days of supplies received by the individual is also captured in the database. The database therefore contains all the patient, disease and drug claim history related to the use of the NHF Card. As a result of this electronic data capture, the NHF database is a rich source of secondary data and contains over 240,000 patients currently receiving subsidies and over 4 million drug claims per year (NHF Annual Report, 2018). While, the database captures the dispensation of medicines to Jamaicans enrolled in the NHF, it is important to note that a limitation of this database is, it does not include prescriptions that were written but not dispensed; prescriptions not eligible for NHF subsidy nor does it include information on prescriptions that were dispensed and not taken. Two cohorts consisting of patient level data were extracted from the NHF pharmacy claims data for the years 2008 and 2017 to address research objective two. Two cohorts consisting of aggregate data were also extracted for the years 2007 to 2009 and was used to address research objective three. The specifications for the extracts are provided in Appendices 4.1 to 4.5.

The idea that health care administrative data, although designed for operational use, can be leveraged for research is not new. Several researchers, particularly in developed countries have used administrative data to address important health research questions (Tricco et al, 2008; Cadarette et al, 2012; Cadarette & Wong, 2015). Administrative data sources used to manage pharmacy claims have been shown to provide valuable information related to prescribing and dispensing patterns, adherence to drug therapy and drug safety and effectiveness (Cadarette & Wong, 2015; Gazmararian et al, 2006, Sinott et al, 2017). The benefit of using these data sources is, they are cost-efficient, and their representation of routine clinical care makes it possible to investigate actual utilization patterns in real-world settings (Schneeweiss & Avorn, 2005; Andrade et al, 2006). Because pharmacy claims data need to be complete and up to date for reimbursement purposes, they are generally considered to be accurate and of good quality (Schneeweiss & Avorn, 2005, Sinnott et al, 2017, Strom et al, 2013, p.119).

The NHF pharmacy claims was used to test the hypotheses related to research objectives two and three:

1) Research Hypothesis two:
    a) H_0: Adherence/continued access to medicines among adult Jamaicans (18 to 59 years) enrolled in the NHF Drug Subsidy in Jamaica was equitable i.e. need and predisposing factors were the strongest predictors.

       H_a: Adherence/continued access to medicines among adult Jamaicans (18 to 59 years) enrolled in the NHF Drug Subsidy in Jamaica, is mostly predicted by enabling and contextual factors.

2) Research Hypotheses three:

   a. H_0: The health policy to remove user-fees from public health facilities in 2008 increased access (new enrollment and NHFCard use) to medicines through NHF Individual Benefit Programme, among adults with diabetes or hypertension in Jamaica

      H_a: There was no difference in access (new enrollment and NHFCard use) to medicines through the NHF Individual Drug Benefit Programme among adults with diabetes and hypertension, following the health policy to remove user-fees from public health facilities in 2008

4 Data management

The JHLS II raw data was received in CSV format and imported directly into SPSS for coding and analysis. The raw data from the NHF pharmacy claims database was received in CSV format. The data was then imported into SQLITE, a software package which provides relational data management capabilities. SQLITE has the ability to process complex queries using structured query language (SQL) and was used to create the cohorts, the explanatory and outcome variables used in the study. The SQL codes used to create the study cohorts are included in appendix 4.6.

5 Study population and sampling

A retrospective cohort study was conducted among adults (18 to 59 years old) with diabetes or hypertension in Jamaica. The government of Jamaica also provides chronic disease drug subsidies for seniors (60+ years) through a separate programme called the Jamaica Drug for the Elderly Programme (JADEP). Individuals over 60 years can be enrolled in both the NHF and JADEP programmes and access their medications through either programme. However, because of the absence of a unique identifier it was not possible to link claims data under both programmes in persons over 60 years old. The analysis was therefore limited to persons under 60 years old who would only have been eligible for the NHF programme. All cohorts included individuals from the 14 parishes in Jamaica.

5.1 Inclusion/exclusion criteria

Research objective one – Factors associated with NHF enrollment among adults with diabetes or hypertension

Only a sub-sample of adults (18 to 59 years old) who responded 'yes' to the question on the JHLS II, "Have you ever been told by a doctor, nurse or other health professional that you have diabetes (sugar)?" or "Have you ever been told that you have high blood pressure?" Based on these criteria a total of 626 respondents were included in the data extracted for this study. This represented 22% of the total sample recruited from the JHLS II Household Survey (2008).

Research objective two – Factors associated with medication adherence among NHF enrollees with diabetes or hypertension

Two cohorts of patients were extracted from the NHF pharmacy claims data (2008 and 2017). Each cohort included adults (18 to 59 years old) enrolled in the NHF with a diagnosis of diabetes or hypertension, and who used their NHFCard to purchase chronic disease medicines (antidiabetics, antihypertensive, antihyperlipidemics) at any of the participating pharmacies in Jamaica. Additionally, to ensure a long enough adherence assessment period, only individuals who had a minimum of 6 months between their first and last prescription fill date in the assessment years (2008 and 2017) were included in the analysis. Individuals who purchased insulin were excluded, because of the difficulty deriving an appropriate adherence metric for injectable medicines from pharmacy claims data (Stolpe et al, 2016). Based on these criteria, 20,264 individuals were included for analysis in 2008 and 77,454 were included in 2017.

Research objective three – Effect of removal user-fees on NHF enrollment and use of the NHFCard

Two cohorts were extracted from the NHF pharmacy claims database, one for each outcome measure examined. The first cohort consisted of adults (18 to 59 years old) who enrolled in the NHF with a diagnosis of diabetes or hypertension between January 1, 2007 and December 31, 2009. The second cohort consisted of adults (18 to 59 years old) who used their NHFCard to purchase medicines between January 1, 2007 to December 31, 2009. Based on these criteria, 49,559 individuals were included in the final cohort for the analysis of New NHF enrollment and 74,520 individuals were included in the final analysis of NHFCard utilization.

6 Study variables

6.1 Research Hypothesis One - Factors associated with NHF enrollment among adults with diabetes or hypertension

Dependent variable:

Are you enrolled in the NHF (Yes/No?)? – This variable captures NHF enrollment status of adults in Jamaica with diabetes and hypertension who were eligible to receive subsidized medicines through the NHF Drug Benefit Programme. Enrollment status was used as a measure of access to the NHF and was based on the survey question, "are you enrolled for an NHFCard?" Possible responses to that question were, 'Yes', 'No', 'Don't Know' or 'No response'. As the research objective was to compare factors influencing NHF enrollment, responses of 'Don't Know' or 'No response' were excluded from the analysis (n=90). Response bias is a known challenge for survey questionnaires and may have impacted the validity of this dependent variable. These biases were mitigated by the quality control measures used by the survey administrators, such as re-interviewing a sample of the survey respondents.

The intent of this dependent variable was to evaluate access to the NHF at the level of enrollment, where the patient is required to seek medical care and have their condition certified by their physician. Following certification by a physician, they are required to enroll in person at one of many locations across the island. It effectively indicates whether the patient was diagnosed by a physician with hypertension and/or diabetes and has enrolled and received an NHFCard. Enrollment in the NHF Programme directly reflects three

dimensions of access, namely accessibility, accommodation and awareness. Accessibility relates to the physical or geographical location of primary care services and the location of NHF enrollment sites. Accommodation relates to the operational and administrative components such as hours of operation of private and public health physicians as well as NHF enrollment sites. Awareness relates to awareness of physicians who are required to confirm the diagnosis, and patient awareness to seek appropriate medical care. However, this measure of access does not indicate whether the patient purchased any drugs using the NHF card.

Explanatory variables

In addition to information on the dependent variable (enrollment in the NHF), the JHLS II survey contained a wide range of explanatory variables to address research objective one. The Andersen-Newman Behavioural Model of Health Service Utilization was used to identify key explanatory variables to address the research objective regarding the factors predicting enrollment in the NHF among diabetics and hypertensives in Jamaica. The variables were grouped into the different categories of predisposing, enabling, need and contextual variables according to the definition of these categories found in the literature. These variables are described in table 4 below. A key limitation is that the data was collected in 2008, however this was the first population health survey to include data on the use of the NHF drug subsidy programme along with several other measured demographic and socio-economic factors and was directly relevant to the research objective. While a similar survey was completed in 2016, it did not include questions to allow examination of access and use of the NHF programme.

Table 4: Description of explanatory variables (Factors associated with NHF enrollment among adults with diabetes or hypertension)

Variable Category	Variable name	Description
Predisposing	Age (years)	5 groups: 18-39[1]; 40-44; 45-49; 50-54;55-59
	Sex	2 groups: Female[1]; Male
	Marital status	3 groups: Married/common-law[1]; Divorced/Separated/Widowed; Single/Visiting
	Education	3 groups: Less than secondary[1]; Secondary; Post-Secondary
Enabling	Employment status	3 groups: Unemployed/student[1]; Part-time/seasonal; Full-time
	Weekly Household income[2]	3 groups: <$10,000[1]; $10,000-$20,000; >$20,000
	Private Health Insurance	2 groups: Yes[1]; No
	Interviewer observed Socio-Economic Status (SES)	3 groups: Low income[1]; Middle Income; High Income
Need	Sick in the past 12 months	2 groups: Yes[1]; No
	Individual has both conditions (diabetes & hypertension)	2 groups: Yes[1]; No
	Suffered a stroke or a heart attack in the past	2 groups: Yes[1]; No
Contextual	Health Administrative Region	4 groups: South East Regional Health Authority (SERHA)[1]; North East Regional Health Authority (NERHA); Southern Regional Health Authority (SRHA); Western Regional Health Authority (WRHA)

	Primarily rural surroundings or living conditions (reside in a parish with > 50% households in rural areas (St. Ann; Clarendon, St. Mary, St. Elizabeth, Manchester, Portland, Westmoreland, St. Thomas, Hanover, Trelawny)	2 groups: Yes[1]; No

1. Reference group
2. Excluded due to >5% missing responses

6.2 Research objective two - Factors associated with medication adherence among NHF enrollees with diabetes or hypertension

Dependent variable

Medication adherence (Y/N) – **Measuring medication adherence (Dependent variable)**

Adherence was measured using the medication possession ratio (MPR). It is an indirect measure of adherence, which quantifies possession of medicines based on the number of days of supplies dispensed over a period of time (Hess et al, 2006). The medication possession ratio (MPR) was derived from the prescription re (fill) data available in the NHF pharmacy claims database. The specific calculation for the MPR was as follows:

$$MPR\ (\%) = \frac{total\ days'supply\ between\ the\ 1st\ and\ last\ prescription\ fill\ date}{Number\ of\ days\ between\ the\ 1st\ and\ last\ prescription\ fill\ date\ +\ last\ prescription\ supply}\ x\ 100$$

The MPR falls within a range of 0 to 100%, where 0 is no adherence and 100% is total adherence (Sperber et al, 2017). It was capped at 100% to account for overestimation of adherence due to early refills. The MPR was dichotomized, where 80% or more MPR was considered adherent, and < 80% MPR non-adherent. According to Karve et al (2009), a

cut-off point of 80% is reasonable and often used in research, for stratifying patients into adherent and non-adherent when they have prevalent chronic conditions. The average MPR for three therapeutic classes (antidiabetics, antihypertensives and antihyperlipidemics) was used to determine if the patient met the adherent threshold of >= 80%.

This measure is the most common measure of adherence when using pharmacy claims administrative data (Hess et al, 2006; Friedman et al, 2007; Wong et al, 2012; Margolis et al, 2017). The MPR is identical to other commonly used measures of adherence such as Continuous Measure of Medication Acquisition (CMA), the Continuous Multiple Interval Measure of Oversupply (CMOS) and Medication Refill Adherence (MRA) (Hess et al, 2006). The values are also close to measures that report more conservative estimates such as the proportion of days covered (PDC). The MPR is not a direct measure of adherence and does not measure consumption, rather it measures possession of medicines and therefore directly reflects access to medicines among individuals enrolled in the NHF.

The MPR was intended to capture continuous access to chronic disease medicines and represents all six dimensions of access (awareness, acceptability, affordability, accessibility, accommodation and availability).

Explanatory variables

The Andersen-Newman Behavioural Model was used to identify key explanatory variables to address the factors associated with adherence to antidiabetic and cardiovascular disease medicines among diabetics and hypertensives enrolled in the NHF. These variables were captured from the NHF pharmacy claims database and are described in table 5 below. A

key strength of the data is, there were no missing variables pertaining to any of the explanatory variables used in the analysis. However, the database does not capture some important explanatory variables known to be associated with use of health services, such as patient's socio-economic status. It is well known that patients' socio-economic status are important enablers to health service utilization and is often explored in health services research. Notwithstanding this limitation, there were important explanatory variables found in this data source that were related to the conceptual model used in the study, and thus relevant to this research objective.

Table 5: Description of explanatory variables (Factors associated with medication adherence among NHF enrollees with diabetes or hypertension)

Variable category	Variable name	Description
Predisposing	Sex	2 groups: Female[1]; Male
	Age Group (at first prescription fill in the year 2017)	5 groups: 18-39[1]; 40-44; 45-49; 50-54; 55-59
Enabling	Average monthly out-of-pocket expenses (J$)	3 groups: <5,000[1]; 5000-10,000; >10,000
Need	Polypharmacy (number of distinct therapeutic classes prescribed during the period)	5 groups: One[1]; Two; Three; Four; Five; > 5
	Diabetes and hypertension comorbidity status	3 groups: Diabetes AND hypertension[1]; Hypertension without diabetes; Diabetes without hypertension
	Diagnosis of high cholesterol (at the time of enrollment)	2 groups: Yes; No[1]
	Number of years enrolled	6 groups: < 1[1]; 1-2; 2-3; 3-4; 4-5; > 5

Contextual	Health Region	4 groups: Southeast Region[1]: Southern Region; North East Region; Western Region
	Primarily rural surroundings or living conditions (reside in a parish with > 50% households in rural areas (St. Ann; Clarendon, St. Mary, St. Elizabeth, Manchester, Portland, Westmoreland, St. Thomas, Hanover, Trelawny)	2 groups: Yes[1]; No

1. Reference group

6.3 Research objective three - Effect of removal user fees on NHF enrollment and use of the NHFCard

Dependent variables

A. New NHF enrollees with diabetes or hypertension

This was the number of new NHF enrollees with diabetes or hypertension. New enrollments were identified using the enrollment date from the NHF pharmacy claims database. The value for this outcome variable was the aggregate number of NHF enrollees with diabetes or hypertension between 18-59 years, within the time-periods of interest. This was meant to capture better access to primary care in the public sector, which should result in the individuals being diagnosed and getting their NHF enrollment application signed off by a physician, subsequently leading to enrollment within the NHF.

B. NHFCard utilization among enrollees with diabetes or hypertension

This was the number of NHF enrollees with diabetes or hypertension who purchased medicines using their NHFCard during the time-period. NHFCard utilization is captured in the NHF pharmacy claims database each time a person purchases medicines using their card. The value of this outcome variable was the aggregate number of NHF enrollees between the ages of 18-59 years, who purchased medicines using their NHFCard within the time-periods of interest. It is intended to capture pharmacy visits in relation to better access to primary care in the public sector.

Explanatory variables

Removal of user fees in public health facilities in 2008

Health facility user fees were charges paid by the patient at the point of care in health facilities in Jamaica. Historically, these charges have been used in developing countries to generate revenue and to discourage misuse of limited resources at health facilities (Campell, A., 2013; Li et al, 2017). Although these fees were promoted by the World Bank as a means of offsetting financial burden within the health sector and promoting sustainability of health services, research in developing countries have shown that they have had a negative impact on access to basic health services (Campbell, A., 2013; Li et al, 2017). Changes to user fees in Jamaica have gone through many iterations since 1968 to its ultimate removal on April 1, 2008 (Coombs, M., 2013):

Table 6: History of changes to user fees at public health clinics in Jamaica

Time Period/Year	Changes to user fees in public health facilities in Jamaica
1968	Fees revised
1975	Removed user fees
1984	Reintroduction user fees
1993	Increase in user fees
1999	Increase in user fees
2005	Increase in user fees
2007	remove user fees for < 18 years
01-Apr-08	Remove user fees for all patients

Source: (Coombs, M., 2013)

In 1975, user fees had been removed from the public health system and then re-introduced in 1984. Since 1993, they had been increasing over-time before being subsequently removed for all patients on April 1, 2008. This policy change was a highly political and publicised change that received months of media attention. Thus, it had been discussed widely in the public sphere prior to its implementation on April 1, 2008. Following implementation on April 1, 2008, daily activity at public health centres and hospitals was also monitored by the Ministry of Health to determine the immediate effect of the policy.

Time-period

The total number of time-period data points used in the analysis was 36 months. January 2007 to March 2008, represented the pre-removal of user fees, April 2008, represented the policy implementation period, while May 2008 to December 2009, represented the post-removal of user fees period.

7 Statistical analysis

Multiple statistical methods were employed in order to address the range of research objectives proposed in this study. This section describes the methods used for each research objective and provides a justification for the selection of each method.

7.1 Research objectives one and two (Factors associated with NHF enrollment and Factors associated with medication adherence among NHF enrollees with diabetes or hypertension)

Descriptive analysis

Descriptive statistics in the form of frequency distributions and percent distribution were performed on all variables included in the study. This was done to describe the characteristics of the population and in the case of Research Objective 2, compare the drug utilization patterns among NHF enrollees in 2008 and 2017.

Bivariate analysis

Contingency tables were used to examine the distribution of the outcome variable and how it changed with each level of the explanatory variables. The Chi-squared test of independence was used to test each explanatory variable against the outcome variable of interest. The Chi-square test is a non-parametric test used to analyze group differences when the outcome variable is measured at the nominal and ordinal level (McHugh, M.L., 2013). The assumptions of the Chi-square include (McHugh, M.L., 2013):

1) The data in the cells must be frequencies or counts

2) Each study respondent should fit into only one cell and
3) The study groups are independent of each other
4) Like the outcome variable, the explanatory variables must be categorical. If there are ratio or interval, they can be collapsed into ordinal categories
5) 80% or more of the cells have expected frequencies of five (5) or greater and no cell should have expected frequencies less than one (1)

The null hypothesis of the chi-squared test is that the outcome variable tested in a bivariate relationship is independent of the explanatory variable. The alternative hypothesis being that the distribution of the outcome is determined by the explanatory variable. For research objective one, the outcome variable of interest was 'NHF Enrollment' which was a dichotomous variable reported by the respondent as 'yes' or 'no' in JHLS II Survey. For research objective two, the dependent variable of interest was 'medication adherence' which was also a dichotomous variable transformed from the medication possession ratio (MPR). The MPR was calculated from the NHF Pharmacy Claims data, where a patient with an MPR of 80% or more was categorized as 'adherent' and a patient with less than 80% MPR was categorized as 'non-adherent'.

With all the conditions and assumptions of the chi-squared test satisfied, it was considered appropriate for bivariate analyses in research objectives one and two. A p-value of 0.05 or less was used to determine statistical significance in the bivariate analysis. The chi-squared test will be followed up by the Cramer's V test to measure the strength of the association (McHugh M.L., 2013). It is calculated using the following formula:

$$V = \sqrt{\frac{X^2/n}{(k-1)}} = \sqrt{\frac{X^2}{n(k-1)}}$$

Where, X^2 is the chi-square, n is sample size and *k* is the lesser of the number of rows or columns (McHugh M.L., 2013). A Cramer's V test value of 0.1 to less than 0.2 is considered a weak association, 0.2 to less than 0.4 is considered moderate and 0.4 and greater is considered a strong association (Kotrlik et al, 2011). It should be noted that a weak association is not an indication of practical or clinical insignificance, as there is an expectation that weak associations will be observed in real world settings, where each predictor variable is only partially explaining the complex outcomes being investigated in this study (McHugh M.L., 2013).

Multivariate analysis

Binary logistic regression was used to model the relationship between the outcome and explanatory variables. This statistical method is commonly used in healthcare research to test the relationship between a dichotomous outcome variable and multiple continuous or categorical explanatory variables. It is frequently used for predictive analysis in order to model the probability of the outcome as a function of the explanatory variables. It resembles ordinary linear regression in many ways in that it allows for a combination of quantitative and categorical explanatory variables and it allows for the inclusion of interaction terms between explanatory variables (Peng et al, 2002). The fundamental characteristic of logistic regression modeling is, the application of the logit transformation to the odds of the outcome variable makes the relationship between the dichotomous outcome variable and its explanatory variables linear (Peng et al, 2002). Thus, allowing for the prediction of the

outcome based on the values of the explanatory variables (Peng et al, 2002). As a result, the relationship between the outcome and explanatory variables can be represented in the form of an ordinary linear regression equation. Other key assumptions underlying logistic regression method is that all observations are independent i.e. it should not be used with data collected from repeated measurements or matched data and there should be little or no correlation between explanatory variables in the model (multicollinearity). The mathematical concept underlying logistic regression is the natural logarithm of the odds (logit), where the odds of the outcome being investigated is equal to the ratio of the probability of the 'success' to the probability of 'failure' (Peng et al, 2002).

$$Logit\ (p) = ln\left(\frac{p}{1-p}\right) = \alpha + \beta X_1$$

Where *p* is the probability of the outcome, X_1 represents an independent variable, α is the intercept when $X_1 = 0$, β is the regression coefficient. Logistic regression allows for the examination of multiple covariates in a single model as follows (Peng et al, 2002):

$$logit\ (p) = \alpha + \beta_1 X_1 + \cdots \beta_k X_k$$

Where α is the y-intercept, p is the probability of the outcome, $X_1\ to\ X_k$ are a set of predictor variables and β_1 to β_k are the regression coefficients.

Based on the literature review which indicated that multiple factors impact on health service utilization, a logistic regression model was used to examine the relationship between the

outcome (enrollment in the NHF and adherence), and the predisposing, enabling, need and contextual factors. Forward logistic regression was performed to identify the model with the best explanatory variables of the likelihood of the outcomes investigated (NHF enrollment and adherence among NHF enrollees).

