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Impact of Health Financing on Communicable and Non-communicable Diseases Outcomes in Nigeria

By

Chukwunweike, Ambrose Boyce, Prof. Mgbemena, Emilia Mukaosolu

Economics Department, Chukwuemeka Odumegwu Ojukwu University, Igbariam Campus, Anambra State

Abstract

This study examines the impact of health financing on communicable and non-communicable diseases outcomes in Nigeria. The study has three specific objectives which are to: investigate the extent to which government health expenditure impacts communicable and non-communicable diseases outcomes; analyze the impact of private sector health expenditure on communicable and non-communicable diseases outcomes; and examine the relationship between out-of-pocket health expenditure and communicable and non-communicable diseases outcomes in Nigeria. Communicable disease outcome is represented by tuberculosis treatment success rate while non-communicable diseases outcome is represented by hypertension/cardiovascular disease mortality rate. Both data are sourced from World Health Organization global tuberculosis database and the World Bank non-communicable disease database. The data are analyzed using the Toda-Yamamoto causality analysis. The results show that government health expenditure does exhibit significant relationship with both communicable and non-communicable diseases outcomes in Nigeria. Also, private sector health expenditure and out-of-pocket show no significant relationship with communicable disease outcome but both variables have significant relationship with non-communicable diseases outcomes. The study concludes that Nigeria's public expenditure on health has remained sub-optimal in addressing communicable and non-communicable disease outcomes over time. Both private and out-of-pocket health expenditure have not had the desired decreasing effect on communicable diseases outcomes in Nigeria. The study recommends substantial increase in public health expenditure as well as public-private partnership in healthcare delivery especially in the treatment and management of communicable and non-communicable diseases.

Keywords: Health Financing, Communicable, Diseases outcomes and Non-communicable

SECTION ONE

INTRODUCTION

1.1 Background to the Study

Health is an important element of the human capital and a key indicator of the productivity, growth, development of a nation socially. The results of health are of great concern in the third world countries such as Nigeria since health financing, service delivery and infrastructure are yet to be resolved. World Health Organization (WHO, 2024) asserts that Nigeria is almost a fifth of Africa disease burden and both communicable and non-communicable diseases (NCDs) are major contributors to morbidity and mortality rates.

Health financing may also be described as mobilization and accumulation as well as distribution of funds to address the health concerns of individuals and the community at large in the health system. It determines the

availability, access, and the quality of the healthcare services and, therefore, the outcomes of the communicable and non-communicable diseases (World Bank, 2023). Health financing system of Nigeria has been structured to a considerable part on three sources viz. government expenditure, private expenditure and out of pocket payments.

Government health expenditure is state spending in the health sector utilizing the annual budgetary allocations and health programs. However, spending on the public health in Nigeria has been sustaining at relatively low levels (average spending on the sector is 3.7 percent of total government spending in 2000-2020, which is significantly less than 15 per cent Abuja Declaration target) (WHO, 2023). By 2022, the percentage of the national budget allocated to health is as low as 4.2% (one of the lowest in Sub-Saharan Africa) (World Bank, 2024). The private health expenditures are the spending of the firms, health insurance schemes and non-governmental organizations that constitute the contribution of 25-30 percent of the total health spending. It is however, highly concentrated in urban areas and among the higher income earners, which constitutes disparity in access to healthcare (Okonjo *et al*., 2023). Out of pocket (OOP) financing is the most popular and contributes to 71.7% of the total health expenditure in 2000 and 68.3% in 2022 (World Bank, 2024). This kind of excessive reliance on OOP payments exposes millions of Nigerians to paying catastrophic health expenses and becoming poor as they pass on because they are sick.

Nigeria continues to experience a dual burden of disease problem with many health financing reforms including the introduction of the National Health Insurance Scheme (NHIS) in 2005, and the Basic Health Care Provision Fund (BHCPF) in 2018. Examples of communicable diseases include tuberculosis, malaria, and HIV/ AIDS; examples of non- communicable diseases include hypertension, diabetes, cardiovascular diseases, and they are on the rise due to urbanization, sedentary lifestyle, and change of dietary habits (Ogunniyi & Olayiwola, 2022). The incidence rate of tuberculosis has decreased by 50% during the past twenty years, such that in 2000, the rate of tuberculosis was 545 per 100, 000 populations, in 2022, the rate has reduced to 321 per 100, 000 populations, but the prevalence of hypertension has risen to 22.5 percent in 2000 and to 36.8 percent in 2023 (WHO, 2024).