The logistic regression models for research hypotheses one and two are represented by the equations below:

1. Research hypothesis one:

   $Logit(enrol) = \alpha + \beta_1 age + \beta_2 sex + \beta_3 mar + \beta_4 ed + \beta_5 sym + \beta_6 mor + \beta_7 str + \beta_8 inc + \beta_9 ses + \beta_{10} hi + \beta_{11} hr + \beta_{12} rur + \mu \ldots$ (*equation 1)*

   where:

   a. *enrol* = response to the question “are you enrolled in the NHF”
   b. α = y-intercept
   c. β_1 to β_9 = regression coefficients
   d. *age* = age of respondent
   e. *sex* = sex of respondent
   f. *mar* = marital status
   g. *ed* = education level
   h. *sym* = symptoms in the last 12 months
   i. *mor* = Diabetes and hypertension comorbidity
   j. *str* = suffered a stroke/heart attack

k. *inc* = reported income

l. *ses* = interviewer observed socio-economic status

m. *hi* = respondent has private health insurance

n. *hr* = administrative health region of residence

o. *rur* = lives in predominantly rural geography

p. μ = *unobserved covariates*

2. Research hypothesis two:

$$Logit(adhere) = \alpha + \beta_1 age + \beta_2 sex + \beta_3 ye + \beta_4 mor + \beta_5 oop + \beta_6 ntc + \beta_7 hr + \beta_8 rur + \beta_9 hc + \mu \ldots \text{(equation 2)}$$

where:

a. *adhere* = adherent (>= 80% MPR) vs nonadherent (<80% MPR)

b. α = y-intercept

c. β_1 to β_{11} = regression coefficients

d. *age* = age (years) at the time of first prescription (2008, 2017)

e. *sex* = sex of respondent (male/female)

f. *ye* = Number of years enrolled in the NHF

g. *mor* = Diabetes and hypertension comorbidity status

h. hc = High cholesterol comorbidity

i. *oop* = Average monthly out-of-pocket expenses

j. *ntc* = Number of therapeutic classes (polypharmacy)

k. *hr* = administrative health region of residence

l. *rur* = lives in predominantly rural geography

m. μ **=** *unobserved covariates*

All explanatory variables were entered in the logistic regression model. According to the above equations, the null hypothesis underlying the overall model states that all **βs** are equal to zero, meaning there is no relationship between the outcome variable and explanatory variables. A rejection of this null implies that at least one β does not equal zero in the population, which means the logistic regression model predicts the probability of the outcome better than the mean of the outcome variable *Y* (Peng et al, 2002).

7.2 Research objective three – Effect of removal user fees on NHF enrollment and use of the NHFCard

Descriptive analysis

The mean was used to describe the population characteristic for each level of the explanatory variable analyzed. Frequency tables were used to present the results of the descriptive analysis.

Multivariate analysis

With the exact timing and nature of the policy change known, an Interrupted Time Series (ITS) model was used to test whether the removal of user fees from public health facilities improved access to the NHF Individual Benefit Programme. In order to utilize an ITS model, data for equal increments of time-periods was also available before and after the removal

of user-fees from public health facilities. A single group pre-post ITS model was constructed to determine whether new enrollments to NHF and NHFCard use increased. Based on the *a priori* assumption that the removal of user fees from public health facilities increased new NHF enrollments and NHFCard use, segmented linear regression was used to model these outcome measures before and after the implementation of the policy. Segmented Linear Regression also known as Piecewise Regression, is a statistical technique used to model temporal trends and is ideal for use with retrospective data for which there is sufficient number of data points before and after a policy implementation (Wagner et al, 2002; Valsamis et al, 2019). Segmented Linear Regression fits a least squares regression line to each segment of the explanatory variable (time) and assumes a linear relationship between the outcome and time (Wagner et al, 2002).

To construct a segmented regression model, the following three parameters are needed in addition to the explanatory and outcome variables.

1) The breakpoint or knot represents the point at which the linear function is expected to change. In this model, the knot value is known as the data point of the policy implementation (X^k).
2) A dichotomous dummy variable (T) which represents each side of the knot.
3) An interaction term between the dummy variable and the explanatory variable (XT). The values for the interaction term between the dummy variable and the values of the explanatory variables were calculated using the following equation:

$$X*T \text{ (interaction term)} = (X- X^k)\, T\ldots \textit{(equation 3)}$$

Below are the Segmented Linear Regression equations for the outcomes, number of new NHF enrollments (equation 4) and number of NHFCard users (equation 5) among diabetics and hypertensives, following the removal of user fees from public health clinics in Jamaica:

1. $new\_enrol_t = \alpha + \beta_1 X + \beta_2 T + \beta_3 (X - X^k) T$... *(equation 4)*
2. $presc_t = \alpha + \beta_1 X + \beta_2 T + \beta_3 (X - X^k) T$ …….. *(equation 5)*

Where:

a. new_enrol_t = Number of new NHF enrollment with diabetes or hypertension per quarter
b. $presc_t$ = Number of individuals who used their NHFCard per quarter
c. X = A continuous variable indicating time in months from the start of the study period
d. T= A dichotomous dummy variable indicating the pre-policy period (coded 0) or the post-policy period (coded 1).
e. α = Baseline level at time X = 0 (y-intercept in the pre-policy period)
f. β_1 = Slope of the regression line in the pre-policy period
g. β_2 = Level of change following the policy implementation (change in y-intercept in post policy period)
h. β_3 = Change in slope following the policy implementation

The linear regression model estimated the level and trend in the number of new NHF enrollment and the number of NHFCard use before the policy, and the changes in level and

trend following the policy. To examine whether the policy had an impact on equitable access to medicines, the analysis was stratified by demographic (age, sex) and contextual variables (health region, rurality). These were independent sub-group analysis intended to analyze whether the policy had an effect on specific sub-groups.

Controlling for confounding

Controlling for autocorrelation between values of the outcome measures over time

A key assumption of linear regression with time series data is the absence of autocorrelation between error terms. Serial autocorrelation is said to exist when the observation at a particular time point is correlated to observations in the previous time points (Wagner et al, 2002). This is a known problem with time series data, which can lead to unreliable estimates. The Durbin-Watson Test was done to detect the most common type of serial autocorrelation, known as first order serial autocorrelation. First order serial autocorrelation is when there is correlation between the error terms of adjacent time points (Wagner et al, 2002). The null hypothesis for this test is that the error term in one time is not correlated to the error term in the previous time. A failure to reject the null indicates that no autocorrelation was detected in the time series data. The values for the Durbin-Watson statistic fall between zero (0) and four (4) (Savin & White, 1991). To determine if autocorrelation exists, the Durbin-Watson test statistic (D) is compared to the lower (d_L) and upper bounds (d_u) in the critical values of the Durbin-Watson Test Statistic (Savin & White, 1991). The values of d_L and d_u are based on the number of observations (n) and the number of regressors (k) in the analysis (Savin & White, 1991). If there is no autocorrelation in the time-series data, then $D>D_u$; if $D<D_L$,

then there is evidence of autocorrelation; if D falls between the d_L and d_u, then the test is inconclusive.

Testing for bias due to exogenous events

Events occurring in the pre and post-policy periods and which are related to the outcomes being measured can bias the results of a single ITS design (Svoronos, T., 2016). As a result, changes detected in the outcome will be incorrectly attributed to the policy being evaluated. Cook & Campbell (1979) highlighted this issue as a major threat to internal validity of single ITS designs. To overcome these biases, it was recommended that a control group be used (Cook & Campbell, p. 211; Wagner et al, 2002), or to carry out an evaluation of a related outcome that was not affected the policy (Wagner et al, 2002). However, due to the design of the study, a control group was not available. Likewise, the evaluation of a related outcome measure that was unaffected by the policy was not in scope for this study. In order to test for the existence of external influences, falsification tests are recommended when using single ITS designs (Svoronos, T., 2016). One such test is the Chow Test for structural break points in the time series data (Svoronos, T., 2016). Based on the null hypothesis that there were no significant events related to access to the NHF directly before and after the removal of user fees, Chow Tests were conducted in SPSS. Structural breaks were chosen *apriori* at 3-month intervals during the pre- and post-policy periods for the test.

8 Approach to missing variables

Missing data as a result of non-response can lead to inaccurate conclusions (Sterne, 2009). This type of missing data is known as item non-response, where a proportion of the respondents provide a response to only some of the items in the questionnaire (Schlomer et al, 2010). Population health surveys are known to be prone to item non-response, especially to questions that respondents may deem sensitive or personal. Therefore, a missing variable approach was required for research objective one, which utilized the JHLS (II).

8.1 Research objective one – Factors associated with NHF enrollment among adults with diabetes or hypertension

A two-staged approach was taken to understand and deal with missing data. First a univariate missing variable analysis (MVA) was performed in SPSS on all variables to examine the extent of missing data. The approach to handling variables with less than 5% missing values in the dataset was to do complete cases analysis, in which only the records that do not have missing values are retained in the analysis. No further missing variable analysis was performed on these variables. Variables with > 5% item non-response were further analyzed to examine their pattern of missingness. The variable income had 33% missing responses (Table 7a).

Table 7a: Missing Values Analysis

Variables	N	Missing	% Missing
Sex	626	0	0.0%
Patient has both conditions (Diabetes & Hypertension)	626	0	0.0%
Has health insurance	624	2	0.3%
Age	626	0	0.0%
Marital Status	624	2	0.3%
Education	607	19	3.0%
Employment Status	608	18	2.9%
Socio-economic status	623	3	0.5%
*Income	415	211	33.7%
Suffered a stroke/heart attack	626	0	0.0%
Have you been sick in the past 12 months	626	0	0.0%
Diagnosed with a mental health problem	626	0	0.0%
Rural	626	0	0.0%
Health Administrative Region	626	0	0.0%
Are you enrolled in the NHF (dependent variable)	626	0	0.0%

To examine the pattern of missingness in the 'income' variable, a Chi-squared test was used to test the association between missingness on the 'income' variable and all other variables, where $p<0.05$ was considered significant. This test was performed to determine if the missing responses were missing completely at random (MCAR), missing at random (MAR) or missing not at random (MNAR). Missingness on the 'income' variable was significantly associated with 'employment status', 'interviewer observed social status', 'administrative health region', 'rurality' and the outcome variable, 'enrolled in the NHF' (Table 7b). Based on its association with multiple covariates, it was assumed that the missing data pattern was not random (MNAR), and a decision was made to exclude the 'income' variable from further analysis. Since the interviewer observed social status was considered a similar and more

objective measure of income status, excluding reported income did not compromise the analysis of this important variable.

Table 7b: Missing Variable Analysis: Cross-tabulation with missing income data

Variable	% Missing income data	chi-square (p-value)
Sex		
Male	30%	0.959 (0.327)
Female	34%	
Age		
18-34	32%	
35-44	29%	4.563(0.207)
45-54	35%	
55+	42%	
Marital Status		
Married/Common-law	33%	
Divorced/Separated/widowed	31%	0.558 (0.757)
Single/visiting	35%	
Education		
Less than Secondary	39%	
Secondary	32%	5.460 (0.065)
Post-Secondary	26%	
Missing	21%	
****Employment status**		
Unemployed/student	47%	31.190 (< 0.001)
Part-time/Seasonal	28%	
Full-time	25%	
****Interviewer Observed Social status**		
High income	50%	6.950 (0.031)
Middle income	32%	
Low income	31%	
Have private health insurance		
Yes	29%	1.191 (0.275)
No	35%	
Have you been sick in the past 12 months		0.169 (0.681)

Yes	35%	
No	33%	
Patients has both diabetes and hypertension		2.834 (0.092)
Yes	41%	
No	32%	
Suffered stroke/heart attack		0.144 (0.704)
Yes	29%	
No	34%	
****Health Administrative Region**		46.05 (< 0.001)
SERHA	26%	
NERHA	66%	
SRHA	38%	
WRHA	27%	
****Rural**		27.86 (<0.001)
Yes	37.90%	
No	27.90%	
****Enrolled in the NHF (dependent variable)**		6.607 (0.01)
Yes	42%	
No	31%	

**variable significantly associated with missing data on income category (p<0.05)

CHAPTER 5 - RESULTS

1 Chapter Introduction

The results were presented in three sections. Each section relates to one of the three research hypotheses.

2 Section one – What factors predicted enrollment in the NHF among adults with diabetes and hypertension?

At the time of the survey, 154 or approximately one-quarter (25%) of adults with diabetes or hypertension between the ages of 18 to 59 years were enrolled in the NHF Drug benefit programme (figure 5).

2.1 Univariate analysis

Figure 5 – Enrollment in the NHF (n=626)

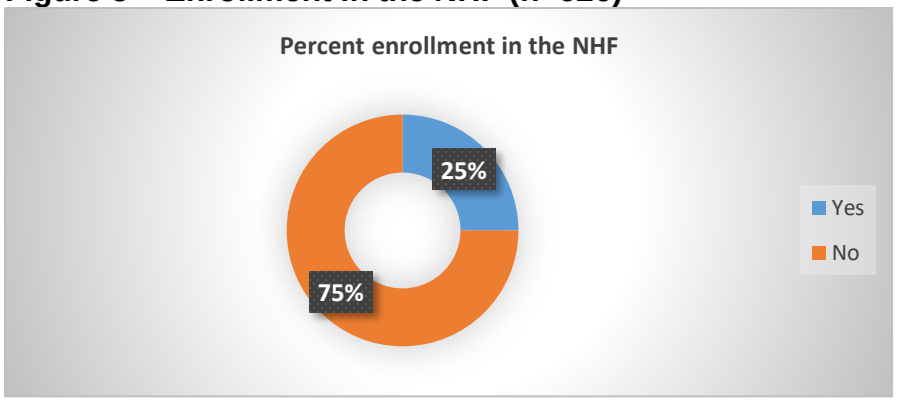


Table 8: Distribution of predisposing, enabling, need and contextual factors (n=626)

		enrolled (yes)		enrolled (no)		
		n	%	n	%	Total
PREDISPOSING FACTORS	**Sex**					
	Female	130	76%	410	24%	540
	Male	24	72%	62	28%	86
	Age					
	18-39	18	9%	188	91%	206
	40-44	22	24%	71	76%	93
	45-49	39	34%	75	66%	114
	50-54	37	32%	80	68%	117
	55-59	38	40%	58	60%	96
	Marital Status					
	Married/Common-law	97	28%	246	72%	343
	Divorced/Separated/widowed	12	46%	14	54%	26
	Single/visiting	45	18%	210	82%	255
	Education					
	Less than Secondary	68	27%	184	73%	252
	Secondary	59	21%	215	79%	274
	Post-Secondary	23	28%	58	72%	81

		enrolled (yes)		enrolled (no)		
		n	%	n	%	Total
ENABLING FACTORS	**Employment status**					
	Unemployed/student	63	27%	170	73%	233
	Part-time/Seasonal	13	15%	72	85%	85
	Full-time	71	25%	219	76%	290
	Interviewer Observed Social status					
	Low income	34	16%	173	84%	207
	Middle income	104	29%	260	71%	364
	High income	16	31%	36	69%	52
	Have private health insurance					
	Yes	30	28%	76	72%	106
	No	124	24%	394	76%	518

		enrolled (yes)		enrolled (no)		
		n	%	N	%	Total
NEED FACTORS	**Have you been sick in past 12 months**					
	Yes	56	28%	142	72%	198
	No	98	23%	330	77%	428
	Patients has both diabetes and hypertension					
	Yes	53	53%	47	47%	100
	No	101	19%	425	81%	526
	***Suffered stroke/heart attack**					
	Yes	6	35%	11	65%	17
	No	148	24%	461	76%	609

		enrolled (yes)		enrolled (no)		
		n	%	N	%	Total
CONTEXTUAL FACTORS	**Health Region**					
	7 - Southeast Regional Health Authority	80	26%	227	74%	307
	20 - Northeast Regional Health Authority	16	24%	56	76%	72
	12 - Southern Regional Health Authority	30	23%	103	77%	133
	18 - Western Regional Health Authority	26	23%	86	77%	112
	Rural parishes					
	Yes	71	23%	235	77%	306
	No	83	26%	237	74%	320

Table 8 summarizes the characteristics of the study participants. Explanatory variables were summarized according to the categories of the Andersen-Newman Framework i.e., predisposing, enabling, need and contextual factors. Female participants outnumbered males by a ratio of six (6) to one (1) and more than half (55%) of the participants were married. Forty eight percent (48%) were under the age of forty-five, while 52% were in the older age categories (45-59 years), indicating a large proportion of middle-aged participants. Approximately 1 in 8 participants reported having post-secondary education, while the majority had either less than secondary or secondary education. Thirty three percent (33%)

of the participants were observed by the interviewer to be in the lowest income category. However, the majority were in the middle-income category, while only 8% were observed to be of high-income status. The percentage with private health insurance was 17%.

Almost one-third (32%) reported being sick in the past 12 months and 16% reported having both chronic conditions (diabetes and hypertension). Three percent (3%) had suffered a stroke or heart attack in the past 12 months.

At the time of the survey, approximately half of the respondents lived in the Southeast administrative health region (SERHA) and 48% lived in a parish which was predominantly rural (>50% households in rural areas).

2.2 Bivariate analysis

Table 9: Bivariate relationship between predisposing factors and NHF Access (n=626)

	enrolled (yes)		enrolled (no)			
PREDISPOSING FACTORS	**n**	**%**	**n**	**%**	**Total**	**Chi-squared p-value (Cramer's V)**
Sex						
Female	130	76%	410	24%	540	
Male	24	72%	62	28%	86	p = 0.443 (0.03)
Age						
18-39	18	9%	188	91%	206	
40-44	22	24%	71	76%	93	
45-49	39	34%	75	66%	114	
50-54	37	32%	80	68%	117	
55-59	38	40%	58	60%	96	P < 0.001 (**0.30)
Marital Status						
Married/Common-law	97	28%	246	72%	343	
Divorced/Separated/widowed	12	46%	14	54%	26	
Single/visiting	45	18%	210	82%	255	p < 0.001 (0.16)
Education						

Less than Secondary	68	27%	184	73%	252	
Secondary	59	21%	215	79%	274	
Post-Secondary	23	28%	58	72%	81	p = 0.291 (0.07)

p<0.05 is significant association
** Moderate to strong association

Table 9 presents the results of the bivariate analysis between explanatory variables and the outcome variable. Significant associations were observed between age and marital status and the participants likelihood of being enrolled in the NHF. Participants who were never married (single/visiting), were less likely to be enrolled in the NHF compared to participants who reported being in a committed relationship at some point (married/common-law, separated/divorced/widowed). However, the relationship between marital status and NHF enrollment could be described as weak (v=0.16). From the analysis it was also observed that, as the age of the participants increased, the probability of enrolling in the NHF also increased. Only 9% of participants with diabetes or hypertension between the ages of 18-39 years were enrolled, compared to 40% of participants between 55-59 years (p<0.001). The Cramer's V measure (v=0.3) suggests a strong relationship between age and the likelihood of NHF enrollment. Likelihood of enrollment in the NHF was similar for males and females at 28% and 24% respectively (p=0.443). Similarly, participants' enrollment in NHF was not significantly associated with level of education attainment (p=0.291).

Table 10: Bivariate relationship between enabling factors and NHF Access (n=626)

	enrolled (yes)		**enrolled (no)**			
ENABLING FACTORS	**n**	**%**	**n**	**%**	**Total**	**Chi-squared p-value (Cramer's V)**
Employment status						
Unemployed/student	63	27%	170	73%	233	p = 0.095 (0.09)

Part-time/Seasonal	13	15%	72	85%	85	
Full-time	71	25%	219	76%	290	
Interviewer Observed Social status						
Low income	34	16%	173	84%	207	
Middle income	104	29%	260	71%	364	
High income	16	31%	36	69%	52	p = 0.003 (0.14)
Have private health insurance						
Yes	30	28%	76	72%	106	
No	124	24%	394	76%	518	p = 0.342 (0.04)

p<0.05 is significant
** Moderate to strong association

Interviewer observed social status was associated with the likelihood of NHF enrollment, with higher proportions of participants in the high- and middle-income category being enrolled compared to those in the low-income group (p = 0.003), although the strength of that association could be described as weak (v=0.14). NHF enrollment was not significantly associated with employment status (p=0.095) and having private health insurance (p= 0.342).

Table 11: Bivariate relationship between need factors and NHF Access (n=626)

	enrolled (yes)		enrolled (no)			
NEED FACTORS	**n**	**%**	**n**	**%**	**Total**	**Chi-squared p-value (Cramer's V)**
Have you been sick in past 12 months						
Yes	56	28%	142	72%	198	
No	98	23%	330	77%	428	p=0.146 (0.06)
Patients has both diabetes and hypertension						
Yes	53	53%	47	47%	100	
No	101	19%	425	81%	526	p < 0.001 **(0.30)
***Suffered stroke/heart attack**						
Yes	6	35%	11	65%	17	
No	148	24%	461	76%	609	p=0.299 (0.04)

p<0.05 is significant
** Moderate to strong association

Fifty three percent (53%) of participants with both diabetes and hypertension were enrolled in the NHF, compared to only 19% with only one of the two conditions ($p < 0.001$). Based on Cramer's V (V=0.30), there was strong relationship between having both diabetes and hypertension and the Likelihood of NHF enrollment. Being sick in the past 12 months (p=0.146) and having a history of stroke or heart attack (p=0.299) were not significantly associated with NHF enrollment.

Table 12: Bivariate relationship between contextual factors and NHF enrollment (n=626)

	enrolled (yes)		enrolled (no)			
CONTEXTUAL FACTOR	**n**	**%**	**n**	**%**	**Total**	**Chi-squared p-value (Cramer's V)**
Health Region						
Southeast Regional Health Authority	80	26%	227	74%	307	
Northeast Regional Health Authority	16	24%	56	76%	72	
Southern Regional Health Authority	30	23%	103	77%	133	
Western Regional Health Authority	26	23%	86	77%	112	p = 0.856 (0.04)
Rural parishes						
Yes	71	23%	235	77%	306	
No	83	26%	237	74%	320	p = 0.427 (0.05)

p<0.05 is significant
** Moderate to strong association

Contextual factors such as administrative health region and rurality were not significantly associated with NHF enrollment (table 12). Administrative Health Region represents differences in health system inputs and organization of health services, while rurality represents the community level factors such as availability of primary care, socio-economic conditions, such as rates of post-secondary education and average income and overall population health.

2.3 Multivariate analysis

Table 13: Relationship between NHF Enrollment and predisposing, enabling, need and contextual covariates (n=600)

Variable	Values	Enrolment in NHF	
		Odds ratio	p-value
Age-group	18-39	1	---
	40-44	3.19 (1.56-6.55)	0.002
	45-49	5.06 (2.60-9.84)	<0.001
	50-54	3.60(1.80-7.20)	<0.001
	55-59	5.33 (2.65-10.71)	<0.001
Marital status	Single/visiting	1	--
	Divorced/Separated/Widowed	2.69 (1.08-6.73)	0.03
	Married/Common Law	1.76 (1.14-2.72)	0.01
Has both conditions (diabetes & hypertension)	No	1	---
	Yes	3.81(2.37-6.16)	<0.001

p<0.05 is significant

The logistic regression model identified age, marital status and the presence of both diabetes and hypertension as significant factors associated with enrollment in the NHF ($p < 0.001$, chi-square 93.23, df=7). The odds of NHF enrollment among older Jamaicans with diabetes or hypertension between the ages of 40-44 years was 3.19 times that of the 18 to 39 years age group (95% CI, 1.56-6.55, p=0.002). While the odds of enrollment were 5.33 times higher in the 55 to 59 years age group (95% CI, 2.65-10.71). Compared to individuals who were single or in visiting relations, the odds of enrollment were 1.76 (95% CI, 1.14-2.72) times higher among respondents who were married or in common-law relationships and 2.54 (95% CI,1.08-6.73) times higher among the group that were previously married (divorced/widowed/separated). The odds of enrollment were 3.81 (95%CI, 2.31-5.99) times higher among respondents who reported being diagnosed with both conditions compared to those diagnosed with only one. Socio-economic status, which was significant on bivariate analysis, was not significant in the multivariate model. Both age and comorbid status were

determined in the bivariate analysis as having a strong effect on NHF enrollment, while marital status was determined to have a small effect.

3 Section two: NHF utilization patterns and the factors associated with adherence among NHF enrollees with diabetes or hypertension

3.1 Univariate analysis

Table 14: Prevalence of drug use among diabetics and hypertensives by therapeutic class in 2008 (n=51,451)

Major Drug Class/Sub-Class	Diabetes and Hypertension (n=25,087)		Hypertension without diabetes (n=20,035)		Diabetes without hypertension (n=6,329)	
ANTIHYPERTENSIVES	**20,699**	**83%**	**19,475**	**97%**	**1,333**	**21%**
ACE INHIBITORS	12,633	50%	8,600	43%	1,154	18%
THIAZIDES AND THIAZIDE-LIKE DIURETICS	8,460	34%	8,957	45%	0	0%
CALCIUM CHANNEL BLOCKERS	7,386	29%	7,676	38%	0	0%
BETA BLOCKERS CARDIO-SELECTIVE	3,767	15%	4,310	22%	16	0%
ANTIHYPERTENSIVE COMBINATIONS	3,326	13%	4,021	20%	48	1%
ANGIOTENSIN II RECEPTOR ANTAGONISTS	3,211	13%	3,044	15%	144	2%
LOOP DIURETICS	1,302	5%	1,005	5%	28	0%
BETA BLOCKERS NON-SELECTIVE	1,207	5%	1,268	6%	27	0%
ANTIADRENERGIC ANTIHYPERTENSIVES	1,173	5%	1,356	7%	10	0%
VASODILATORS	640	3%	567	3%	0	0%

CARBONIC ANHYDRASE INHIBITORS	87	0%	81	0%	19	0%
ANTIDIABETICS	**19,005**	**76%**	**0**	**0%**	**6,144**	**97%**
BIGUANIDES (METFORMIN)	14,549	58%	0	0%	4,317	68%
SULFONYLUREAS	10,888	43%	0	0%	3,309	52%
INSULIN	4,236	17%	0	0%	1,830	29%
THIAZOLIDINEDIONES (PIOGLITAZONE)	1,840	7%	0	0%	544	9%
ALPHA-GLUCOSIDASE INHIBITORS	1,829	7%	0	0%	579	9%
DIABETIC OTHER	587	2%	0	0%	192	3%
MEGLITINIDE ANALOGUES	63	0%	0	0%	26	0%
DIPEPTIDYL PEPTIDASE-4 (DPP-4) INHIBITORS	22	0%	0	0%	3	0%
ANTIHYPERLIPIDEMICS	**7,882**	**31%**	**4,623**	**23%**	**1,245**	**20%**
HMG COA REDUCTASE INHIBITORS (STATIN)	7,451	30%	4,254	21%	1,183	19%
ANTIHYPERLIPIDEMICS - MISC.	728	3%	591	3%	105	2%

**Excluded from adherence analysis

Table 15: Prevalence of drug use among diabetics and hypertensives by therapeutic class in 2017 (n=124,593)

Therapeutic Class/Sub-Class	Diabetes and Hypertension (n=46,279)		Hypertension without diabetes(n=64,420)		Diabetics without hypertension (n=13,894)	
ANTIHYPERTENSIVES	40,673	88%	63,267	98%	3,958	28%
CALCIUM CHANNEL BLOCKERS	18,315	40%	28,593	44%	66	0%
ACE INHIBITORS	16,939	37%	17,859	28%	2,603	19%
THIAZIDES AND THIAZIDE-LIKE DIURETICS	15,285	33%	26,387	41%	1	0%
ANGIOTENSIN II RECEPTOR ANTAGONISTS	12,025	26%	17,634	27%	1,148	8%
ANTIHYPERTENSIVE COMBINATIONS	9,125	20%	17,387	27%	316	2%
BETA BLOCKERS CARDIO-SELECTIVE	5,030	11%	8,111	13%	37	0%
BETA BLOCKERS NON-SELECTIVE	4,809	10%	6,100	9%	54	0%

LOOP DIURETICS	2,743	6%	2,676	4%	29	0%
POTASSIUM SPARING DIURETICS	1,262	3%	1,534	2%	0	0%
VASODILATORS	1,242	3%	1,539	2%	0	0%
ANTIADRENERGIC ANTIHYPERTENSIVES	717	2%	1,336	2%	10	0%
DIURETIC COMBINATIONS	227	0%	366	1%	0	0%
CARBONIC ANHYDRASE INHIBITORS	151	0%	185	0%	35	0%
ANTIDIABETICS	39,274	85%	5	0%	13,520	97%
BIGUANIDES (METFORMIN)	25,934	56%	0	0%	8,140	59%
SULFONYLUREAS	19,934	43%	5	0%	6,631	48%
INSULIN	8,085	17%	0	0%	3,761	27%
ANTIDIABETIC COMBINATIONS	7,299	16%	0	0%	2,714	20%
THIAZOLIDINEDIONES (PIOGLITAZONE)	7,188	16%	0	0%	2,478	18%
ALPHA-GLUCOSIDASE INHIBITORS	2,944	6%	0	0%	878	6%
DIPEPTIDYL PEPTIDASE-4 (DPP-4) INHIBITORS	2,690	6%	0	0%	783	6%
DIABETIC OTHER	351	1%	0	0%	110	1%
MEGLITINIDE ANALOGUES	4	0%	0	0%	1	0%
ANTIHYPERLIPIDEMICS	20,457	44%	18,564	29%	4,003	29%
HMG COA REDUCTASE INHIBITORS (STATINS)	19,960	43%	17,960	28%	3,916	28%
ANTIHYPERLIPIDEMICS - MISC.	765	2%	880	1%	137	1%

**Excluded from adherence analysis

An analysis was conducted on all the individuals who enrolled with diabetes or hypertension and who used their NHFCard to purchase chronic disease medicines (antidiabetic, antihypertensives or antihyperlipidemics) in 2008 and 2017. In 2008, 51,451 diabetics and/or hypertensives used their NHFCard to purchase antidiabetics or cardiovascular disease medicines (antihypertensive and antihyperlipidemics), by 2017, that number increased by 242% (124,593). The proportion of users who were comorbid diabetes and hypertension at the time of enrollment differed between the two cohorts (2008 and 2017). In

2008, 49% of users enrolled both conditions, 39% enrolled with hypertension only, and 12% enrolled with diabetes only. In 2017, the proportion of comorbid users was relatively smaller at 37%, and the proportion with hypertension only was larger at 52%, while the proportion with diabetes only slightly lower at 11%.

In 2017, the most prevalent antihypertensive was Calcium Channel Blockers (40%); ACE Inhibitors (37%); Thiazide and Thiazide-Like Diuretics (33%) and Angiotensin II Receptor Antagonists (26%). The prevalence of Calcium Channel Blockers among all hypertensives increased relative to 2008, where ACE Inhibitors was more prevalent at that time. The use of antihypertensive combinations increased among all individuals with hypertension. There was an increase from 20% in 2008 to 27% in 2017, within the group with hypertension only, and from 13% to 20% within the comorbid group. Use of Beta-blockers decreased while Angiotensin II Receptors use increased from 2008 to 2017. More than 1 in 5 adults who enrolled with diabetes only, were treated with antihypertensive medicines in 2008 and 2017. The most prevalent antihypertensive used among this group was ACE Inhibitors (19% in 2017; 18% in 2008), while a lesser proportion received ARBs (8%) and antihypertensive combinations (2%). The likelihood that these were individuals diagnosed later with hypertension is strong, as those medicines are typically recommended as a first line treatment for diabetics with hypertension (ADA, 2020; O'Hare et al, 2015, NICE guidelines).

Among diabetics, metformin and sulfonylureas were the most prevalent antidiabetics. However, there was a decrease in the prevalence of metformin from 68% in 2008 to 59% in 2017. There was also a decrease in the prevalence of sulfonylureas from 52% to 48% in

this same group. In 2017, the prevalence of antidiabetic combinations ranged from 16% to 20%, whereas it was 0% in 2008. Insulin prevalence was higher among the diabetics who enrolled without comorbid hypertension, but it decreased slightly from 29% to 27% from 2008 to 2017.

In 2017, the prevalence of Statin was higher among the comorbid group at 43% compared to 28%. There was also an overall increase in statin use among all the disease groups from 2008 to 2017.

Table 16: Percent adherent among diabetics and hypertensives who met the study criteria in 2008 (n=20,264)

Therapeutic Class	Hypertension and Diabetes		Hypertension with no diabetes		Diabetes with no hypertension	
	Number	% Adherent	Number	% Adherent	Number	% Adherent
ANTIHYPERTENSIVES	8,006	63.1%	8,430	64.9%	193	32.6%
ANTIDIABETICS	6,497	60.2%	0	---	1,511	61.2%
ANTIHYPERLIPIDEMICS	2,025	24.6%	1,440	24.3%	230	24.3%
TOTAL	**10,018**	**55.8%**	**8,670**	**59.1%**	**1,576**	**54.0%**

p<0.05 is significant

Table 17: Percent adherent among diabetics and hypertensives who met the study criteria in 2017 (n=77,454)

Therapeutic Class	Hypertension and Diabetes		Hypertension with no diabetes		Diabetes with no hypertension	
	Number	% Adherent	Number	% Adherent	Number	% Adherent
ANTIHYPERTENSIVES	23,573	62.8%	41,509	60.0%	1,418	23.0%
ANTIDIABETICS	21,836	60.0%	0	--	6,502	61.8%
ANTIHYPERLIPIDEMICS	8,038	19.9%	8,316	17.7%	1,247	18.8%
TOTAL	**28,426**	**52.3%**	**42,277**	**52.4%**	**6,751**	**50.2%**

p<0.05 is significant

Regardless of comorbidity status, the proportion adherent in 2017 had decreased when compared to 2008 (Tables 16 and 17). Proportion adherent to antidiabetics was similar in both years examined. However, in 2017, proportion adherent to antihypertensives and antihyperlipidemics decreased among all three groups when compared to 2008. Of the three therapeutic classes examined, percent adherent to antihyperlipidemics was the lowest in both years (tables 16 and 17).

3.2 Bivariate analysis

Table 18: Percent adherent among individuals enrolled in the NHF with diabetes or hypertension and who met the study criteria in 2008 (n=20,264)

Variable category	Variables	N	%	% Adherent (MPR >= 80%)	Chi-squared test p-value (Cramer's V)
Predisposing	**Sex**				
	Female	14,467	71%	55%	p<0.001(0.05)
	Male	5,797	29%	61%	
	Age				
	18-39	1739	9%	57%	p=0.015 (0.03)
	40-44	2379	12%	57%	
	45-49	3661	18%	58%	
	50-54	5039	25%	59%	
	55-59	7446	37%	56%	
Enabling	**Average monthly OOP on medicines (J$)**				
	< 5,000	14,907	78%	55%	p<0.001 (0.10)
	5,000 - 10,000	2,839	15%	64%	
	> 10,000	1,417	7%	71%	
Need	**Number of therapeutic classes**				
	One	6,863	34%	61%	p<0.001 (0.06)
	Two	6,487	32%	56%	
	Three	3,921	19%	54%	
	Four	1,867	9%	54%	
	Five	707	3%	59%	
	> 5	419	2%	58%	

	Diabetes and hypertension comorbidity status				
	Diabetes and hypertension	10018	49%	56%	p<0.001 (0.04)
	Hypertension without diabetes	8670	43%	59%	
	Diabetes without hypertension	1576	8%	54%	
	Diagnosis of high cholesterol				
	Yes	11,257	56%	59%	p<0.001 (0.03)
	No	9,007	44%	56%	
	Number of years enrolled				
	< 1	6,760	33%	56%	p<0.001 (0.02)
	1-2	7,040	35%	58%	
	2-3	2,668	13%	57%	
	3-4	859	4%	56%	
	>4	2,937	14%	58%	
Contextual	**Health Region**				
	South East Health Region	11,047	55%	59%	p<0.001 (0.03)
	Northeast Health Region	1,765	9%	56%	
	Southern Health Region	4,380	22%	56%	
	Western Health Region	3,072	15%	55%	
	Resides in predominantly rural parish (> 50% dwellings in rural areas)				
	Yes	8,057	40%	59%	p<0.001 (0.04)
	No	12,207	60%	55%	

p<0.05 is significant
**Moderate to strong association

Table 19: Percent adherent among individuals enrolled in the NHF with diabetes or hypertension and who met the study criteria in 2017 (n=77,454)

Variable category	Variables	N	%	% Adherent (MPR >= 80%)	Chi-squared test p-value (Cramer's V)
Predisposing	**Sex**				
	Female	54,793	71%	51%	p<0.001 (0.05)
	Male	22,661	29%	55%	
	Age				
	18-39	4,729	6%	48%	p<0.001 (0.03)
	40-44	5,936	8%	50%	
	45-49	10,227	13%	53%	
	50-54	15,030	19%	53%	
	55-59	41,532	54%	53%	
Enabling	**Average monthly OOP on medicines (J$)**				
	< 5,000	66,437	86%	48%	p<0.001 **(0.20)
	5,000 - 10,000	7,990	10%	73%	
	> 10,000	3,027	4%	82%	
Need	**Number of therapeutic classes**				
	One	23,386	30%	54%	p<0.001 (0.04)
	Two	21,950	28%	50%	
	Three	15,712	20%	51%	
	Four	9,150	12%	52%	
	Five	4,277	6%	53%	
	>5	2,979	4%	57%	
	Diabetes and hypertension comorbidity status				
	Diabetes and Hypertension	28,426	37%	52%	p=0.003 (0.12)
	Hypertension without diabetes	42,277	55%	52%	
	Diabetes without hypertension	6,751	9%	52%	
	Diagnosis of high cholesterol				
	Yes	38,999	50%	51%	p<0.001 (0.02)
	No	38,455	50%	53%	
	Number of years enrolled				
	<1	6,719	9%	45%	p<0.001 (0.07)
	1-2	5,743	7%	45%	

	2-3	4,815	6%	49%	
	3-4	5,588	7%	50%	
	4-5	5,371	7%	50%	
	> 5	49,218	64%	55%	
Contextual	**Health Region**				
	South East Health Region	37,640	49%	52%	p<0.001 (0.02)
	Northeast Health Region	10,564	14%	54%	
	Southern Health Region	16,395	21%	52%	
	Western Health Region	12,855	17%	53%	
	Resides in predominantly rural parish (> 50% dwellings in rural areas)				
	Yes	35,432	46%	52%	p=0.654 (0.002)
	No	42,022	54%	52%	

p<0.05 is significant association
**Moderate to strong association

Among the diabetics or hypertensives who used their NHFCard in 2017 to purchase antihypertensive, antidiabetic or antihyperlipidemic medicine, the majority were female (71%) over the age of 50 years (73%). Approximately half (49%) lived in the Southeast Health Region and 46% resided in parishes that were predominantly rural. 37% enrolled with both diabetes and hypertension; 55% enrolled with a diagnosis of hypertension without diabetes; and only 9% enrolled with a diagnosis of diabetes without hypertension. Half of this population also had a diagnosis of high cholesterol at the time of enrollment. 64% were enrolled for more than 5 years, and the majority (86%) spent on average less than J$5,000 per month on medications. 42% purchased medicines in more than two therapeutic classes (Table 19).

In 2008, all explanatory variables were significantly associated with adherence on bivariate analysis, while in 2017 all except residing in a rural area were found to be significant (Tables 18 and 19). However, the Cramer's V, which measures the strength of association between adherence and the predictor variables suggests small differences within each variable tested, except in the case of Monthly Out-of-Pocket expense where moderate differences were observed in 2017 (0.20).

3.3 Multivariate analysis

Table 20: Factors associated with adherence in 2008 (n=20,264)

Variable	Categories	Adherence			
		Odds ratio	Lower 95% CI	Upper 95% CI	p-value
Average monthly OOP on medicines (J$)	<5,000	1			---
	5,000-10,000	1.46	1.34	1.59	<0.001
	> 10,000	2.08	1.84	2.35	<0.001
Number of therapeutic classes	One	1			--
	Two	0.82	0.76	0.88	<0.001
	Three	0.78	0.72	0.85	<0.001
	Four	0.73	0.65	0.82	<0.001
	Five	0.91	0.77	1.08	0.28
	> Five	0.85	0.69	1.05	0.13
Sex	Female	1			---
	Male	1.20	1.13	1.28	< 0.001
High cholesterol	Yes	1			---
	No	1.13	1.06	1.20	<0.001
Predominantly rural parish	Yes	1			---
	No	1.10	1.04	1.17	0.001
Comorbidity	Diabetes and Hypertension	1			--

	Hypertension without diabetes	1.1	1.03	1.18	0.005
	Diabetes without hypertension	0.91	0.81	1.02	0.095
Number of years enrolled	< 1	1			---
	1-2	1.09	1.02	1.17	0.019
	2-3	1.07	0.98	1.18	0.192
	3-4	1.08	0.93	1.25	0.443
	>4	1.23	1.12	1.35	p<0.001
Age-group	18-39	1			---
	40-44	1.02	0.90	1.17	0.742
	45-49	1.08	0.96	1.22	0.205
	50-54	1.10	0.98	1.24	0.098
	55-59	0.98	0.87	1.09	0.681

p<0.05 is significant

Table 21: Factors associated with adherence in 2017 (n=77,454)

Variable	Categories	Adherence			
		Odds ratio	Lower 95% CI	Upper 95% CI	p-value
Average monthly OOP on medicines (J$)	<5,000	1			---
	5,000-10,000	3.01	2.86	3.18	<0.001
	> 10,000	5.52	5.01	6.08	<0.001
Number of therapeutic classes	One	1			--
	Two	0.78	0.75	0.81	<0.001
	Three	0.72	0.69	0.75	<0.001
	Four	0.69	0.65	0.73	<0.001
	Five	0.66	0.61	0.7	<0.001
	> Five	0.65	0.6	0.71	<0.001
Number of years enrolled	< 1	1			---
	1-2	1	0.93	1.07	0.906
	2-3	1.14	1.06	1.23	0.001
	3-4	1.18	1.1	1.27	<0.001
	4-5	1.23	1.14	1.32	<0.001
	> 5	1.46	1.38	1.54	<0.001
Health Region	Southeast Health Region	1			--

	Northeast Health Region	1.44	1.34	1.55	<0.001
	Southern Health Region	1.2	1.12	1.29	<0.001
	Western Health Region	1.26	1.2	1.33	<0.001
High cholesterol diagnosis	Yes	1			
	No	1.14	1.11	1.18	< 0.001
Sex	Female	1			---
	Male	1.13	1.09	1.16	< 0.001
Age-group	18-39	1			---
	40-44	1.06	0.98	1.14	0.181
	45-49	1.18	1.11	1.27	< 0.001
	50-54	1.19	1.11	1.28	< 0.001
	55-59	1.13	1.05	1.19	0.001
Predominantly rural parish	Yes	1			---
	No	1.11	1.05	1.18	0.001

$p < 0.05$ is significant

Multivariate analysis on the 2017 cohort identified monthly out-of-pocket expense, number or therapeutic class, number of years enrolled, health region, high cholesterol comorbidity, sex, age group and living in a rural geography as significant factors in the logistic regression model ($p<0.001$; chi-square = 3,946.15; df = 23). The characteristics associated with the lowest odds of adherence were, spending an average of less than J$5,000 per month out-of-pocket on medicines ($p<0.001$); obtaining multiple drug therapies; residing in the Southeast Health Region ($p<0.001$); having a diagnosis of high cholesterol ($p<0.001$); being female ($p<0.001$); age less than 45 years old and residing in a rural parish ($p=0.001$) (table 21). Being enrolled in the NHF for more than two years was associated with an increased odds of adherence ($p=0.001$).

The forward logistic regression model with the 2008 cohort was also significant ($p<0.001$; chi-square = 369.06; df = 18). Consistent with the 2017 cohort, odds of adherence in the 2008 cohort were also lower among females ($p< 0.001$), individuals who had lower out-of-pocket expenditure on medicines ($p<0.001$), those on multiple drug therapies ($p<0.001$), those with comorbid high cholesterol and individuals who resided in rural geographies ($p=0.001$) (table 20). Odds of adherence was found to be higher in individuals with hypertension only when compared to those who enrolled with comorbid diabetes and hypertension ($p=0.005$), but there was no difference between the comorbid group and those with diabetes only. Health region and age were not found to be significant in the 2008 model, diabetes and hypertension comorbidity was not significant in the 2017 model. The variable with the strongest effect on adherence was monthly out of pocket expenditure, where odds of adherence was 3 to 6 times higher among individuals with the highest monthly Out-of-pocket expense on medicines in 2017 (table 21). Similarly in 2008, odds of adherence were 1.5 to 2 times higher in the groups with the highest out-of-pocket expense, although the effect was notably lower than in the 2017 cohort (table 20).