This epidemiological change is a sign of sophistication in the health issue in Nigeria and the necessity to investigate how various health financing systems influence the pathophysiology of disease. The global and regional studies experience has shown that the appropriate organization of health financing and equity will result in the improvement of health outcomes of the populations, an improved level of service coverage, and a reduced rate of mortality (Carrin & Xu, 2020; Ataguba, 2022). However, the role of the government, the role of the private and out-of-pocket spending in determining the communicable or non-communicable diseases in Nigeria has not been researched adequately.

This study therefore looks at how health funding will affect the consequences of communicable and non-communicable diseases in Nigeria in the period between the year 2000 and 2025. By examining proxies of these disease categories, i.e. tuberculosis and hypertension/cardiovascular diseases, the research will generate the empirical evidence, which can be employed to implement sustainable and equitable health financing reforms in Nigeria.

1.2 Statement of the Problem

Despite Nigeria having a significant economic potential, the health rates of the country are not as high as they should be, and it scores poor in the comparison with other countries that have the same income level. Nigeria is always burdened with both communicable and non-communicable diseases, where tuberculosis is one of the top causes of public health problems and hypertension and other cardiovascular diseases are increasing at an alarming rate and are becoming the leading causes of high morbidity and mortality. However, the legislation between health financing systems and disease-specific outcomes in Nigeria is not well known.

Numerous studies examine total health (e.g. life expectancy), infant mortality), but do not identify the communication and non-communicable disease processes, thus restricting their applicability in specific policy. The Nigerian health financing system has been typified by excessive dependence on out-of-pocket expenditure with research indicating that most health expenditures are direct payments at point care with the large percentage. Nevertheless, the bulk of evidence on the amount of outcomes of out-of-pocket financing is on catastrophic spending or overall poverty outcomes but not the impact of out-of-pocket financing burden to disease-specific prevalence or survival. Once again, most of the literature exists is that which combines the private expenditure with out of pocket expenditures and failing to disaggregate them by financing source. This sets contextual issues and restricts in-depth knowledge of their nexus.

Moreover, despite the fact that Nigeria has continued to spend on health financing, it appears that government expenditure on health is not in line with the international standards, like the benchmark of 15 percent of the Abuja Declaration. Therefore, empirical evidence on whether the improvements in particular aspects of government spending have a different impact on communicable and non-communicable diseases is limited. These issues pose a lot of confusion in terms of the most effective allocation of the limited health resources to enhance the outcomes of particular diseases. These uncertainties hence lead to this research.

1.3 Objectives of the Study

The main objective of this study is to examine the impact of health financing on communicable and non-communicable diseases outcomes in Nigeria. The study has some specific objectives which it intends to achieve. These specific objectives are to:

1. investigate the extent to which government health expenditure impacts communicable and non-communicable diseases outcomes in Nigeria;
2. analyze the impact of private sector health expenditure on communicable and non-communicable diseases outcomes in Nigeria;
3. examine the relationship between out-of-pocket health expenditure and communicable and non-communicable diseases outcomes in Nigeria.

1.4 Research Questions

The following questions are posed in order to serve as a guide to the study:

1. To what extent has government health expenditure impacted on communicable and non-communicable diseases outcomes in Nigeria?
2. What level of impact does private sector health expenditure have on communicable and non-communicable diseases outcomes?
3. What is the relationship between out of pocket health expenditure and communicable and non-communicable diseases outcomes in Nigeria?

1.5 Research Hypotheses

H_{01}: There is no significant relationship government health expenditure and communicable and non-communicable diseases outcomes in Nigeria.

H_{02}: Private sector health expenditure has no significant relationship with communicable and non-communicable diseases outcomes.

H_{03}: Out-of-pocket health expenditure has no significant relationship with communicable and non-communicable diseases outcomes in Nigeria.

1.6 Scope of the Study

This research focuses on three dimensions of health financing namely government health expenditure, private sector health expenditure, and out of pocket health expenditure. The study adopts tuberculosis and hypertension/cardiovascular diseases prevalence rate as the two dependent variables representing communicable and non-communicable diseases respectively. The study spans the period 2000–2025 representing 26 years. This is based on the availability of consistent time-series data for the selected variables from reliable international databases such as the World Bank's World Development Indicators (WDI) and the WHO Global Health Expenditure Database. This period also captures major policy interventions in Nigeria's health sector.

1.7 Significance of the Study

This study will be beneficial to the academic community because it will clearly distinguish between communicable and non-communicable diseases and how various health financing options affects their outcomes. This will add to empirical literature in health economics and enrich theoretical perspectives in this area of study.

This study will also assist policymakers in Nigeria especially in evaluating governments' current health financing mechanisms. It will also guide resource allocation and strategic planning in Nigeria's health sector.

This study holds strong importance to international agencies as it will directly quantify the extent to which out-of-pocket health expenditure affects health outcomes. This will help identify strategies to reduce catastrophic health spending among low-income populations.

SECTION TWO

LITERATURE REVIEW

This section focuses on critical review of relevant concepts surrounding the study. The three dimensions of health financing are conceptualized together with the communicable (tuberculosis) and non-communicable diseases (cardiovascular disease) prevalence rate. Relevant theories are also reviewed providing theoretical framework for the study. Empirical literature provides evidence from various authors on the subject matter. The chapter ends with identification of gap in literature.

2.1 Conceptual Literature Review

2.1.1 Health Financing

Health financing is a critical component of any health system and it determines accessibility, quality and sustainability of healthcare services in every economy. Health financing refers to the process of mobilizing, accumulating, allocating and utilization of financial resources in order to achieve sustained health needs of individuals and groups (WHO, 2023). Change *et al* (2019) defined health financing as the total public, private and external financial flows aimed towards health services. Effective health financing framework is vital for balancing disease prevention, treatment and long term population health. Again, health financing is a component of human capital that ensures a productive economy.

2.1.2 Government Health Expenditure

Government health financing encompasses the totality of public spending on health services, health infrastructure, preventive health programs and health administration often financed through budgetary allocations, taxes and statutory transfers (Piabuo & Tieguhong, 2017). Another definition was given by Dieleman *et al* (2017) where-in government health financing was defined as the share of total health spending financed by central and subnational governments for health services provision, infrastructure and public health programs. Public spending plays a crucial role in financing immunization programs, disease surveillance, and large-scale interventions such as malaria and tuberculosis control (Berger & Messer, 2002). However, in many developing countries, including Nigeria, WHO (2023) observed that government health expenditure remains persistently low relative to international benchmarks such as the Abuja Declaration target of allocating at least 15 percent of total government expenditure to health. This underinvestment limits the effectiveness of public health interventions and constrains the health system's capacity to address the growing burden of communicable and non-communicable diseases, which require sustained and long-term financing.

2.1.3 Private Sector Health Expenditure

According to Chang *et al.* (2019), private sector health expenditure comprises the health spending made by private firms, non-governmental organizations, and private insurance schemes. It comprises payments for healthcare services delivered by private providers and expenditures financed through voluntary health insurance arrangements. Private health financing is considered more responsive and efficient in service provision, contributing positively to access to healthcare services for communicable diseases as noted by Sfakianakis, Grigorakis, and Galyfianakis (2021). Bertram *et al*. (2018), Haque *et al*. (2020), Dieleman *et al*., (2017) noted that private health expenditure tends to favor curative over preventive care and is often less effective in addressing non-communicable diseases, which require continuous and coordinated care.

2.1.4 Out-of-Pocket Health Expenditure

Out-of-pocket expenditure (OOPE) refers to direct payments by individuals or households for healthcare services at the point of consumption, excluding insurance reimbursements, covering consultations, medications, diagnostics, hospital stays, and related services (World Bank, 2024; Fofack & Sarpong, 2019). High out-of-pocket expenditure is linked to catastrophic and impoverishing spending, highlighting its role as a critical component of health expenditure and a determinant of health outcomes.

2.1.5 Communicable and Non-Communicable Diseases Outcomes

Disease outcomes are measurable consequences of disease conditions that affect population health. In this study, disease outcomes are examined for both communicable and non-communicable diseases. Communicable disease is represented by tuberculosis prevalence rate while non-communicable disease is represented by hypertension and cardiovascular diseases.

The World Health Organization (WHO, 2023) defined tuberculosis as an airborne disease that has strong dependence on public health interventions such as surveillance, vaccination, early diagnosis and sustained treatment adherence. Hypertension and cardiovascular diseases, on the other hand, are chronic conditions that develop gradually and need long term, continuous and coordinated care and often require financing to sustain (Shabil et al., 2023). Hypertension outcomes are typically measured using prevalence rates, control rates, complications, and cardiovascular mortality (Huaman *et al*., 2015), while cardiovascular disease outcomes include incidence of heart disease, stroke, disability-adjusted life years (Adefuye, Manjunatha, Ganduri & Rajasekaran, 2020).