4 Section three: – Effect of removal user fees on NHF enrollment and use of the NHFCard

4.1 Descriptive analysis

Table 22: Numbers of new NHF enrollees and enrollees who used their NHFCard to purchase medicines before and after the policy to remove user fees from government health facilities

Year	Month	Total Population 18-59 years	Number of New NHF enrollments with diabetes or hypertension (18-59 years)	Number of new NHF enrollments with diabetes or hypertension per 10,000 population (18-59 years)	Number of NHFCard users with diabetes or hypertension (18-59 years)	Number of NHFCard users with diabetes or hypertension per 10,000 population (18-59 years)
2007	Jan	1,449,612	1,804	12	16,210	112
2007	Feb	1,449,612	1,434	10	15,799	109
2007	Mar	1,449,612	2,161	15	18,156	125
2007	Apr	1,449,612	1,358	9	17,770	123
2007	May	1,449,612	1,776	12	19,640	135
2007	Jun	1,449,612	1,604	11	19,978	138
2007	Jul	1,449,612	1,626	11	21,412	148
2007	Aug	1,449,612	1,300	9	20,022	138
2007	Sep	1,449,612	1,274	9	21,099	146
2007	Oct	1,449,612	1,426	10	23,231	160
2007	Nov	1,449,612	1,626	11	23,275	161
2007	Dec	1,449,612	1,024	7	23,742	164
2008	Jan	1,466,273	1,282	9	24,695	168
2008	Feb	1,466,273	1,261	9	24,149	165
2008	Mar	1,466,273	1,502	10	25,526	174
2008	Apr	1,466,273	1,346	9	25,723	175
2008	May	1,466,273	1,558	11	25,773	176
2008	Jun	1,466,273	1,196	8	25,393	173
2008	Jul	1,466,273	1,380	9	27,119	185
2008	Aug	1,466,273	818	6	24,978	170
2008	Sep	1,466,273	1,391	9	27,293	186
2008	Oct	1,466,273	1,320	9	28,051	191
2008	Nov	1,466,273	1,221	8	27,415	187
2008	Dec	1,466,273	1,142	8	29,549	202
2009	Jan	1,483,830	1,135	8	29,319	198
2009	Feb	1,483,830	1,634	11	27,471	185
2009	Mar	1,483,830	1,632	11	30,721	207
2009	Apr	1,483,830	1,463	10	30,166	203
2009	May	1,483,830	1,274	9	30,898	208
2009	Jun	1,483,830	1,445	10	31,717	214
2009	Jul	1,483,830	1,404	9	32,740	221
2009	Aug	1,483,830	1,261	8	31,064	209
2009	Sep	1,483,830	1,207	8	32,218	217
2009	Oct	1,483,830	1,043	7	33,428	225
2009	Nov	1,483,830	1,153	8	31,845	215
2009	Dec	1,483,830	1,078	7	33,692	227

In the month of January 2007, there were approximately 1,800 new NHF enrollments with diabetes or hypertension between the ages of 18 to 59 years. Since then that number had

been decreasing over time to 1,000 in the month of December 2009 (table 22). Simultaneously, the number of NHFCard users with diabetes or hypertension increased overtime from approximately 16,000 individuals in January 2005 to 33,000 by December 2009 (table 22). In April 2008, the government implemented the policy to remove user fees from public health facilities. At that time, there were approximately 1,300 new enrollees (9 per 10,000 population) with diabetes or hypertension between the ages of 18 to 59 years. In addition, approximately 25,000 individuals (175 per 10,000 population) used their NHFCard to purchase medicines (table 22).

Table 23: Mean number of new NHF enrollment and NHF Card Utilization per month between Jan 1, 2007 and Dec 31, 2009

Explanatory variable	Variable category	New NHF Enrollment		NHF Utilization	
		Mean	Standard Deviation	Mean	Standard Deviation
Gender	Female	923	177	17,918	3,299
	Male	454	82	7,951	1,785
Age-Group	18-39	248	37	3,516	718
	40-44	215	43	3,522	773
	45-49	282	53	5,167	1,115
	50-54	320	69	6,665	1,297
	55-59	311	68	6,999	1,182
Rural	Yes	597	122	9,995	1,888
	No	780	142	15,874	3,205
Health Region	SERHA	720	133	14,370	2,901
	NERHA	152	35	2,286	428
	SRHA	303	67	5,309	1,037
	WRHA	203	48	3,904	731

On average, majority of new NHF enrollees and NHFCard users were females who outnumbered the males by a ratio of more than 2 to 1. Individuals in the 45 years and older age groups outnumbered those in the younger age groups and accounted for more than two-thirds of new enrollments and NHFCard users. Likewise, Individuals residing in

predominantly urban areas and those residing in the Southeast Health Region accounted for a higher proportion of new NHF enrollment and NHFCard users over the study period.

4.2 Multivariate analysis

Durbin-Watson test for autocorrelation

The Durbin-Watson test statistic for the effect of the policy to remove user fees from public health facilities on 'new NHF enrollment' was 2.3 and on NHFCard use was 2.7. The critical values for the Durbin-Watson tests (n=36, k=3) were D_L = 1.07 and D_U = 1.44. Since D>D_U, the null hypothesis that there is no autocorrelation in the time-series was not rejected.

Table 24: Results of the Chow Test for structural breaks in the time-series data

	Number of new NHF enrollment		Number of NHF Card users	
Structural Breakpoints	**F-statistics**	**p-value**	**F-statistics**	**p-value**
Pre-policy				
12 months	1.249	0.325	0.479	0.632
9 months	0.273	0.766	0.789	0.478
6 months	0.281	0.76	1.112	0.363
3 months	0.678	0.527	0.537	0.599
Post-policy				
3 months	0.768	0.48	0.18	0.837
6 months	0.998	0.39	0.396	0.679
9 months	3.106	0.072	0.116	0.892
12 months	2.108	0.154	0.585	0.569

*significant at p<0.05

The results of the Chow Test indicated that there were no significant events influencing NHF enrollment and use of the NHF card within the 12-month period before and after the policy

was implemented (table 24). This helped to guide the decision around the observation period used in the analysis.

Unstratified analysis

Table 25: Unstratified Interrupted time series model of the impact of removal of user fees on new NHF enrollments among adults with diabetes and hypertension

Parameter	Coefficient	Standard error	*t*-statistic	*P*-value
Intercept	1,784.09	118.74	15.03	<0.001
Baseline trend	-35.86	13.06	-2.75	0.01
Level change after the policy	135.26	150.26	0.90	0.38
Trend change after policy	30.36	15.25	1.99	0.06

$p < 0.05$ is significant

Interrupted time series analysis, which is summarized in table 25, indicated that prior to January 2007, there was an average of 1,784 new NHF enrollments per month among individuals with diabetes or hypertension ($p<0.001$). Before the policy to remove user fees from public health facilities in Jamaica, new NHF enrollments decreased at a rate of 36 individuals per month ($p=0.01$). After accounting for secular trends in the pre-policy period, there was no indication of a change in the level of new enrollments, directly following the implementation of the policy (p-value = 0.375) and there was no significant change in the rate of new NHF enrollments per month compared to the pre-policy period (p-value = 0.06). With the inclusion of the additional parameter, the adjusted R^2 for the Segmented Regression Model was 0.269, compared to 0.225 for the linear model. Figure 6 below is a graphical representation of the segmented time-series trend describing the effect of the removal of user fees in public health facilities on new NHF enrollment among individuals with diabetes or hypertension. Based on the graph in Figure 6, there is an observed increase in new NHF enrollment in the post-policy period around February 2009.

Figure 6: Unstratified interrupted time series chart of the trend in new NHF Enrollments with Diabetes or Hypertension before and after the removal of user fees

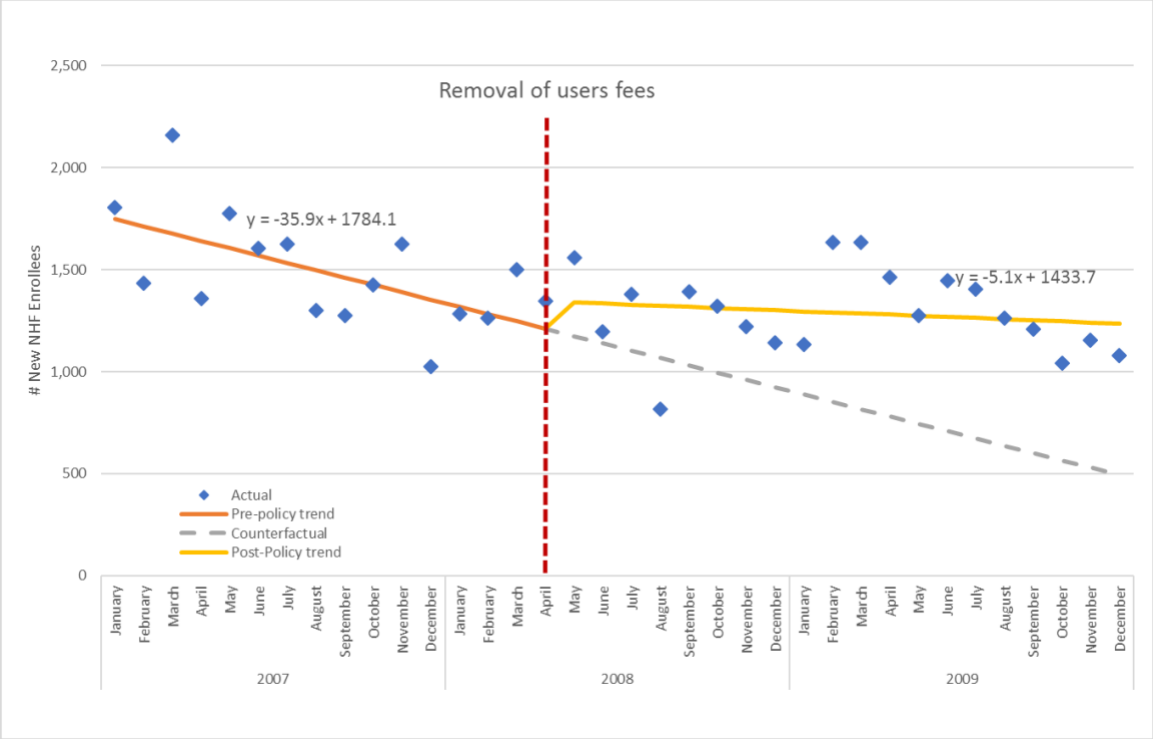


Table 26: Unstratified Interrupted time series model of the impact of removal of user fees on NHFCard use among adults with diabetes and hypertension

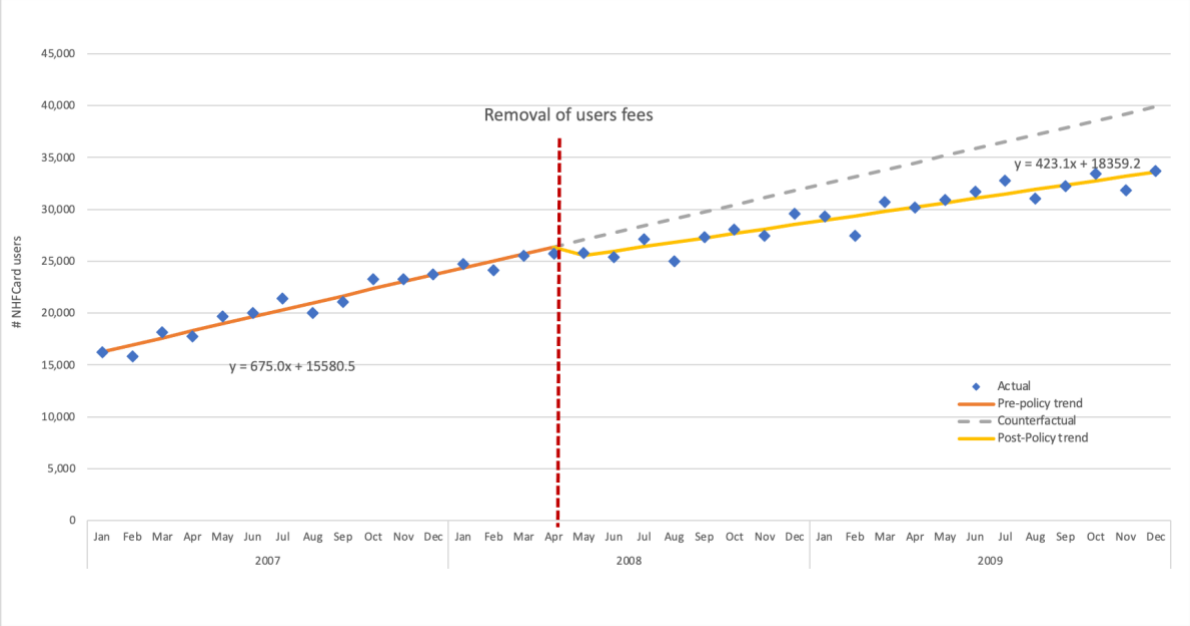
Parameter	Coefficient	Standard error	*t*-statistic	*p*-value
Intercept	15,580.47	457.42	34.06	<0.001
Baseline trend	674.98	50.310	13.42	<0.001
Level change after the policy	-1,250.76	578.810	-2.16	0.04
Trend change after policy	-251.84	58.75	-4.29	<0.001

$p < 0.05$ is significant

As summarized in table 26, prior to January 2007, an average of 15,580 individuals with diabetes or hypertension used their NHFCard to purchase medicines per month (p<0.001). Before the policy to remove user fees from public health facilities, this number increased at a monthly rate of approximately 675 individuals (p<0.001). After accounting for secular trends in the pre-policy period, there was a decrease in the level of NHFCard users directly

following the implementation of the policy (p=0.04) and the NHFCard use increased at a significantly lower rate of approximately 423 individuals per month compared to 675 in the pre-policy period (p<0.001). Figure 7 below is a graphical representation of the segmented time-series trend describing the effect of the removal of user fees from public health facilities on NHFCard use among adults with diabetes and hypertension.

Figure 7: Unstratified interrupted time series chart of the trend in NHFCard utilization among enrollees with diabetes or hypertension before and after the removal of user fees



Stratified analysis of New NHF Enrollment

Table 27: Interrupted time series model of the impact of the removal of user fees from public health facilities on new NHF enrollment among adults with diabetes or hypertension by gender

Gender	Parameter	Coefficient	Standard error	*t*-statistic	*p*-value
Female	Intercept	1,216.43	79.88	15.23	<0.001
	Baseline trend	-25.30	8.79	-2.88	0.001
	Level change after the policy	83.23	101.08	0.82	0.416

	Trend change after policy	21.55	10.26	2.10	0.04
Male	Intercept	567.66	40.47	14.03	<0.001
	Baseline trend	-10.56	4.45	-2.37	0.024
	Level change after the policy	52.03	51.21	1.02	0.317
	Trend change after policy	8.80	5.20	1.69	0.100

p < 0.05 is significant

Prior to January 2007, an average of 1,200 females and 560 males with diabetes or hypertension enrolled in the NHF each month (p<0.001). Before the policy there was a significant decline in the rate of NHF enrollment for females (p=0.001) and males (p=0.025). Immediately following the policy, there was no significant change in the level of enrollment for females (0.416) or males (p=0.317). However, the rate of decline in the new NHF enrollments among females during the post-policy period was significantly lower (p=0.04) compared to the pre-policy period, but there was no significant change in the rate of decline among males (p=0.100).

Table 28: Interrupted time series model of the impact of the removal of user fees from public health facilities on new NHF enrollment among adults with diabetes or hypertension by age

Age	Parameter	Coefficient	Standard error	*t*-statistic	*p*-value
18-39	Intercept	299.96	18.17	16.51	p<0.001
	Baseline trend	-4.63	2.00	-2.32	0.03
	Level change after the policy	7.04	22.99	0.31	0.76
	Trend change after policy	5.08	2.33	2.18	0.04
40-44	Intercept	259.37	22.67	11.44	p<0.001
	Baseline trend	-3.87	2.49	-1.55	0.13
	Level change after the policy	15.65	28.69	0.55	0.589
	Trend change after policy	3.19	2.91	1.09	0.282
45-49	Intercept	367.34	24.79	14.82	p<0.001
	Baseline trend	-8.32	2.73	-3.05	0.00
	Level change after the policy	52.86	31.37	1.69	0.10
	Trend change after policy	6.53	3.18	2.05	0.05

50-54	Intercept	433.46	31.66	13.69	p<0.001
	Baseline trend	-10.03	3.48	-2.88	0.01
	Level change after the policy	32.12	40.07	0.80	0.43
	Trend change after policy	9.10	4.07	2.24	0.03
55-59	Intercept	423.95	28.61	14.82	p<0.001
	Baseline trend	-9.01	3.15	-2.86	0.01
	Level change after the policy	27.59	36.20	0.76	0.45
	Trend change after policy	6.45	3.67	1.76	0.09

p < 0.05 is significant

Prior to January 2007, the average number of new NHF enrollments ranged from 300 to 420 adults with diabetes or hypertension, depending on age group (p<0.001). During the pre-policy observation period, new NHF enrollments was declining at a significant rate in all age groups (table 28). Immediately following the implementation of the policy, there was no significant change in the level of new NHF enrollments (table 28). However, after the policy there was a significant increase in the rate of new NHF enrollments among the 18 to 39 years (p=0.04), while the rates of decline in the 45 to 49 years age group (p=0.05) and the 50 to 54 years age group (p=0.03) was lower compared to the pre-policy period. There was no signficant change in the rate of new NHF enrollments in the 40 to 44 years (p=0.282) and the 55 to 59 years age group (p=0.09) (table 28).

Table 29: Interrupted time series model of the impact of the removal of user fees from public health facilities on new NHF enrollment among adults with diabetes or hypertension by rurality

Rurality	Parameter	Coefficient	Standard error	*t*-statistic	*p*-value
Rural	Intercept	791.50	54.65	14.48	< 0.001
	Baseline trend	-16.75	6.01	-2.79	0.01
	Level change after the policy	85.88	69.15	1.24	0.22
	Trend change after policy	11.09	7.02	1.58	0.12
Urban	Intercept	992.58	68.79	14.43	< 0.001
	Baseline trend	-19.11	7.57	-2.53	0.02

	Level change after the policy	49.39	87.05	0.57	0.57
	Trend change after policy	19.26	8.84	2.18	0.04

p < 0.05 is significant

Prior to January 2007, new NHF enrollments among adults with diabetes or hypertension was an average of 790 per month in rural areas and 1,000 per month in urban areas (table 29). In both areas, there was a decline in the rate of new NHF enrollments during the pre-policy observation period. Following the implementation of the policy, there was no change in the level of new enrollments in both areas (table 29). However, the rate of new NHF enrollments increased in urban areas after the policy (p = 0.04), but there was no change in the rate of new NHF enrollments in rural areas (p=0.12) (table 29).

Table 30: Interrupted time series model of the impact of the removal of user fees from public health facilities on new NHF enrollment among adults with diabetes or hypertension by health region

Health Region	Parameter	Coefficient	Standard error	*t*-statistic	*p*-value
Southeast	Intercept	929.95	63.83	14.57	< 0.001
	Baseline trend	-19.71	7.02	-2.81	0.01
	Level change after the policy	63.66	80.77	0.79	0.44
	Trend change after policy	20.11	8.20	2.45	0.02
Northeast	Intercept	188.96	18.12	10.43	< 0.001
	Baseline trend	-4.38	1.99	-2.20	0.04
	Level change after the policy	48.58	22.93	2.12	0.04
	Trend change after policy	2.63	2.33	1.13	0.27
Southern	Intercept	407.85	29.15	13.99	< 0.001
	Baseline trend	-7.91	3.21	-2.47	0.02
	Level change after the policy	7.50	36.88	0.20	0.84
	Trend change after policy	6.34	3.74	1.69	0.10
Western	Intercept	257.32	22.67	11.35	< 0.001
	Baseline trend	-3.86	2.49	-1.55	0.13
	Level change after the policy	15.52	28.69	0.54	0.59
	Trend change after policy	1.29	2.91	0.44	0.66

p < 0.05 is significant

Prior to January 2007, rates of new NHF enrollments with diabetes or hypertension was an average of 930 per month in the Southeast Health Region, 200 per month in the Northeast Health Region, 400 per month in the Southern Health Region and 250 per month in the Western Health Region (table 30). During the pre-policy period, the rate of new NHF enrollments was on a declining trend in all health regions. Following the implementation of the policy, there was a significant decrease in the level of new enrollments in the Northeast Health Region only. While the Southeast Health Region (p=0.02) experienced an increased rate of new NHF enrollments when compared to the pre-policy period (table 30).

Stratified analysis of NHFCard Use

Table 31: Interrupted time series model of the impact of the removal of user fees from public health facilities on NHF utilization among adults with diabetes or hypertension by gender

Gender	Parameter	Coefficient	Standard error	*t*-statistic	*p*-value
Female	Intercept	11,144.21	335.40	33.23	<0.001
	Baseline trend	453.71	36.89	12.30	<0.001
	Level change after the policy	-955.31	424.40	-2.25	0.03
	Trend change after policy	-182.15	43.08	-4.23	<0.001
Male	Intercept	4,436.26	131.51	33.73	<0.001
	Baseline trend	221.27	14.46	15.30	<0.001
	Level change after the policy	-295.45	166.42	-1.78	0.09
	Trend change after policy	-69.69	16.89	-4.13	<0.001

$p < 0.05$ is significant

NHFCard utilization was an average of 11,144 per month for females and 4,400 per month for males prior to January 2007 ($p < 0.001$). During the pre-policy observation period

NHFCard utilization was increasing at a rate of 454 female users and 222 male users per month. Immediately following the policy, there was a significant decline in the level (p=0.03) of NHFCard users among females only (p=0.03). There was also a significant decline in the rate of NHCard users among both genders during the post-policy observation period (table 31).

Table 32: Interrupted time series model of the impact of the removal of user fees from public health facilities on NHF utilization among adults with diabetes or hypertension by age-group

Age	Parameter	Coefficient	Standard error	*t*-statistic	*p*-value
18-39	Intercept	2,010.61	69.88	28.77	< 0.001
	Baseline trend	103.81	7.69	13.51	< 0.001
	Level change after the policy	-274.13	88.43	-3.10	0.004
	Trend change after policy	-43.71	8.98	-4.87	< 0.001
40-44	Intercept	1,982.85	65.77	30.15	< 0.001
	Baseline trend	98.59	7.23	13.63	< 0.001
	Level change after the policy	-152.94	83.22	-1.84	0.08
	Trend change after policy	-33.56	8.45	-3.97	< 0.001
45-50	Intercept	2,970.41	91.07	32.62	< 0.001
	Baseline trend	139.61	10.02	13.94	< 0.001
	Level change after the policy	-229.29	115.24	-1.99	0.06
	Trend change after policy	-43.20	11.70	-3.69	< 0.001
50-54	Intercept	4,061.68	119.82	33.90	< 0.001
	Baseline trend	168.91	13.18	12.82	< 0.001
	Level change after the policy	-288.60	151.61	-1.90	0.07
	Trend change after policy	-60.61	15.39	-3.94	< 0.001
55-59	Intercept	4,554.92	125.06	36.42	< 0.001
	Baseline trend	164.07	13.76	11.93	< 0.001
	Level change after the policy	-305.79	158.25	-1.93	0.06
	Trend change after policy	-70.76	16.06	-4.41	< 0.001

p < 0.05 is significant

Prior to January 2007, the average NHFCard users among adults with diabetes or hypertension was between 2,000 per month in the youngest age group (18-34 years) to 4,500 per month in the oldest age group (55-59 years) studied. During the pre-policy period, the number of NHFCard users increased at a significant rate each month among all age groups (p<0.001). There was a significant decline in the level of NHFCard users among the youngest age group only (p=0.004) and although the monthly NHF user rates increased, the rate of increase was significant lower in all age groups during the post policy period (table 32).

Table 33: Interrupted time series model of the impact of the removal of user fees from public health facilities on NHF utilization among adults with diabetes or hypertension by rurality

Rurality	Parameter	Coefficient	Standard error	*t*-statistic	*p*-value
Rural	Intercept	5,857.43	186.61	31.39	< 001
	Baseline trend	293.25	20.52	14.29	< 001
	Level change after the policy	-638.93	236.13	-2.71	0.011
	Trend change after policy	-156.78	23.97	-6.54	< 001
Urban	Intercept	9,723.04	284.16	34.22	< 001
	Baseline trend	381.73	31.25	12.21	< 001
	Level change after the policy	-611.83	359.57	-1.70	0.099
	Trend change after policy	-95.06	36.50	-2.60	< 001

p < 0.05 is significant

Prior to January 2007, an average of 5,800 individuals with diabetes or hypertension in rural areas and 9,700 in urban areas used their NHFCard to purchase medicines on a monthly basis (p < 0.001). During the pre-policy policy period, that number increased by 293 in the rural areas and 381 in urban areas each month (p < 0.001). Immediately following the

implementation of the policy, there was a decline in the level of NHFCard use in rural areas (p=0.011) but none in the urban areas (p=0.099) (table 33). However, after accounting for secular trends in the pre-policy period, there was a decline in the rates of NHFCard use in rural and urban areas during the post-policy period (p < 0.001).

Table 34: Interrupted time series model of the impact of the removal of user fees from public health facilities on NHF utilization among adults with diabetes or hypertension by health region

Health Region	Parameter	Coefficient	Standard error	*t*-statistic	*p*-value
Southeast	Intercept	8,778.90	259.40	33.84	< 0.001
	Baseline trend	349.75	28.53	12.26	< 0.001
	Level change after the policy	-619.79	328.24	-1.89	0.07
	Trend change after policy	-88.79	33.32	-2.67	< 0.001
Northeast	Intercept	1,360.14	51.72	26.30	< 0.001
	Baseline trend	64.76	5.69	11.38	< 0.001
	Level change after the policy	-119.11	65.45	-1.82	0.08
	Trend change after policy	-34.81	6.64	-5.24	< 0.001
Southern	Intercept	3,052.23	104.28	29.27	< 0.001
	Baseline trend	158.27	11.47	13.80	< 0.001
	Level change after the policy	-304.45	131.96	-2.31	0.03
	Trend change after policy	-84.61	13.39	-6.32	< 0.001
Western	Intercept	2,389.20	74.48	32.08	< 0.001
	Baseline trend	102.20	8.19	12.48	< 0.001
	Level change after the policy	-207.40	94.25	-2.20	0.04
	Trend change after policy	-43.62	9.57	-4.56	< 0.001

p < 0.05 is significant

Prior to January 2007, rates of NHFCard users among adults with diabetes or hypertension was an average of 8,800 per month in the Southeast Health Region, 1,300 per month in the Northeast Health Region, 3,000 per month in the Southern Health Region and 2,400 per month in the Western Health Region (p < 0.001). Prior to the policy, the NHFCard use was increasing significantly by 350 per month in the Southeast, 65 per month in the Northeast,

160 per month in the Southern and 102 per month in the Western health region ($p < 0.001$). Immediately following the policy, the number of NHFCard use dropped suddenly in the Southern and Western Health Regions (table 34). After accounting for secular trends in the pre-policy period, there was a significant decline in the rate of NHFCard users in the post-policy period in all health regions (table 34).

CHAPTER 6 - DISCUSSION

1 Chapter introduction

Mortality from NCDs in Jamaica ranks within the top 10 highest among the 28 Caribbean nations (PAHO, 2018). Drug therapy is a key component of effective chronic disease management. The NHF individual benefits (2003) was designed to improve access to medicines and quality drug therapy for chronic diseases patients in Jamaica, by subsidizing the cost of chronic disease medicines in private pharmacies or providing it for free in public pharmacies. Previous studies in Jamaica have highlighted disparities in health status and access to health services (Bourne et al, 2010; Scott & Theodore, 2013). Similar to other developing nations, there is a paucity of research on access to essential medicines in Jamaica to support government policies. This study explored three research questions related to access to medicines among adult Jamaicans with diabetes or hypertension through the NHF Individual Benefits programme.

This chapter discusses the main findings from each of the research objectives, and the overall strengths and limitations of the study.

2 Main findings

2.1 Factors associated with NHF enrollment among Jamaicans with diabetes or hypertension

Enrollment in the NHF is necessary for individuals with diabetes or hypertension to gain access to government subsidized chronic disease medicines through the NHF. This study found that in 2008, only 25% of adults with diabetes or hypertension were enrolled in the NHF. Considering enrollment in the NHF enables access to medicines at a reduced cost in private pharmacies or free in public pharmacies, low levels of enrollment may be an indication that many adults in Jamaica with diabetes or hypertension face barriers to accessing their medicines. To identify some of those barriers and determine whether they may be disproportionately affecting some individuals more than others, the Andersen-Newman Behavioural Model of Health Service Utilization was used to examine the predictors of enrollment in the NHF. The study hypothesized that equitable access exists when need and predisposing variables are the strongest predictors of access to health services (Andersen, MR, 2008). The findings of this study indicate that predisposing (age and marital status) and need (disease burden or comorbidity status) factors were significant predictors of NHF enrollment. Individuals less than 40 years with diabetes or hypertension were 3 to 5 times less likely to enroll in the NHF compared to those over 40 years. This is consistent with studies by Christiani et al (2016) and Vialle-Valentin et al (2015), who reported decreased access to chronic disease medicines among younger people in some developing countries. Comorbid individuals are known to be at a higher risk of CVD events

and were 4 times more likely to enroll in the NHF. Maquart de Terline et al (2016) considered comorbidity in their analysis and did not find a significant association. This study found that married people/common-law relationships or those who were previously married were between 1.7 and 2.5 times more likely to enroll in the NHF than those who were single. This is consistent with the study by Srivastava et al (2015) who found that people who were married were more likely to seek medical care and access medicines.

None of the enabling factors such as education, income, and having private health insurance were associated with the odds of enrollment. The contextual factors, such as administrative health region and rurality were also not significant. Administrative health regions are geography-based and represent differences in health system inputs and organization of health services, while rurality represents the community level factors such as availability of primary care, socio-economic conditions, such as rates of post-secondary education, average income and overall population health. This is contrary to what was found from the literature review, where poor accommodations in primary care, socioeconomic development and geographic accessibility were significant barriers to accessing medicines in some developing countries (Srivastava et al, 2015; Yao et al, 2015; Elias et al, 2016; Christiani et al, 2016; Sarayani et al, 2014; Rahmawati et al, 2018; Huang et al, 2018; Xi et al 2018). This is not surprising, as the systematic review of 15 developing countries conducted by Christiani et al (2016) also noted contrasting evidence among the included studies on multiple factors associated with access to chronic disease medicines. It is likely that the differences in observed findings between this study and the studies evaluated in the systematic literature review was due to methodological and contextual differences.

Methodological differences include study population, data sources, study design and outcome measures. Contextual differences include health system structure, administration and operation, community and culture.

It should be highlighted that age and comorbid status, which are predisposing and need variables respectively, had a strong effect on NHF enrollment, suggesting the likelihood of NHF enrollment being equitable. Marital status is also a predisposing variable and was found to have a relatively small effect on NHF enrollment. However, due to the increasing prevalence of diabetes and hypertension and the mortality from NCDs in Jamaica, a small effect would be considered significant because of the potential for public health gains resulting from even a small increase in NHF enrollment.

2.2 Drug utilization patterns and the factors predicting adherence to medicines among NHF enrollees with diabetes and hypertension

NHF pharmacy administrative claims data were used to examine utilization patterns and adherence to medicines on two large cohorts of Jamaicans enrolled in the National Health Fund with diabetes or hypertension. The cohorts consisted of adults 18 to 59 years who enrolled with diabetes or hypertension and used their NHFCard to purchase medicines in the years 2008 or 2017.

There were some differences observed in the profile of NHF users and their patterns of drug utilization between 2008 and 2017. Firstly, the disease profile at enrollment was different

between the two years examined. By 2017, the proportion of NHFCard users who had just one of the disease conditions (diabetes or hypertension) at the time of enrollment was higher when compared to 2008. This may be an indication of increased awareness to early initiation of drug therapy. Secondly, the number of individuals using their NHFCard to purchase prescriptions increased by 242% between the two years. This is likely due to cumulative increase in enrollment over the years, as the programme expanded to more pharmacies and people. An increase in the drug classes subsidized would have also contributed to the observed increase in the NHF utilization over time. Thirdly, the prevalence of use of the different drug class also differed between the two years. There was an increase in the use of Calcium Channel Blockers (CCB) and a decrease in the use of Angiotensin-Converting Enzymes (ACE) inhibitors among persons with hypertension. Antihypertensive combinations also increased from 2008 to 2017. There was a notable decrease in use of Metformin and Sulfonylureas as well as a slight decrease in the use of Insulin and an increase in the use of Antidiabetic Combinations from 2008 to 2017. Statin, which is commonly used for treating high cholesterol, increased among all individuals in the study. These drug utilization patterns are likely associated with availability of drug classes within the private sector where 80% of medicines are accessed. They are also reflective of physician prescribing patterns in Jamaica. Government policies aimed at improving access to medicines have been shown to impact physician prescribing behaviour and in some instances have resulted in irrational prescribing, such as the tendency towards prescribing brand names or polypharmacy (Uzochukwu et al, 2002; Maiga et al, 2003). In some countries where physicians prescribing is tied to financial incentives, government policies have not been successful in curtailing irrational prescribing (Yang et al, 2013; Chen et al,

2014; Song et al, 2014b; Yi et al, 2015; He et al, 2018; Chu et al, 2011; Liu et al, 2003). These challenges with irrational prescribing can lead to poor quality treatment and are costly for the healthcare system, so understanding the drug utilization pattern is the first step in identifying if irrational prescribing is present within the Jamaican context.

Individuals diagnosed with chronic diseases require continuous access to life-long treatment with medicines. Adherence to these medicines is important for effective drug therapy, making it an important quality of care measure related to access to medicines. Only a small number of studies related to adherence to chronic disease medicines were identified within developing countries and no studies specifically examined the effect of government policies on adherence in these settings. This study found that in 2017, just over half of NHF claimants with diabetes and/or hypertension were adherent with their medication. The overall percentage who were adherent declined from 54% in 2008 to 50% in 2017 in this population (chi-square=159.04, Cramer's V=0.04, $p < 0.001$), although the degree of decline was small. The percent who were adherent to Statin therapy was relatively low compared to antidiabetic and antihypertensive therapies in the study population. This is concerning as Statin therapy is an effective treatment for high cholesterol in diabetics and hypertensives and is known to reduce cardiovascular risk in these populations (Parris et al, 2005; ADA, 2020). The overall low percentage of individuals with diabetes or hypertension who were found to be adherent with chronic disease therapy, supports previous studies showing low prevalence of good glycemic and blood pressure control among adult diabetics or hypertensives in Jamaica (Wilks et al ,2000; Duff et al, 2006; Harris et al, 2014; Cunningham-Myrie et al, 2013; Ferguson et al, 2013). Using the Andersen-Newman Behavioural Model of Health Service

Utilization, the study found that a combination of predisposing, need, enabling and contextual factors were associated with adherence behaviour among NHF users with diabetes or hypertension in 2008 and 2017. In the most recent year examined (2017), eight variables were significantly associated with adherence. The strongest predictor of adherence in 2008 and 2017, was monthly out-of-pocket expense. This was the portion of the medicine cost that was not subsidized by the NHF. Lower adherence was observed among individuals with the lowest out-of-pocket expense. Out-of-pocket expense has been linked to family income and therefore represents resources at the family or individual level (Monteiro et al, 2016; Bertoldi et al, 2011). Studies have found that lower income families spend less on medicines compared to upper income families (Monteiro et al, 2016; Bertoldi et al, 2011). Monthly out-of-pocket expenses may also reflect variation in cost of medicines to treat the same condition. In the private sector in Jamaica, the cost of originator brands for treating hypertension was estimated at 5.2 days' worth of wages for low-income individuals compared to 80% of a day's wage for a 30-day supply of the generic equivalent (PAHO, 2012). Similarly, the cost of originator brands for treating diabetes was 2.1 days' worth of wages compared 10% of a day's wage for a 30-day supply of generic equivalent (PAHO, 2012). Considering, that the amount of the NHF subsidy is not dependent on income and the Jamaican government has no policy to regulate the price of medicines (NHF Act, 2003; PAHO, 2012), low-income individuals may forego treatment in the absence of a low-cost generic equivalent. One possible explanation for the decreased adherence seen in this population from 2008 to 2017 could be due to decreases in NHF subsidy rates over time (NHF 2016, 2018). This view is supported by numerous studies in other settings, which showed that cost of medicines is an important predictor of adherence to chronic disease

medicines, even among those in receipt of subsidies (Macquart de Terline, 2019; Aziz et al, 2016; Zheng et al, 2012; Jensen et al, 2012). It is also consistent with a household survey conducted in Jamaica, where one-quarter of respondents identified cost as the most significant barrier to adherence (PAHO, 2012).

Other significant predictors of medication adherence in this population were, number of therapies, number of years enrolled, administrative health region, comorbidity, sex, age and rurality. These predictors although described in the analysis as having small effects on adherence, were considered to be significant from a public health perspective, because a small increase in adherence levels within this population can have a significant impact at the individual and societal level. Also, the relatively small effect of some these variables was expected, given that adherence is a complex behaviour determined by many inter-related factors. The predictors of adherence in 2008 cohort were largely consistent with the findings from the 2017 cohort.

The findings from this study supports previous findings that medication adherence is a complex behavior predicted by multiple factors. The consistent finding from both study years that enabling and contextual factors were among the predictors of medication adherence, indicates the likelihood that socio-economic and geographic differences were impacting continued access to medicines through the NHF. This is also consistent with previous studies in Jamaica that identified poor socio-economic conditions, gender, cultural beliefs, low education levels, comorbidity and not having private health insurance as significant predictors of adherence to chronic disease medicines (Bridgelal-Nagassar et al, 2016; Wilks

et al, 2008; Swaby et al, 2001). Other factors that were found to be significant from previous Jamaican studies were, medication side effects, affordability, poor availability, use of alternate therapy, symptom experience, disease perception, duration of illness, treatment modality, health literacy and health status (Wilks et al, 2008; Chambers et al, 2008, Mowatt et al, 2011). These findings are also consistent with studies on adherence in other developing countries that identified a range of factors associated with adherence (Macquart de Terline et al, 2019; Marfo et al, 2017; Jande et al, 2015; Shams et al, 2016; Sarayani et al, 2013).

2.3 Effect of the removal of user fees from primary care on use of the NHF

The removal of user fees from public health facilities in Jamaica in 2008 marked an important policy to mitigate the economic burden of accessing primary care and by extension medicines. This study examined whether the introduction of that policy had the desired effect of improving access to the NHF among adults with diabetes or hypertension. Based on Interrupted Time Series (ITS) models, this study found that there was an increase in the rate of new NHF enrollment in the post-policy period, although this effect was not deemed to be significant in the ITS Model. The time series trend also suggests that there was an increase in new enrollments several months following the policy implementation date (February 2009). This increase may have been due to periodic public advertising campaigns or community outreach events to promote NHF enrollment. However, the exact timing and nature of these events in 2009 are unknown. In terms of the policy's impact on the number

of NHFCard users, there was an overall increasing trend during the post-policy period. However, the rate of increase was significantly lower when compared to the pre-policy period. The reduced rate in NHFCard use versus the increased rate of new NHF enrollments seems counterintuitive, since one would expect increased rate of enrollment would lead to increased rate of NHFCard use. As these trends could be influenced by multiple system related factors, the exact reasons would need further exploration. For example, the Auditor General (2011) reported that between 2006 and 2010, pharmacies were unable to satisfy the demand for medicines in primary care, due to low medicine stock levels at the government's central pharmaceutical warehousing and distribution centre. NHFCard use is based on the dispensation of available chronic medicines among individuals who are enrolled in the NHF. The increased demand for chronic disease medicines in the post-policy period, may have exacerbated the lack of availability of medicines, resulting in reduced drug dispensation among holders of the NHFCard. A more recent Auditor General report (2017) also noted continued deficiencies in the management of inventory as it relates to medicine stocks between 2011 and 2017 in public pharmacies. Furthermore, the literature review highlighted that some countries experienced unintended consequences of government policies aimed at improving access to medicines. Drug supply as well as other access issues may have impacted access to the NHF in the post-policy period.

In addition to the unstratified ITS Models used to evaluate the effect on the policy to remove user fees from public health facilities on NHF enrollment and NHFCard use, several independent ITS models were also used to examine if the policy had an effect on specific sub-groups. Sub-group analysis was used to determine if the effect of the policy on specific

sub-groups was obscured in the unstratified ITS Models. These independent ITS studies found that the policy significantly increased new NHF enrollments among females; people living in urban areas; people in the 18 to 24 years, 45 to 49 years and 50 to 54 years age groups. However, there was no indication that the policy impacted NHFCard use differently in these same sub-groups examined. A previous study by Campbell (2013), reported an increase in access to medicines at public health facilities immediately following the implementation of the policy to remove user fees. The findings from this study suggests that the policy, which removed a cost barrier from primary care in public health facilities, enabled access to the NHF among some individuals who were previously not enrolled. However, the study found no evidence that the policy increased continued access to medicines through the NHF. Since there were no direct comparisons made during the stratified ITS analysis, the sub-group differences highlighted in the independent ITS Models need further analysis to determine if these differences were significant. Additionally, observed statistical significance within the sub-group analysis were likely influenced by sub-group sample sizes, for example, the study showed that the rate of new NHF enrollment within the 55 to 59 age-group did not reach statistical significance (p=0.09), compared to the 18 to 39 age-group (p=0.04), although the change during the post-poicy period in the 55 to 59 age-group (Trend change in the post-policy period = 6.45) was observed to be greater than in the 18 to 39 age-group (Trend change in the post-policy period = 5.08).

3 Strengths

This was a novel study intended to build a body of evidence to inform the design of effective policies around interventions aimed at improving access and adherence to diabetes and hypertension medicines in Jamaica. The information gained from this research will be able to support policy decisions around efficient allocation of public health resources, and to reduce health inequities in the country. It will also be useful to support the development of a National Pharmaceutical Policy to ensure equitable access and quality use of medicines for treating NCDs in Jamaica.

The use of multiple quantitative methodological approaches in the study allowed for the interrogation of existing secondary data sources to address multiple policy questions relevant to access and use of the NHF at a national level. To ensure the findings were relevant to policy makers, different conceptual frameworks were used to characterize the relationship between the explanatory and outcome variables. The frameworks used had theoretical as well as practical applicability for future health services research in the country. Because of this approach, multiple insights were gained from this study as it relates to access to chronic disease medicines that would have otherwise been impractical and expensive to operationalize as a primary study. It also provides a roadmap for researchers interested in drug utilization research, which to date is limited in Jamaica. Furthermore it was the first study to examine the factors associated with medication adherence on two large cohorts at a national level. It is firmly established that improving adherence to medicines to treat chronic disease such as hypertension and diabetes would lead to public

health and economic gains in many countries. Understanding the factors that contribute to decreased adherence for these conditions is needed to support policies and programmes to improve quality drug therapy.

A secondary goal of the research was to demonstrate the importance and utility of real-world data in advancing healthcare utilization research in Jamaica. It is the first of its kind in Jamaica to mine and use real world data to examine access and adherence to medicines and fills an important gap in research related to the quality of drug therapy in the country. The main advantages of using real world data, is they are inexpensive, objective and non-invasive sources for studying drug use patterns within the population (Hess et al, 2006). As was demonstrated in this study, they have been shown to provide valuable information related to prescribing and dispensing patterns and adherence to drug therapy (Cadarette & Wong, 2015; Gazmararian et al, 2006, Sinott et al, 2017).

4 Limitations

There were several limitations related to the use secondary data sources in this research project. Firstly, the JHLS (II) which was conducted in 2008 may not reflect NHF enrollement patterns of today. However, since there has been no formal evaluation of the characteristics influencing access and use of this important drug subsidy programme since its implementation in 2003, this survey provided a unique opportunity to examine these factors. Secondly, as is the case with most face-to-face interviewer-administered survey, there was

a potential for ‘yes-saying’ and interviewer bias in the JHLS (II). These biases could have ultimately affected the validity of the results related to NHF enrollment. Thirdly, the use of the NHF Pharmacy Claims database, meant that potential confounders such as income, education, medication side effects, health insurance coverage and duration of disease were missing from the analyses (Macquart de Terline et al, 2019; Shams et al, 2016; Wilks et al, 2008; Chambers et al, 2008, Mowatt et al, 2011; Bridgelal-Nagassar et al, 2016; Swaby et al, 2001). The availability of those variables would have strengthened the findings of the research. The possibility of supplementing the pharmacy claims with primary care data collection, though contemplated, was not feasible due to the extra cost related to operationalizing such a data collection strategy, and thus beyond the scope of this PhD Thesis. Finally, in terms of its inclusivity, the NHF pharmacy claims database captures the dispensation of medicines to Jamaicans enrolled in the NHF, it is important to note that it does not include prescriptions that were written but not dispensed, prescriptions not eligible for NHF subsidy nor does it include information on prescriptions that were dispensed and not taken. Individuals may also take their prescriptions to be filled outside of these private pharmacies and so no record of the medication being dispensed from these sources is captured. It also does not capture prescriptions among diabetics and hypertensives who are not enrolled in the NHF.

The use of a cut-off of 80% medication possession ratio (MPR) is often used in similar research to classify individuals as adherent versus non-adherent (Karve et al, 2009), but this may oversimplify the complex relationship between medication adherence and the multiple factors influencing this behaviour. Additionally, due to methodological differences,

it was difficult to compare the medication adherence measure used in this study to those used in previous Jamaican studies (Swaby et al, 2001; Duff et al, 2006; Wilks et al, 2008; Mowatt et al, 2011; Bridgelal-Nagassar et al, 2016). Previous studies were all done in clinic settings, on selective populations with relatively small sample sizes and measurement of adherence varied between the studies (Swaby et al, 2001; Duff et al, 2006; Bridgelal-Nagassar et al, 2016). In addition, most studies relied on patient self-reported measures of adherence, which has been shown to overestimate adherence behaviour compared to other assessment methods (Stirrat et al, 2015; Fujita et al, 2015).

There were also some key limitations with the ITS Models used to determine the effect of the removal of user fees in public health facilities on NHF access. Firstly, the assumption that a change will occur at the time of the intervention does not account for delays in intervention effects, which is characteristic of complex healthcare interventions (Cruz et al, 2017). It also does not account for the sometimes-varied effects of these of complex interventions in real-world settings due to undetected exogenous factors (Cruz et al, 2017). Secondly, even though first order autocorrelation was not detected by the Durbin-Watson test, the ITS approach used in this study did not specifically address the effect of autocorrelation on the model estimates. However, it is noteworthy that 50% of drug utilization studies reportedly used a similar approach to ITS modelling as the one used in this study i.e. Segmented Regression (Hawley et al, 2019).

CHAPTER 7 - CONCLUSION

1 Chapter introduction

Diabetes and hypertension are significant public health problems in Jamaica. At the same time, the healthcare system with its mix of public and private health sectors is complex and poses additional challenges with equitable access to health services. This study utilized real world data from two sources to identify key factors that may be facilitating or impeding access to chronic disease medicines for adult Jamaicans with diabetes or hypertension. The study was specifically concerned with examining access and use of the National Health Fund (NHF) Individual Benefit programme. A programme designed and implemented in 2003 to improve access to medicines for Jamaicans with chronic diseases.

This study found multiple barriers to accessing medicines through the NHF and highlights the need for government policies and interventions to take a multidimensional approach to policy and programme development. Some policy implications derived from this research are discussed in this chapter. The chapter closes by proposing further research to improve access and use of the NHF.

2 Policy Implications

The literature review highlighted that the factors associated with access to chronic disease medicines varied by region and country (Ewen et al, 2019; Barbar et al, 2019; Macquart de Terline et al, 2019; Chow et al, 2018; Attaei et al, 2017; Ewen et al 2017; Emmerick et al, 2015; Srivastava et al, 2015; Vialle-Vallentin et al, 2015; Wagner et al, 2011), largely because of differences in the healthcare system and other contextual factors that drive the consumption of medicines. However, a key takeaway from the systematic review of experiences in other developing countries, was that policies primarily aimed at addressing affordability of medicines were either ineffective or created unintended consequences around the use of chronic disease medicines (Ding et al, 2017; Guo et al, 2017; He at al, 2018; Maiga et al, 2003; Huang et al, 2018; Xi et al, 2018; Yao et al, 2015). This was largely because, they ignored other important dimensions of access to chronic disease medicines and as a result, disparities in access to chronic disease medicines was still a problem in many developing countries (Rockers et al, 2019; Shannon et al, 2019; Ewen et al, 2019; Barbar et al, 2019; Macquart de Terline et al, 2019; Chow et al, 2018; Rahmawati et al, 2018; Rockers et al, 2018; Attaei et al, 2017; Ewen et al 2017; Marfo et al, 2017; Jande et al, 2017; Flood et al, 2017; Elias et al, 2017; Shams et al, 2016; Christiani et al, 2016; Murphy et al, 2016; Srivastava et al, 2015; Emmerick et al, 2015; Vialle-Vallentin et al, 2015; Sarayani et al, 2014; Sarayani et al, 2013; Gama et al, 2013; Wagner et al, 2011). Similarly, the NHF Individual Benefits provides a subsidy which addresses the affordability of chronic disease medicines. However, the amount and type of benefit received is the same regardless of age, gender

and socio-economic status. Additionally, those with private health insurance are at an advantage because they may get an additional reduction on the cost of their medicines. However, previous Jamaican studies have highlighted significant disparities in chronic disease burden among specific groups such as females, rural populations, and people in lower socio-economic groups (Tulloch-Reid, 2013; Scott & Theodore, 2013). This study found that enrollement was largely equitable with need and predisposing factors (chronic disease burden and age) being the strongest predictors of NHF enrollement. However, adherence to medicines among NHF enrolless, may not have been equitable as other non-need factors were found to be significant predictors, with out-of-pocket expense being the strongest predictor of adherence. It could therefore be argued that the NHF does not adequately reduce disparities in access to medicines for the groups with the highest chronic disease burden in Jamaica. As such, policymakers in Jamaica should consider whether more targeted strategies are needed in order to ensure equitable access to chronic disease medicines. Also, I would argue that the removal of user fees from public health facilities to increase access to primary care and by extension access to the NHF, had only limited impact, because of the private sector dominance in primary healthcare. This highlighted the importance for policies targeting primary care providers, especially in a healthcare system like Jamaica where the government is not the predominant provider of primary care services.

Furthermore, to ensure all Jamaicans with diabetes or hypertension gain access to low-cost essential medicines, government interventions may be needed to improve awareness about the NHF individual benefits and the role of primary care in accessing

chronic disease medicines. The study identified that younger adults were less likely to enroll in the NHF. Younger people reportedly have a lower risk perception of themselves and are less likely to have a usual place of primary care (Victor et al, 2008; Appleton et al, 2012; Heidemann et al, 2019). Considering NHF enrollment is predicated on primary care access, and the onset of diabetes and hypertension occur at a younger age in developing countries, these interventions would be an important step towards quality chronic disease management for younger people. Given that both age and comorbidity status had a strong effect on NHF enrollment, awareness interventions could also target physicians to ensure that younger at-risk populations are screened and individuals with a single condition are referred for NHF enrollment.

Once individuals are enrolled in the NHF, interventions to improve medication adherence in persons with diabetes or hypertension are also needed in Jamaica. The NHF programme, by subsidizing the cost of chronic disease medicines, accounts for the affordability dimension of access to medicines. But as was seen from the experience in other developing countries that adopted national policies or programmes to address access to medicines, patients face many other barriers to medication adherence. Although the reasons for low medication adherence was not specifically explored in this study, one could argue that this is also one of the main reasons why adherence to essential medicines was low among this NHF subsidized population and showed signs of a decline over time. The finding that enabling and contextual factors were significant predictors of adherence, suggests that there are health-system, drug-related and socio-economic factors acting as barriers to continued access to chronic disease medicines.

Differences in adherence by contextual factors i.e., geographic factors (rurality) and administrative health region, indicate that there are disparities in accessibility and accommodations within the health system. The barriers may include, geographic location of primary care services, where patients can be diagnosed, receive ongoing monitoring and access pharmacies to fill their prescriptions. Primary care is the gateway to accessing medicines through the NHF in Jamaica. As the literature review highlighted, organization of primary care can have a significant impact on access to chronic disease medicines (Elias et al, 2016; Christiani et al, 2016; Sarayani et al, 2014). The volume of patients receiving primary care services in the private sector where fees are unregulated, is likely contributing to disparities in access to chronic disease medicines in Jamaica. This is one possible explanation for why the policy to remove user fees from public health facilities did not increase use of the NHF. The policy only addressed user fees in the public sector and did not alleviate the financial cost for the majority of Jamaicans who utilize primary care in the private sector in order to access NHF benefits. Due to the perception of better-quality care, there is a tendency towards higher utilization of more expensive private healthcare in developing countries (Wagner et al, 2011). Accommodation issues, such as longer wait times and less comfortable settings in public health facilities versus private clinics contribute to these negative perceptions of public health facilities. In the case of Jamaica, declining use of the public health sector was reportedly due to lack of financing and inefficient organization and delivery of primary healthcare services in the public sector (MOHW, 2019). Studies in other countries have shown that positive perception of the public health sector leads to better access to care

and medicines in developing countries (Wagner et al, 2011). Expansion and improvement of government facilities and services may be needed in the long-term to increase use of public health facilities and reduce these disparities. Efforts should focus on rural areas, where poverty was highlighted as a significant barrier to accessing health services (Bourne et al, 2010; Theodore et al, 2013). Secondly, eighty (80%) of medicines are purchased in private pharmacies and the government has no medicine monitoring system to track these prices and no policies to regulate them. Therefore, even with the NHF subsidizing the cost of medicines, the out-of-pocket costs are still financially burdensome for some Jamaicans, particularly in light of the declining subsidy rates over time (NHF, 2018). People in rural areas who are less likely to have health insurance, will face more financial barriers (Chambers et al, 2008; Mowatt et al, 2011). Studies in other settings have shown that when medicine prices are unregulated, markups can be as high as 150%, thus contributing to a larger share of the medicine's price (Srivastava et al, 2015). On the other hand, government price regulations have been shown to improve affordability of medicines in some settings (Sarayani et al, 2014). Considering that out-of-pocket expense had a strong effect on medication adherence, policies and mechanisms for government to track and regulate the retail price of medicines should be prioritized in order to ensure affordability. The government should also make every effort to seek out cost savings in their NCD drug purchases and pass those savings on the consumers.

Other important dimensions of access should also be addressed within the health system. For example, this study found that the number of drug therapies (polypharmacy)

significantly increased risk of non-adherence among NHF enrollees. Although polypharmacy had a small effect on medication adherence in this study, the findings suggests that to some degree, treatment acceptability was a barrier to continued access to chronic disease medicines. Evidence-based policies or guidelines are needed to address combination therapies in order to reduce polypharmacy and drug side effects. Interventions to improve medication adherence also need to target patients at enrollment and address the disparities in women and younger adults with these conditions.

The literature review also highlighted the key role of health system infrastructure in supporting efforts to improve access to medicines. Thus, the health system infrastructure while complex should be a key consideration for policymakers when developing or evaluating pharmaceutical policies or programmes aimed at increasing access to chronic diseases medicines. Emmerick et al (2015), whose study focused on access to medicines in three Latin American countries, found that the main factor associated with access to medicines for treating chronic diseases was seeking care in the formal healthcare system. The strong private sector presence in the management of chronic diseases in Jamaica might be challenging for policymakers when it comes to strengthening the healthcare system, none-the-less, Emmerick et al (2015) reinforced the need for policymakers to focus in this area. This study supports the argument by Emmerick et al (2012) and also highlights the need for programmes and policies to take a multi-dimensional approach to improving access to medicines. This recommendation aligns with a multi-dimensional framework proposed by Jacobs et al (2012) to tackle interventions aimed at improving access to health services in developing countries.

Due to the complex nature of access to medicines and adherence behaviour, many of the predictor variables explored in this study were observed to have a small effect. However, it should be noted that weak associations were not regarded in this study as an indication of public health insignificance, as there is an expectation that weak associations will be observed in real world settings, where each predictor variable is only partially explaining the complex outcomes being investigated in this study (McHugh M.L., 2013).

3 Further research

This study is the first to examine access and adherence to medicines on such a large population in Jamaica and it offers some important insights for policy makers and researchers alike. It fills an important gap in research on access to chronic disease medicines, specifically in the Caribbean region. It also underscores numerous challenges developing countries face when implementing chronic disease medicine policies to address the wide range of factors influencing access to medicines. In order for the government to design a comprehensive multidimensional policy to address access to chronic disease medicines, research is also needed to understand factors associated with access and adherence to medicines in the older population (60+ years). Due to data limitations, this population was not included in this study. The prevalence of diabetes and hypertension in Jamaicans over 60 years has increased significantly over the past three decades (Mitchell-Fearon et al, 2014). They are also at greater risks of having poor medical outcomes because of these conditions. The finding from this study that females

are less likely to be adherent to chronic disease medicines requires further investigation. Although, gender had a small effect on adherence in this study, it warrants further exploration since a previous Jamaican study showed excess cardiovascular risk burden in females (Tulloch-Reid et al, 2013). Therefore, females are at a higher risk of poor medical outcomes without quality drug therapy. Research is also needed to understand access barriers encountered by young adults with diabetes or hypertension. As the majority of primary care is provided by the private sector, research is also needed to understand barriers to accessing primary care in the private sector and their impact on access and adherence to medicines in Jamaica. The drug utilization profile described in this study provides useful information on physician prescribing behavior within this population. However, more research is needed to understand if irrational prescribing exists as have been found in other settings (Jia et al, 2014; Luiza et al, 2015; Kolasa & Kowalczyk et al, 2017).

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APPENDICES

CHAPTER 2 -APPENDICES

Appendix 2.1 – Scoping review search terms

(adherence) AND TITLE-ABS (medicine)) AND (TITLE-ABS-KEY-AUTH ("chronic diseases") OR TITLE-ABS-KEY-AUTH ("chronic disease") OR TITLE-ABS-KEY-AUTH ("chronic illness") OR TITLE-ABS-KEY-AUTH ("chronic illnesses") OR TITLE-ABS-KEY-AUTH ("chronic conditions") OR TITLE-ABS-KEY-AUTH ("chronic condition") OR TITLE-ABS-KEY-AUTH (diabetes) OR TITLE-ABS-KEY-AUTH (hypertension) OR TITLE-ABS-KEY-AUTH ("high blood pressure")) AND (TITLE-ABS ("developing country") OR TITLE-ABS ("developing countries") OR TITLE-ABS ("low-income countries") OR TITLE-ABS ("low-income country") OR TITLE-ABS ("low income country") OR TITLE-ABS ("low income countries") OR TITLE-ABS ("resource poor") OR TITLE-ABS ("middle income country") OR TITLE-ABS ("middle income countries") OR TITLE-ABS ("middle-income country") OR TITLE-ABS ("middle-income countries")) AND NOT ((TITLE-ABS-KEY-AUTH (children) OR TITLE-ABS-KEY-AUTH (paediatric) OR TITLE-ABS-KEY-AUTH (pediatric)) AND (TITLE-ABS ("developing country") OR TITLE-ABS ("developing countries") OR TITLE-ABS ("low-income countries") OR TITLE-ABS ("low-income country") OR TITLE-ABS ("low income country") OR TITLE-ABS ("low income countries") OR TITLE-ABS ("resource poor") OR TITLE-ABS ("middle income country") OR TITLE-ABS ("middle income countries") OR TITLE-ABS ("middle-income country") OR TITLE-ABS ("middle-income countries"))) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "re")) AND (LIMIT-TO (SUBJAREA , "MEDI") OR LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "ECON") OR LIMIT-TO (SUBJAREA , "NURS") OR LIMIT-TO (SUBJAREA , "PHAR") OR LIMIT-TO (SUBJAREA , "MULT") OR LIMIT-TO (SUBJAREA , "HEAL") OR LIMIT-TO (SUBJAREA , "Undefined")) AND (LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2012) OR LIMIT-TO (PUBYEAR , 2011) OR LIMIT-TO (PUBYEAR , 2010) OR LIMIT-TO (PUBYEAR , 2009) OR LIMIT-TO (PUBYEAR , english)) AND (EXCLUDE (PUBYEAR , 2009))*

Appendix 2.2 - Systematic review search terms

Filters: English Language

1) *MH [developing countries]*

2) *TIAB [“developing countr*” OR “under-developed countr*” OR “under developed countr* “OR “third-world countr*” OR “third world countr*” OR “developing nation*” OR “under-developed nation*” OR “under developed nation*” OR “third-world nation*” OR “third world nation*” OR l”ess-developed countr* “OR “less developed countr*” OR “less-developed nation*” OR l”ess developed nation*” OR “low income countr*” OR “low and middle income countr*” OR “low-income countr*” OR “low-and-middle income countr*” OR “middle income countr*” OR “middle-income countr*” OR “LMIC*”; “deprived countr*” OR “low income econom*” OR “low-income econom*” OR “low gross domestic” OR “low gross national” OR “low GDP “OR “low GNP” OR “poor* countr*”]*

3) *MH [Africa OR Latin America OR Central America OR Caribbean Region OR South America OR Asia]*

4) *[Afghanistan OR Albania OR Algeria OR “American Samoa” OR Angola OR Armenia OR Azerbaijan OR Bangladesh OR Belarus OR Byelarus OR Belorussia OR Belize OR Benin OR Bhutan OR Bolivia OR Bosnia OR Botswana OR Brazil OR Bulgaria OR Burma OR “Burkina Faso” OR Burundi OR “Cabo Verde” OR “Cape verde” OR Cambodia OR Cameroon OR “Central African Republic” OR Chad OR China OR Colombia OR Comoros OR Comores OR Comoro OR Congo OR “Costa Rica” OR “Côte d'Ivoire” OR Cuba OR Djibouti OR Dominica OR “Dominican Republic” OR Ecuador OR Egypt OR “El Salvador” OR Eritrea OR Ethiopia OR Fiji OR Gabon OR Gambia OR Gaza OR “Georgia Republic” OR Georgian OR Ghana OR Grenada OR Grenadines OR Guatemala OR Guinea OR “Guinea Bisau” OR Guyana OR Haiti OR Herzegovina OR Hercegovina OR Honduras OR India OR Indonesia OR Iran OR Iraq OR Jamaica OR Jordan OR Kazakhstan OR Kenya OR Kiribati OR Korea OR Kosovo OR Kyrgyz OR Kirghizia OR Kirghiz OR Kirgizstan OR Kyrgyzstan OR “Lao PDR” OR Laos OR Lebanon OR Lesotho OR Liberia OR Libya OR Macedonia OR Madagascar OR Malawi OR Malay OR Malaya OR Malaysia OR Maldives OR Mali OR “Marshall Islands” OR Mauritania OR Mauritius OR Mexico OR*

Micronesia OR Moldova OR Mongolia OR Montenegro OR Morocco OR Mozambique OR Myanmar OR Namibia OR Nepal OR Nicaragua OR Niger OR Nigeria OR Pakistan OR Palau OR Panama OR "Papua New Guinea" OR Paraguay OR Peru OR Philippines OR Phillippines OR Philipines OR Phillipines OR Principe OR Romania OR Rwanda OR Ruanda OR Samoa OR "Sao Tome" OR Senegal OR Serbia OR "Sierra Leone" OR "Solomon Islands" OR Somalia OR "South Africa" OR "South Sudan" OR "Sri Lanka" OR "St Lucia" OR "St Vincent" OR Sudan OR Surinham OR Suriname OR Swaziland OR Syria OR "Syrian Arab Republic" OR Tajikistan OR Tadzhikistan OR Tadjikistan OR Tadzhik OR Tanzania OR Thailand OR Timor OR Togo OR Tonga OR Tunisia OR Turkey OR Turkmen OR Turkmenistan OR Tuvalu OR Uganda OR Ukraine OR Uzbek OR Uzbekistan OR Vanuatu OR Vietnam OR "West Bank" OR Yemen OR Zambia OR Zimbabwe]

5) *1 OR 2 OR 3 OR 4*

6) *MH [public policy OR health policy OR healthcare financing OR government financing OR public sector or healthcare sector] OR Keyword [pharmaceutical policy OR healthcare financing OR national drug policy]*

7) *TIAB ["public polic*" OR "health polic*" OR "healthcare financing" OR "government financ*" OR "public sector" OR "healthcare sector" OR "national drug polic*" OR "pharmaceutical polic*"]*

8) *6 OR 7*

9) *MH ["pharmaceutical fees" OR "pharmaceutical services" OR "pharmaceutical economics" OR "pharmaceutical insurance services" OR "prescription fees" OR "prescription drugs" OR "insurance benefits" OR "health insurance" OR "deductibles" OR "Coinsurance" OR "cost sharing"] OR Keyword [drug insurance OR coinsurance]*

10) *TIAB "pharmaceutical service*" OR "prescription fee*" OR "prescription drugs" OR "pharmaceutical insurance" OR "cost-sharing" OR "cost sharing" OR "drug insurance" OR "drug benefits" OR "deductible*" OR "copay*" OR "co-pay*" OR "drug user fee*" OR "drug user-fee*" OR "drug subsidy" OR "medication subsidy" OR "co-insurance" OR "coinsurance" OR "insurance coverage" OR "insurance benefits" OR "health insurance"*

11) 9 OR 10

12) MH [health service accessibility OR drugs, essential OR drug substitution OR treatment adherence and compliance OR medication adherence OR drug utilization OR drug utilization review OR prescription drug misuse OR prescription drug overuse OR drug prescription OR inappropriate prescribing OR hospitalization OR drug costs OR healthcare cost OR cost-benefit analysis OR cost savings OR treatment outcomes OR medication therapy management OR disease management]

13) TIAB "access to medicine" OR "access to prescription" OR "essential medicine*" OR "essential drugs" OR "adherence" medication management" OR "medication therapy" OR "prescription" OR "prescribing patterns" OR "dispensing patterns" OR "generic drugs" OR "generic medicine*" OR "drug utilization" OR "drug utilisation" OR "drug use" OR "hospitalization" OR "hospitalisation OR "hospital use *" OR "out of pocket" OR "out-of-pocket" OR "cost-saving" OR "cost saving" OR "treatment outcome*"*

14) 12 OR 13
15) 5 AND 8 AND 11 AND 14

Appendix 2.3 - Data Extraction Elements

- First author, year of publication, title
- Study setting
- Characteristics of policies and interventions
- Study objective
- Study design
- Outcome measures
- Results from main outcome measures
- Sources of data (e.g. surveys, administrative etc.)
- Analytic methods

Appendix 2.4 – Methodological Quality Assessment Tool

QUALITY ASSESSMENT TOOL FOR QUANTITATIVE STUDIES

COMPONENT RATINGS

A) SELECTION BIAS

(Q1) Are the individuals selected to participate in the study likely to be representative of the target population?

1 Very likely
2 Somewhat likely
3 Not likely
4 Can't tell

(Q2) What percentage of selected individuals agreed to participate?

1 80 - 100% agreement
2 60 – 79% agreement
3 less than 60% agreement
4 Not applicable
5 Can't tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

B) STUDY DESIGN

Indicate the study design

1 Randomized controlled trial
2 Controlled clinical trial
3 Cohort analytic (two group pre + post)
4 Case-control
5 Cohort (one group pre + post (before and after))
6 Interrupted time series
7 Other specify _____
8 Can't tell

Was the study described as randomized? If NO, go to Component C.

No Yes

If Yes, was the method of randomization described? (See dictionary)

No Yes

If Yes, was the method appropriate? (See dictionary)

No Yes

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

C) CONFOUNDERS

(Q1) Were there important differences between groups prior to the intervention?

1 Yes
2 No
3 Can't tell

The following are examples of confounders:

1 Race
2 Sex
3 Marital status/family
4 Age
5 SES (income or class)
6 Education
7 Health status
8 Pre-intervention score on outcome measure

(Q2) If yes, indicate the percentage of relevant confounders that were controlled (either in the design (e.g. stratification, matching) or analysis)?

1 80 – 100% (most)
2 60 – 79% (some)
3 Less than 60% (few or none)
4 Can't Tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

D) BLINDING

(Q1) Was (were) the outcome assessor(s) aware of the intervention or exposure status of participants?

1 Yes
2 No
3 Can't tell

(Q2) Were the study participants aware of the research question?

1 Yes
2 No
3 Can't tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

E) DATA COLLECTION METHODS

(Q1) Were data collection tools shown to be valid?

1 Yes
2 No
3 Can't tell

(Q2) Were data collection tools shown to be reliable?

1 Yes
2 No
3 Can't tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

F) WITHDRAWALS AND DROP-OUTS

(Q1) Were withdrawals and drop-outs reported in terms of numbers and/or reasons per group?

1 Yes
2 No
3 Can't tell
4 Not Applicable (i.e. one time surveys or interviews)

(Q2) Indicate the percentage of participants completing the study. (If the percentage differs by groups, record the lowest).

1 80 -100%
2 60 - 79%
3 less than 60%
4 Can't tell
5 Not Applicable (i.e. Retrospective case-control)

RATE THIS SECTION	STRONG	MODERATE	WEAK	
See dictionary	1	2	3	Not Applicable

G) INTERVENTION INTEGRITY

(Q1) What percentage of participants received the allocated intervention or exposure of interest?

1 80 -100%
2 60 - 79%
3 less than 60%
4 Can't tell

(Q2) Was the consistency of the intervention measured?

1 Yes
2 No
3 Can't tell

(Q3) Is it likely that subjects received an unintended intervention (contamination or co-intervention) that may influence the results?

4 Yes
5 No
6 Can't tell

H) ANALYSES

(Q1) Indicate the unit of allocation (circle one)

community organization/institution practice/office individual

(Q2) Indicate the unit of analysis (circle one)

community organization/institution practice/office individual

(Q3) Are the statistical methods appropriate for the study design?

1 Yes
2 No
3 Can't tell

(Q4) Is the analysis performed by intervention allocation status (i.e. intention to treat) rather than the actual intervention received?

1 Yes
2 No
3 Can't tell

GLOBAL RATING

COMPONENT RATINGS
Please transcribe the information from the gray boxes on pages 1-4 onto this page. See dictionary on how to rate this section.

A	**SELECTION BIAS**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	
B	**STUDY DESIGN**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	
C	**CONFOUNDERS**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	
D	**BLINDING**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	
E	**DATA COLLECTION METHOD**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	
F	**WITHDRAWALS AND DROPOUTS**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	Not Applicable

GLOBAL RATING FOR THIS PAPER (circle one):

1	STRONG	(no WEAK ratings)
2	MODERATE	(one WEAK rating)
3	WEAK	(two or more WEAK ratings)

With both reviewers discussing the ratings:

Is there a discrepancy between the two reviewers with respect to the component (A-F) ratings?

No Yes

If yes, indicate the reason for the discrepancy

1	Oversight
2	Differences in interpretation of criteria
3	Differences in interpretation of study

Final decision of both reviewers (circle one):

1	**STRONG**
2	**MODERATE**
3	**WEAK**

Appendix 2.5 - Methodological Quality of Included Studies

Author, Year	Selection Bias	Study design	Confounders	Blinding	Data Collection Methods	Withdrawals and dropouts	Global Rating
Zhang et al, 2017	Moderate	Moderate	Strong	Strong	Strong	Strong	Strong
Mengue et al, 2016	Moderate	Weak	Strong	Strong	Strong	NA	Moderate
Holloway et al, 2001	Strong	Moderate	Strong	Weak	Moderate	NA	Moderate
Huang et al, 2018	Strong	Weak	Weak	Weak	Weak	Weak	Weak
Bertoldi et al, 2012	Weak	Weak	Weak	Weak	Weak	NA	Weak
Bertoldi et al, 2009	Strong	Weak	Strong	Weak	Weak	NA	Weak
Bertoldi et al, 2011	Moderate	Weak	Strong	Weak	Weak	NA	Weak
Monteiro et al, 2016	Moderate	Weak	Strong	Weak	Weak	NA	Weak
Araujo et al, 2014	Moderate	Weak	Weak	Weak	Weak	NA	Weak
Paniz et al, 2010	Moderate	Weak	Weak	Weak	Weak	NA	Weak
Ding et al, 2017	Moderate	Moderate	Strong	Weak	Weak	NA	Weak
Song et al, 2014	Moderate	Moderate	Strong	Weak	Weak	NA	Weak
Zhang et al, 2014	Moderate	Moderate	Strong	Weak	Weak	NA	Weak
Chen et al, 2014	Moderate	Moderate	Weak	Weak	Weak	NA	Weak
Song et al, 2014	Moderate	Moderate	Strong	Weak	Weak	NA	Weak
Yao et al, 2015	Moderate	Moderate	Weak	Weak	Weak	NA	Weak
Zhou et al, 2015	Moderate	Moderate	Moderate	Weak	Weak	NA	Weak
Guo et al, 2017	Strong	Weak	Weak	Weak	Weak	Strong	Weak
He et al, 2018	Weak	Moderate	Weak	Weak	Weak	NA	Weak
Yi et al, 2015	Weak	Weak	Strong	Weak	Strong	Weak	Weak
Sun et al, 2009	Moderate	Moderate	Strong	Weak	Weak	NA	Weak
Yang et al, 2013	Moderate	Moderate	Weak	Weak	Weak	NA	Weak
Xi et al, 2018	Weak	Weak	Weak	Weak	Strong	NA	Weak
Maiga et al, 2003	Weak	Weak	Moderate	Weak	Weak	NA	Weak
Moye-Holz et al, 2018	Moderate	Moderate	Weak	Weak	Weak	NA	Weak

Rivera-Hernandez et al, 2016	Weak	Weak	Weak	Weak	Moderate	NA	Weak
Holloway et al, 2001	Moderate	Moderate	Strong	Weak	Weak	NA	Weak
Uzochukwu et al, 2001	Weak	Moderate	Weak	Weak	Weak	NA	Weak
Gray et al, 2016	Moderate	Moderate	Weak	Weak	Weak	NA	Weak
Liu et al, 2003	Moderate	Moderate	Weak	Weak	Weak	NA	Weak
Chu et al, 2011	Moderate	Moderate	Weak	Weak	Weak	NA	Weak
Chu et al, 2008	Moderate	Moderate	Weak	Weak	Weak	NA	Weak
Garabedian, 2012	moderate	Moderate	Weak	Weak	Weak	NA	Weak
Gur Ali et al, 2011	Moderate	Moderate	Weak	Weak	Weak	NA	Weak

CHAPTER 4 - APPENDICES

Appendix 4.1 – NHF Technical Specification cohort selection

Cohort	Year (NHF card was used to purchase medicine)	Inclusion criteria (Records to include)	Exclusion criteria (records to exclude)	File type
Research objective two	Jan 1, 2017 - Dec 31, 2017 AND Jan 1, 2008 - Dec 31, 2008	1. All parishes 2. All eligible and enrolled male and female 3. Disease condition on the NHF enrollment form = 'Diabetes' (type 2) and/or 'hypertension' 4. Used NHF card to purchase medicines at least once between Jan 1, 2017-Dec 31, 2017 5. Age at the time of enrollment was between 18 and 59	1. Diabetes (type 2) OR Hypertension NOT among conditions on NHF enrollment Form 2. Patient < 18 or >= 60 years at the time of NHF enrollment	Three (3) Record level MS Excel File linkable by an anonymous unique identifier: 1) Patient table[1] 2) Patient Disease Table[2] 3) Patient claims table[3]
Research objective three	Jan 1, 2004 - Dec 31, 2012	1. All parishes 2. All eligible and enrolled male and female 3. Disease condition on the NHF enrollment form = 'Diabetes' (type 2) and/or 'hypertension' 4. Used NHF card to purchase medicines at least once between Jan 1, 2004-Dec 31, 2012 5. Age at the time of enrollment was between 18 and 59	1. Diabetes (type 2) OR Hypertension NOT among conditions on NHF enrollment Form 2. Patient < 18 or >= 60 years at the time of NHF enrollment	Three (3) Record level MS Excel File linkable by an anonymous unique identifier: 1) Patient table[1] 2) Patient Disease Table[2] 3) Patient Pharmacy claims table[3]

Appendix 4.2: NHF Technical Specifications (Patient Table)

Data element	Description	Data values	Data type
Patient ID	Anonymous unique patient identifier		varchar
Age	Age at the time patient enrolled for NHF card		Numeric
Parish of residence	Parish patient was residing at the time of enrollment	Kingston; St. Andrew; St. Catherine; St. Ann; Trelawny; St. James; Hanover; Westmoreland; St. Elizabeth; Manchester; St. Mary; St. Thomas; Portland; Clarendon	varchar
Gender	Male/Female/Unknown	M; F	varchar
Occupation	Occupation on the NHF enrollment form		varchar
Date of NHF enrollment	Date the patient first enrolled in the NHF program	yyyy-mm-dd	Date

Appendix 4.3: NHF Technical Specifications (Patient Disease Table)

Data elements	Description	Data values	Data type
Patient ID	Anonymous unique patient identifier from patient table	Unique number	Numeric
Disease ID	Unique identifier for each of the 16 chronic disease condition eligible for NHF subsidy	Unique number	Numeric
Diseases condition	Disease condition on NHF enrollment form	1 of the 16 eligible chronic diseases covered by the NHF	varchar
Date certified by physician	Date the disease was certified by a physician as indicated on the NHF enrollment form	yyyy-mm-dd	Date
Disease Severity	Disease severity as indicated on the NHF enrollment form	Mild; Severe	varchar

Appendix 4.5: NHF Technical Specifications (Patient Claims Table)

Data elements	Description	Data values	Data type
Patient ID	Anonymous unique patient identifier from patient table	unique numbers	numeric
Pharmacy ID	Anonymous unique ID for pharmacies	unique numbers	numeric
Pharmacy is private/public	Determine if pharmacy is privately/publicly owned	Private; public	varchar

Parish Pharmacy Located	Parishes where pharmacy is located	Kingston; St. Andrew; St. Catherine; St. Ann; Trelawny; St. James; Hanover; Westmoreland; St. Elizabeth; Manchester; St. Mary; St. Thomas; Portland; Clarendon	varchar
Prescription fill date	Date the patient used the NHF Card to fill prescription at the pharmacy		Date
Generic Product Identifier	Unique identifier of the medication		numeric
Medication name	Name as is listed on the NHF list of 'Individuals benefit for prescription drugs' e.g. Metformin		varchar
Total cost of medicine (j$)	This is the absolute retail cost of the medicine including applicable taxes	Dollar amount (j$)	numeric
Cost in J$ paid by NHF	This is the portion of the absolute retail cost covered by the NHF	Dollar amount (j$)	numeric
Cost in J$ paid by patient/claimant	This is the amount the patient/claimant paid out of pocket for the medicine	Dollar amount (j$)	numeric
Quantity purchased	This quantity of medication purchased e.g. 112 pills		numeric
Days supplied	The is number of days of medication supplied to the patient		numeric

Appendix 4.6: SQL Code used to mine NHF data

1) Research Objective two

```
CREATE TABLE PATIENT_CLAIM_TABLE AS

select distinct b.Age
,b.Age + (cast (julianday(d.ABS_min_date)- julianday (b.date_enrolled) as integer)/ 365)
as Age_at
,b.parish as Parish_Residence
,b.Gender
,b.Occupation
,b.Date_enrolled as Date_enrolled
,a.*
,c.MajorClass_recode as MC
,c.total_cost
,c.Subsidy_amount
,(c.total_cost - Subsidy_amount) as OOP
,c.Min_date
,c.Max_date
,cast (julianday(d.ABS_min_date)- julianday (b.date_enrolled) as integer)/ 30 as
Since_enrollment
,cast (julianday(c.max_date)- julianday (c.min_date) as integer)as Days_period
,cast (julianday(d.max_date)- julianday (d.ABS_min_date) as integer)/ 30 as
months_period
from Revised_SUM_Supplies a
join Revised_Days_Period c on c.MemberID=a.MemberID and
a.MajorClass_recode=c.MajorClass_recode
join Revised_Patient b on a.MemberID=b.MemberID
join MIN_MAX_DATE d on d.MemberID=a.memberID
```

```
CREATE TABLE INTERIM_DIAB_HYP_COHORT AS
select
a.memberid
,Age_at
,case when age_at between 18 and 39 then 0
when age_at between 40 and 44 then 1
when age_at between 45 and 49 then 2
when age_at between 50 and 54 then 3
when age_at >= 55 then 4 end as 'Age_Range'
,case when Parish_Residence in ('KINGSTON','ST. ANDREW') then 'KSA' else
Parish_Residence end as 'Paris_Residence'
,case when Parish_Residence in ('KINGSTON', 'ST. ANDREW', 'ST. CATHERINE', 'ST.
JAMES') then 0 else 1 END AS 'RURAL'
```

```
,case when Parish_residence in ('KINGSTON','ST. ANDREW', 'ST. CATHERINE', 'ST. THOMAS') THEN 1
when Parish_residence in ('PORTLAND','ST. ANN','ST. MARY') THEN 2
WHEN PARISH_RESIDENCE IN ('MANCHESTER', 'CLARENDON', 'ST.ELIZABETH') THEN 3
WHEN PARISH_RESIDENCE IN ('TRELAWNY', 'HANOVER', 'ST. JAMES', 'WESTMORELAND') THEN 4
END AS 'HEALTH_REGION'

,Gender
,Occupation
,Date_enrolled
,Since_enrollment
,min_date
,Max_date as date
,MajorClass_Recode
,sum_supplies
,case when sum_Supplies > (Days_period + Last_day_supplies) then (Days_period + Last_day_supplies)
else sum_supplies end as RECAL_SUM_Supplies
,Last_day_supplies
,Days_Period
,days_period + Last_day_supplies as RECAL_last_days_supplies
,Diabetes
,Hypertension
,High_cholesterol
,other
,case when since_enrollment < 12 then 1
when since_enrollment between 12 and 24 then 2
when since_enrollment between 25 and 36 then 3
when since_enrollment between 37 and 48 then 4
when since_enrollment between 49 and 60 then 5
else 6 end as 'enrollment_period'
,Case when c.AVG_monthly_OOP < 5000 then 1
when c.AVG_monthly_OOP between 5000 and 10000 then 2
when c.AVG_monthly_OOP > 10000 then 3 end as Mthly_OOP
from PATIENT_CLAIM_TABLE a
join Revised_Patient_Disease b on a.memberid=b.memberid
join Monthly_OOP c on c.memberid=a.memberid
where a.MajorClass_recode in ('ANTIDIABETICS', 'ANTIHYPERTENSIVES', 'ANTIHYPERLIPIDEMICS')
and a.memberid not in (select memberID from INSULIN_TABLE)
and (diabetes = 1 OR hypertension = 1)
and Days_Period >= 180
```

```
---------------------------
CREATE TABLE FINAL_DIAB_HYP_COHORT AS
select distinct a.MemberID
,Age_range
,CASE WHEN gender = 'F' THEN 0 ELSE 1 END AS GENDER
,CASE WHEN PARIS_RESIDENCE = 'KSA' THEN 1
WHEN PARIS_RESIDENCE = 'ST. THOMAS' THEN 2
WHEN PARIS_RESIDENCE = 'ST. CATHERINE' THEN 3
WHEN PARIS_RESIDENCE = 'ST. ANN' THEN 4
WHEN PARIS_RESIDENCE = 'ST. MARY' THEN 5
WHEN PARIS_RESIDENCE = 'PORTLAND' THEN 6
WHEN PARIS_RESIDENCE = 'MANCHESTER' THEN 7
WHEN PARIS_RESIDENCE = 'CLARENDON' THEN 8
WHEN PARIS_RESIDENCE = 'ST.ELIZABETH' THEN 9
WHEN PARIS_RESIDENCE = 'ST. JAMES' THEN 10
WHEN PARIS_RESIDENCE = 'HANOVER' THEN 11
WHEN PARIS_RESIDENCE = 'TRELAWNY' THEN 12
WHEN PARIS_RESIDENCE = 'WESTMORELAND' THEN 13 END AS PARISH
,HEALTH_REGION
,RURAL
,MajorClass_Recode
,Occupation
,Date_Enrolled
,Enrollment_Period
,Mthly_OOP
,Number_Therapy
,case when c.MemberId is not null then 1 else 0 end as Hypertension
,case when d.MemberId is not null then 1 else 0 end as high_cholesterol
,case when e.MemberId is not null then 1 else 0 end as diabetes
--,case when c.memberid is not null AND d.memberID is not null then 1 else 0 end as
hyp_chol
,Round(RECAL_SUM_Supplies,2)/round(RECAL_last_days_supplies, 2) as MPR
from INTERIM_DIAB_HYP_COHORT a
join Number_Therapeutic_Class b on a.MemberID=b.MemberID
left outer Join (Select distinct memberID from Revised_Patient_Disease where
hypertension = 1 )c on c.MemberID=a.MemberID
left outer join (Select distinct memberId from Revised_Patient_Disease where
High_cholesterol =1) d on d.MemberID=a.MemberID
left outer join (Select distinct memberId from Revised_Patient_Disease where Diabetes
=1) e on e.MemberID=a.MemberID

-----------------------------------
--INSULIN Table----
CREATE TABLE INSULIN_TABLE AS
Select distinct memberid from Revised_Drug_Claim_Class
where subClass = 'INSULIN'
```

----------SPSS File----------

```
select distinct memberid
,age_range
,gender
,Parish
,health_region
,rural
,enrollment_period
,Mthly_oop
,number_therapy
,diabetes
,hypertension
,high_cholesterol
,Case when (diabetes = 1 AND hypertension = 1) then 1
when (hypertension = 1 AND diabetes = 0) then 2 else 3 end as comorbidity
--,hyp_chol
,case when (hypertension = 1 AND high_cholesterol = 0 and diabetes = 0)then 1
when (hypertension = 0 AND high_cholesterol = 0 and diabetes = 1)then 1
when (hypertension = 1 AND high_cholesterol = 0 and diabetes = 1)then 2
when (hypertension = 1 AND high_cholesterol = 1 and diabetes = 0)then 2
when (hypertension = 0 AND high_cholesterol = 1 and diabetes = 1)then 2
when (hypertension = 1 AND high_cholesterol = 1 and diabetes = 1)then 3 end as Number_CD
,AVG (MPR) as Avg_MPR
from FINAL_DIAB_HYP_COHORT
group by
memberid
,age_range
,gender
,Parish
,health_region
,rural
,enrollment_period
,Mthly_oop
,number_therapy
,diabetes
,hypertension
,high_cholesterol
,Case when (diabetes = 1 AND hypertension = 1) then 1
when (hypertension = 1 AND diabetes = 0) then 2 else 3 end
,case when (hypertension = 1 AND high_cholesterol = 0 and diabetes = 0)then 1
when (hypertension = 0 AND high_cholesterol = 0 and diabetes = 1)then 1
when (hypertension = 1 AND high_cholesterol = 0 and diabetes = 1)then 2
when (hypertension = 1 AND high_cholesterol = 1 and diabetes = 0)then 2
```

```
when (hypertension = 0 AND high_cholesterol = 1 and diabetes = 1)then 2
when (hypertension = 1 AND high_cholesterol = 1 and diabetes = 1)then 3 end

-----Drug Prevalence----------------------------------------------
--------------------------------------------------------------------------
select count (distinct a.memberid), a.MajorClass_Recode, subclass
from Revised_Drug_Claim_Class a
join Revised_Patient_Disease b on a.memberid=b.memberid
join PATIENT_CLAIM_TABLE c on c.MemberID=a.MemberID
where (diabetes=1 OR hypertension=1)
AND
a.MajorClass_Recode in ('ANTIDIABETICS',
'ANTIHYPERTENSIVES','ANTIHYPERLIPIDEMICS')
AND
Days_Period >= 180
group by a.MajorClass_Recode, subclass
```

2) **Research Objective three**

   a. **Unstratified code for Segmented Regression – New enrollment**

```
select count (distinct a.MemberID) as count , substr(date_enrolled, 1,4) as
year , case when substr(Date_enrolled, 6,2) in ('01') then 1 when
substr(Date_enrolled, 6,2) in ('02') then 2 when substr(Date_enrolled, 6,2) in
('03') then 3 when substr(Date_enrolled, 6,2) in ('04') then 4 when
substr(Date_enrolled, 6,2) in ('05') then 5 when substr(Date_enrolled, 6,2) in
('06') then 6 when substr(Date_enrolled, 6,2) in ('07') then 7 when
substr(Date_enrolled, 6,2) in ('08') then 8 when substr(Date_enrolled, 6,2) in
('09') then 9 when substr(Date_enrolled, 6,2) in ('10') then 10 when
substr(Date_enrolled, 6,2) in ('11') then 11 when substr(Date_enrolled, 6,2)
in ('12') then 12 end as month
from Revised_Patient a
join Revised_Patient_Disease b on a.MemberID=b.MemberID
where (diabetes = 1 or hypertension =1)
            and date_enrolled between '2006-04-01' and '2009-04-30'
            and age between 18 and 59
group by substr(date_enrolled, 1,4)
    , case when substr(Date_enrolled, 6,2) in ('01') then 1 when
    substr(Date_enrolled, 6,2) in ('02') then 2 when substr(Date_enrolled, 6,2) in
    ('03') then 3 when substr(Date_enrolled, 6,2) in ('04') then 4 when
    substr(Date_enrolled, 6,2) in ('05') then 5 when substr(Date_enrolled, 6,2) in
    ('06') then 6 when substr(Date_enrolled, 6,2) in ('07') then 7 when
    substr(Date_enrolled, 6,2) in ('08') then 8 when substr(Date_enrolled, 6,2) in
    ('09') then 9 when substr(Date_enrolled, 6,2) in ('10') then 10 when
    substr(Date_enrolled, 6,2) in ('11') then 11 when substr(Date_enrolled, 6,2) in
    ('12') then 12 end
```

b. Unstratified code for Segmented Regression – NHF Card Use

```
        select count (distinct a.MemberID) as count , substr(datepurchase, 1,4) as year ,
        case when substr(Datepurchase, 6,2) in ('01') then 1 when substr(datepurchase,
        6,2) in ('02') then 2 when substr(datepurchase, 6,2) in ('03') then 3 when
        substr(datepurchase, 6,2) in ('04') then 4 when substr(datepurchase, 6,2) in ('05')
        then 5 when substr(datepurchase, 6,2) in ('06') then 6 when substr(datepurchase,
        6,2) in ('07') then 7 when substr(datepurchase, 6,2) in ('08') then 8 when
        substr(datepurchase, 6,2) in ('09') then 9 when substr(datepurchase, 6,2) in ('10')
        then 10 when substr(datepurchase, 6,2) in ('11') then 11 when
        substr(datepurchase, 6,2) in ('12') then 12 end as month
from Revised_Patient a
join Revised_Patient_Disease b on a.MemberID=b.MemberID
Join Revised_Claims1_Finale c on c.MemberID=b.MemberID
        where (diabetes = 1 or hypertension =1) and datepurchase between '2006-01-01'
        and '2010-12-31' and age between 18 and 59
group by substr(datepurchase, 1,4)
        , case when substr(Date_enrolled, 6,2) in ('01') then 1 when substr(datepurchase,
        6,2) in ('02') then 2 when substr(datepurchase, 6,2) in ('03') then 3 when
        substr(datepurchase, 6,2) in ('04') then 4 when substr(datepurchase, 6,2) in ('05')
        then 5 when substr(datepurchase, 6,2) in ('06') then 6 when substr(datepurchase,
        6,2) in ('07') then 7 when substr(datepurchase, 6,2) in ('08') then 8 when
        substr(datepurchase, 6,2) in ('09') then 9 when substr(datepurchase, 6,2) in ('10')
        then 10 when substr(datepurchase, 6,2) in ('11') then 11 when
        substr(datepurchase, 6,2) in ('12') then 12 end
```

c. Stratified code for Segmented Regression – New enrollment

```
select w.*, x.male, y.urban, z.rural,z1.SERHA, z2.NERHA, z3.SRHA, z4.WRHA
,n1.Age_Cat1
,n2.Age_Cat2
,n3.Age_Cat3
,n4.Age_Cat4
,n5.Age_Cat5

from
(
select count (distinct a.MemberID) as Female
, substr(date_enrolled, 1,4) as year
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
```

```
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end as quarter
from Revised_Patient a
join Revised_Patient_Disease b on a.MemberID=b.MemberID
where (diabetes = 1 or hypertension =1)
and date_enrolled between '2007-01-01' and '2009-12-31'
and age between 18 and 59
and gender = 'F'
group by substr(date_enrolled, 1,4)
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end
)w

join
(
select count (distinct e.MemberID) as male
, substr(date_enrolled, 1,4) as year
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end as quarter
from Revised_Patient e
join Revised_Patient_Disease f on e.MemberID=f.MemberID
where (diabetes = 1 or hypertension =1)
and date_enrolled between '2007-01-01' and '2009-12-31'
```

```
and age between 18 and 59
and gender = 'M'
group by substr(date_enrolled, 1,4)
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end


)x on w.year=x.year and w.quarter=x.quarter

Join
(
select count (distinct g.MemberID) as urban
, substr(date_enrolled, 1,4) as year
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end as quarter
from Revised_Patient g
join Revised_Patient_Disease h on g.MemberID=h.MemberID
where (diabetes = 1 or hypertension =1)
and date_enrolled between '2007-01-01' and '2009-12-31'
and age between 18 and 59
and Parish in ('KINGSTON', 'ST. ANDREW', 'ST. CATHERINE', 'ST. JAMES')
group by substr(date_enrolled, 1,4)
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
```

```
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end
)y on w.year=y.year and w.quarter=y.quarter

join
(
select count (distinct i.MemberID) as Rural
, substr(date_enrolled, 1,4) as year
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end as quarter
from Revised_Patient i
join Revised_Patient_Disease j on i.MemberID=j.MemberID
where (diabetes = 1 or hypertension =1)
and date_enrolled between '2007-01-01' and '2009-12-31'
and age between 18 and 59
and Parish not in ('KINGSTON', 'ST. ANDREW', 'ST. CATHERINE', 'ST. JAMES')
group by substr(date_enrolled, 1,4)
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end
)z on w.year=z.year and w.quarter=z.quarter
```

```
join
(
select count (distinct i1.MemberID) as SERHA
, substr(date_enrolled, 1,4) as year
,case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end as quarter
from Revised_Patient i1
join Revised_Patient_Disease j1 on i1.MemberID=j1.MemberID
where (diabetes = 1 or hypertension =1)
and date_enrolled between '2007-01-01' and '2009-12-31'
and age between 18 and 59
and Parish in ('KINGSTON', 'ST. ANDREW', 'ST. CATHERINE', 'ST. THOMAS')
group by substr(date_enrolled, 1,4)
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end
)z1 on w.year=z1.year and w.quarter=z1.quarter

join
(
select count (distinct i2.MemberID) as NERHA
, substr(date_enrolled, 1,4) as year
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
```

```
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end as quarter
from Revised_Patient i2
join Revised_Patient_Disease j2 on i2.MemberID=j2.MemberID
where (diabetes = 1 or hypertension =1)
and date_enrolled between '2007-01-01' and '2009-12-31'
and age between 18 and 59
and Parish in ('ST. ANN', 'ST. MARY', 'PORTLAND')
group by substr(date_enrolled, 1,4)
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end
)z2 on w.year=z2.year and w.quarter=z2.quarter

join
(
select count (distinct i3.MemberID) as SRHA
, substr(date_enrolled, 1,4) as year
,case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end as quarter
from Revised_Patient i3
```

```
join Revised_Patient_Disease j3 on i3.MemberID=j3.MemberID
where (diabetes = 1 or hypertension =1)
and date_enrolled between '2007-01-01' and '2009-12-31'
and age between 18 and 59
and Parish in ('ST.ELIZABETH', 'CLARENDON', 'MANCHESTER')
group by substr(date_enrolled, 1,4)
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end
)z3 on w.year=z3.year and w.quarter=z3.quarter

join
(
select count (distinct i4.MemberID) as WRHA
, substr(date_enrolled, 1,4) as year
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end as quarter
from Revised_Patient i4
join Revised_Patient_Disease j4 on i4.MemberID=j4.MemberID
where (diabetes = 1 or hypertension =1)
and date_enrolled between '2007-01-01' and '2009-12-31'
and age between 18 and 59
and Parish in ('ST. JAMES', 'HANOVER', 'WESTMORELAND', 'TRELAWNY')
group by substr(date_enrolled, 1,4)
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
```

```
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end
)z4 on w.year=z4.year and w.quarter=z4.quarter
join
(
select count (distinct m1.MemberID) as Age_Cat1
, substr(date_enrolled, 1,4) as year
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end as quarter
from Revised_Patient m1
join Revised_Patient_Disease o1 on m1.MemberID=o1.MemberID
where (diabetes = 1 or hypertension =1)
and date_enrolled between '2007-01-01' and '2009-12-31'
and age between 18 and 39
group by substr(date_enrolled, 1,4)
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end
)n1 on w.year=n1.year and w.quarter=n1.quarter
```

```
join
(
select count (distinct m2.MemberID) as Age_Cat2
, substr(date_enrolled, 1,4) as year
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end as quarter
from Revised_Patient m2
join Revised_Patient_Disease o2 on m2.MemberID=o2.MemberID
where (diabetes = 1 or hypertension =1)
and date_enrolled between '2007-01-01' and '2009-12-31'
and age between 40 and 44
group by substr(date_enrolled, 1,4)
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end
)n2 on w.year=n2.year and w.quarter=n2.quarter

join
(
select count (distinct m3.MemberID) as Age_Cat3
, substr(date_enrolled, 1,4) as year
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
```

```
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end as quarter
from Revised_Patient m3
join Revised_Patient_Disease o3 on m3.MemberID=o3.MemberID
where (diabetes = 1 or hypertension =1)
and date_enrolled between '2007-01-01' and '2009-12-31'
and age between 45 and 49
group by substr(date_enrolled, 1,4)
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end
)n3 on w.year=n3.year and w.quarter=n3.quarter

join
(
select count (distinct m4.MemberID) as Age_Cat4
, substr(date_enrolled, 1,4) as year
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end as quarter
from Revised_Patient m4
join Revised_Patient_Disease o4 on m4.MemberID=o4.MemberID
where (diabetes = 1 or hypertension =1)
and date_enrolled between '2007-01-01' and '2009-12-31'
```

```
and age between 50 and 54
group by substr(date_enrolled, 1,4)
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end
)n4 on w.year=n4.year and w.quarter=n4.quarter

join
(
select count (distinct m5.MemberID) as Age_Cat5
, substr(date_enrolled, 1,4) as year
, case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end as quarter
from Revised_Patient m5
join Revised_Patient_Disease o5 on m5.MemberID=o5.MemberID
where (diabetes = 1 or hypertension =1)
and date_enrolled between '2007-01-01' and '2009-12-31'
and age between 55 and 59
group by substr(date_enrolled, 1,4)
,case when substr(Date_enrolled, 6,2) in ('01') then 1
when substr(Date_enrolled, 6,2) in ('02') then 2
when substr(Date_enrolled, 6,2) in ('03') then 3
when substr(Date_enrolled, 6,2) in ('04') then 4
when substr(Date_enrolled, 6,2) in ('05') then 5
when substr(Date_enrolled, 6,2) in ('06') then 6
when substr(Date_enrolled, 6,2) in ('07') then 7
when substr(Date_enrolled, 6,2) in ('08') then 8
```

```
when substr(Date_enrolled, 6,2) in ('09') then 9
when substr(Date_enrolled, 6,2) in ('10') then 10
when substr(Date_enrolled, 6,2) in ('11') then 11
when substr(Date_enrolled, 6,2) in ('12') then 12 end
)n5 on w.year=n5.year and w.quarter=n5.quarter
```

d. Stratified code for Segmented Regression – NHF Card Use

```
select w.*, x.male, y.urban, z.rural,z1.SERHA, z2.NERHA, z3.SRHA, z4.WRHA
,n1.Age_Cat1
,n2.Age_Cat2
,n3.Age_Cat3
,n4.Age_Cat4
,n5.Age_Cat5

from
(
select count (distinct a.MemberID) as Female
, substr(datepurchase, 1,4) as year
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end as quarter
from Revised_Patient a
join Revised_Patient_Disease b on a.MemberID=b.MemberID
Join Revised_Claims1_Finale c on c.MemberID=b.MemberID
where (diabetes = 1 or hypertension =1)
and datepurchase between '2007-01-01' and '2009-12-31'
and age between 18 and 59
and gender = 'F'
group by substr(datepurchase, 1,4)
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
```

```
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end
)w
join
(
select count (distinct e.MemberID) as male
, substr(Datepurchase, 1,4) as year
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end as quarter
from Revised_Patient e
join Revised_Patient_Disease f on e.MemberID=f.MemberID
Join Revised_Claims1_Finale cc1 on cc1.MemberID=e.MemberID
where (diabetes = 1 or hypertension =1)
and datepurchase between '2007-01-01' and '2009-12-31'
and age between 18 and 59
and gender = 'M'
group by substr(datepurchase, 1,4)
,case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end
)x on w.year=x.year and w.quarter=x.quarter
```

```
Join
(
select count (distinct g.MemberID) as urban
, substr(datepurchase, 1,4) as year
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end as quarter
from Revised_Patient g
join Revised_Patient_Disease h on g.MemberID=h.MemberID
Join Revised_Claims1_Finale cc2 on cc2.MemberID=g.MemberID
where (diabetes = 1 or hypertension =1)
and datepurchase between '2007-01-01' and '2009-12-31'
and age between 18 and 59
and Parish in ('KINGSTON', 'ST. ANDREW', 'ST. CATHERINE', 'ST. JAMES')
group by substr(datepurchase, 1,4)
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end

)y on w.year=y.year and w.quarter=y.quarter

join
(
select count (distinct i.MemberID) as Rural
, substr(datepurchase, 1,4) as year
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
```

```
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end as quarter
from Revised_Patient i
join Revised_Patient_Disease j on i.MemberID=j.MemberID
Join Revised_Claims1_Finale cc3 on cc3.MemberID=i.MemberID
where (diabetes = 1 or hypertension =1)
and datepurchase between '2007-01-01' and '2009-12-31'
and age between 18 and 59
and Parish not in ('KINGSTON', 'ST. ANDREW', 'ST. CATHERINE', 'ST. JAMES')
group by substr(datepurchase, 1,4)
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end
)z on w.year=z.year and w.quarter=z.quarter

join
(
select count (distinct i1.MemberID) as SERHA
, substr(datepurchase, 1,4) as year
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
```

```
when substr(datepurchase, 6,2) in ('12') then 12 end as quarter
from Revised_Patient i1
join Revised_Patient_Disease j1 on i1.MemberID=j1.MemberID
Join Revised_Claims1_Finale cc4 on cc4.MemberID=i1.MemberID
where (diabetes = 1 or hypertension =1)
and datepurchase between '2007-01-01' and '2009-12-31'
and age between 18 and 59
and Parish in ('KINGSTON', 'ST. ANDREW', 'ST. CATHERINE', 'ST. THOMAS')
group by substr(datepurchase, 1,4)
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end
)z1 on w.year=z1.year and w.quarter=z1.quarter

join
(
select count (distinct i2.MemberID) as NERHA
, substr(datepurchase, 1,4) as year
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end as quarter
from Revised_Patient i2
join Revised_Patient_Disease j2 on i2.MemberID=j2.MemberID
Join Revised_Claims1_Finale cc5 on cc5.MemberID=i2.MemberID
where (diabetes = 1 or hypertension =1)
and datepurchase between '2007-01-01' and '2009-12-31'
and age between 18 and 59
and Parish in ('ST. ANN', 'ST. MARY', 'PORTLAND')
```

```
group by substr(datepurchase, 1,4)
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end
)z2 on w.year=z2.year and w.quarter=z2.quarter

join
(
select count (distinct i3.MemberID) as SRHA
, substr(datepurchase, 1,4) as year
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end as quarter
from Revised_Patient i3
join Revised_Patient_Disease j3 on i3.MemberID=j3.MemberID
Join Revised_Claims1_Finale cc6 on cc6.MemberID=i3.MemberID
where (diabetes = 1 or hypertension =1)
and datepurchase between '2007-01-01' and '2009-12-31'
and age between 18 and 59
and Parish in ('ST.ELIZABETH', 'CLARENDON', 'MANCHESTER')
group by substr(datepurchase, 1,4)
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
```

```
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end
)z3 on w.year=z3.year and w.quarter=z3.quarter

join
(
select count (distinct i4.MemberID) as WRHA
, substr(datepurchase, 1,4) as year
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end as quarter
from Revised_Patient i4
join Revised_Patient_Disease j4 on i4.MemberID=j4.MemberID
Join Revised_Claims1_Finale cc7 on cc7.MemberID=i4.MemberID
where (diabetes = 1 or hypertension =1)
and datepurchase between '2007-01-01' and '2009-12-31'
and age between 18 and 59
and Parish in ('ST. JAMES', 'HANOVER', 'WESTMORELAND', 'TRELAWNY')
group by substr(datepurchase, 1,4)
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end
)z4 on w.year=z4.year and w.quarter=z4.quarter
join
(
```

```
select count (distinct m1.MemberID) as Age_Cat1
, substr(datepurchase, 1,4) as year
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end as quarter
from Revised_Patient m1
join Revised_Patient_Disease o1 on m1.MemberID=o1.MemberID
Join Revised_Claims1_Finale cc8 on cc8.MemberID=m1.MemberID
where (diabetes = 1 or hypertension =1)
and datepurchase between '2007-01-01' and '2009-12-31'
and age between 18 and 39
group by substr(datepurchase, 1,4)
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end
)n1 on w.year=n1.year and w.quarter=n1.quarter

join
(
select count (distinct m2.MemberID) as Age_Cat2
, substr(datepurchase, 1,4) as year
,case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
```

```
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end as quarter
from Revised_Patient m2
join Revised_Patient_Disease o2 on m2.MemberID=o2.MemberID
Join Revised_Claims1_Finale cc9 on cc9.MemberID=m2.MemberID
where (diabetes = 1 or hypertension =1)
and datepurchase between '2007-01-01' and '2009-12-31'
and age between 40 and 44
group by substr(datepurchase, 1,4)
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end
)n2 on w.year=n2.year and w.quarter=n2.quarter

join
(
select count (distinct m3.MemberID) as Age_Cat3
, substr(datepurchase, 1,4) as year
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end as quarter
from Revised_Patient m3
join Revised_Patient_Disease o3 on m3.MemberID=o3.MemberID
Join Revised_Claims1_Finale cc10 on cc10.MemberID=m3.MemberID
where (diabetes = 1 or hypertension =1)
```

```
and datepurchase between '2007-01-01' and '2009-12-31'
and age between 45 and 49
group by substr(datepurchase, 1,4)
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end
)n3 on w.year=n3.year and w.quarter=n3.quarter

join
(
select count (distinct m4.MemberID) as Age_Cat4
, substr(datepurchase, 1,4) as year
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end as quarter
from Revised_Patient m4
join Revised_Patient_Disease o4 on m4.MemberID=o4.MemberID
Join Revised_Claims1_Finale cc11 on cc11.MemberID=m4.MemberID
where (diabetes = 1 or hypertension =1)
and datepurchase between '2007-01-01' and '2009-12-31'
and age between 50 and 54
group by substr(datepurchase, 1,4)
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
```

```
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end
)n4 on w.year=n4.year and w.quarter=n4.quarter

join
(
select count (distinct m5.MemberID) as Age_Cat5
, substr(datepurchase, 1,4) as year
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end as quarter
from Revised_Patient m5
join Revised_Patient_Disease o5 on m5.MemberID=o5.MemberID
Join Revised_Claims1_Finale cc12 on cc12.MemberID=m5.MemberID
where (diabetes = 1 or hypertension =1)
and datepurchase between '2007-01-01' and '2009-12-31'
and age between 55 and 59
group by substr(datepurchase, 1,4)
, case when substr(Datepurchase, 6,2) in ('01') then 1
when substr(datepurchase, 6,2) in ('02') then 2
when substr(datepurchase, 6,2) in ('03') then 3
when substr(datepurchase, 6,2) in ('04') then 4
when substr(datepurchase, 6,2) in ('05') then 5
when substr(datepurchase, 6,2) in ('06') then 6
when substr(datepurchase, 6,2) in ('07') then 7
when substr(datepurchase, 6,2) in ('08') then 8
when substr(datepurchase, 6,2) in ('09') then 9
when substr(datepurchase, 6,2) in ('10') then 10
when substr(datepurchase, 6,2) in ('11') then 11
when substr(datepurchase, 6,2) in ('12') then 12 end
)n5 on w.year=n5.year and w.quarter=n5.quarter
```

ETHICS APPROVALS – APPENDICES

Lancaster University

Applicant: Shelly-Ann Hall
Supervisors: Siobhan Reilly and Eugenio Zuccheli
Department: Health Research
FHMREC Reference: FHMREC17091

05 June 2018

Dear Shelly-Ann

Re: Jamaica's experience with drug subsidization: A multi-method approach examining access, use and adherence to prescription medication among patients with diabetes and hypertensions enrolled in the National Health Fund (NHF)

Thank you for submitting your research ethics application for the above project for review by the **Faculty of Health and Medicine Research Ethics Committee (FHMREC)**. The application was recommended for approval by FHMREC, and on behalf of the Chair of the Committee, I can confirm that approval has been granted for this research project.

As principal investigator your responsibilities include:

- ensuring that (where applicable) all the necessary legal and regulatory requirements in order to conduct the research are met, and the necessary licenses and approvals have been obtained;
- reporting any ethics-related issues that occur during the course of the research or arising from the research to the Research Ethics Officer at the email address below (e.g. unforeseen ethical issues, complaints about the conduct of the research, adverse reactions such as extreme distress);
- submitting details of proposed substantive amendments to the protocol to the Research Ethics Officer for approval.

Please contact me if you have any queries or require further information.

Tel:- 01542 592838
Email:- fhmresearchsupport@lancaster.ac.uk

Yours sincerely,

Dr Diane Hopkins
Research Integrity and Governance Officer, Secretary to FHMREC.

MINISTRY OF HEALTH

☐ RKA BUILDING, 10-16 GRENADA WAY ☒ 45-47 BARBADOS AVENUE ☐ 24-26 GRENADA CRESCENT ☐ 10A CHELSEA AVENUE
KINGSTON 5, JAMAICA, W.I.
Tel: (876) 633-7400/7433/7771/8172
Website: www.moh.gov.jm

ANY REPLY OR SUBSEQUENT REFERENCE SHOULD BE ADDRESSED TO THE PERMANENT SECRETARY AND THE FOLLOWING REFERENCE QUOTED:

Ref. No.:

17 October 2018

Dr. Marshall Tulloch Reid
Principal Investigator
Caribbean Institute for Health Research
University of the West Indies
7 Ring road
Mona
Kingston 7

Dear Dr. Tulloch Reid

RE: Jamaica's experience with drug subsidization a Multi-method approach examining access use and adherence to prescription medication among patients with diabetes and hypertension enrolled in the National Health Fund

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This serves to inform you that the Advisory Panel on Ethics & Medico-Legal Affairs in the Ministry of Health has reviewed and approved the captioned study. The study has been assigned the number **2018/22.**

The researcher named for the study is Ms. Shelly Hall.

Attached, please find the approve cover page stamped and signed by the Ministry's Advisory Panel.

Please keep the Ministry updated regarding the progress and submit a summary of the results and conclusion on completion of the study.

We wish you every success in this endeavour.

Yours sincerely,

for

Professor Owen Morgan
Chairman
Advisory Panel on Ethics and Medico-Legal Affairs
Standards and Regulation Division