2.2 Theoretical Framework

Three theories are linked to the study of health financing and diseases outcomes in Nigeria. These theories are inter-linked and provide a foundation for understanding the health financing and diseases nexus. They are the health capital model, resource allocation theory and the health financing transition theory.

The health capital model was put forward by Michael Grossman (1972). The theory sees health as a long-lasting stock which produces healthy time and which serves as an input into market and non-market activities. The ability of individuals to invest in their health by financing their wellbeing over time is what builds health capital. Thus, when individuals spend too high on health financing through increased out-of-pocket expenditure, it raises the cost of health investment, particularly for communicable and non-communicable diseases. However, when government and private sector health expenditure increases, it eases the individual out-of-pocket health expenditure hence enhancing health capital. The theory treats health as a form of capital that can be accumulated through investment, yet high out-of-pocket health expenditure in Nigeria limits such investment.

The theory that supports government health expenditure is the Resource allocation theory by Musgrave (1959) which highlights the state's responsibility in providing public goods. The theory explains how government health funding in Nigeria can accelerate health capital and boost productivity (Berger & Messer, 2002; Gupta et al., 2003). However, when government health expenditure are inadequate, it forces households to bear the burden, increasing inequities. With Nigeria's health expenditure falling short of global standards, this theory comes in handy in explaining why communicable and non-communicable diseases prevalence rate may increase over time despite increased economic growth.

Furthermore, one theory that takes care of the inadequacy of health capital theory and resource allocation theory is the health financing transition theory proposed by Kutzin (1995). This theory argues that countries should move from reliance on out-of-pocket health financing and government allocations to pooled health financing. According to this theory, risk pooling enhances financial protection and enables sustained investments in preventive and chronic care services. Thus, this theory upholds the recent reforms in Nigeria's health insurance initiative and the basic care provision which effectively tackles the difficulties experienced in out-of-pocket health financing.

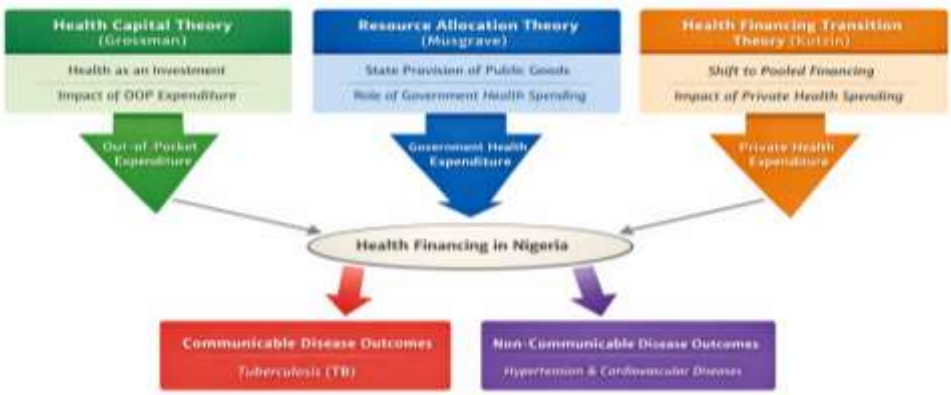

Figure 2.1: Theoretical Framework

Intuitively, while health capital theory explains the ability of individuals and households to finance healthcare over time in order to achieve better health outcomes, the resource allocation theory emphasizes the role of government in the provision and financing of merit goods such as healthcare, especially where market failures and positive externalities exist. Also, the health financing transition theory provides a framework that upholds private health expenditure rather than over-reliance on government and out-of-pocket health expenditure. The efficacy of these theories shall be tested in this study as we try to ascertain the most efficient health financing that decreases the prevalence rate of communicable and non-communicable diseases in Nigeria.

2.3 Empirical Review

Novignon, Olakojo and Novignon (2012) determined the effect of health care expenditure on population health status focusing on public and private expenditure sources. They adopted panel data from 1995 to 2010 covering 44 countries in SSA. Their analysis revealed that health care expenditure significantly influences health status through improving life expectancy at birth, reducing death and infant mortality rates. Both public and private health care spending showed strong positive association with health status even though public health care spending had relatively higher impact.

Makuta and O'hare (2015) investigated whether or not the quality of governance has a modifying effect on the impact of public health spending on health outcomes, measured by under-five mortality and life expectancy at birth, in SSA. Using two staged least squares regression technique on panel data from 43 countries in SSA, they found that public spending on health has a statistically significant impact in improving health outcomes.

Wang et al (2015) explored patterns and determinants of out-of-pocket (OOP) expenditure on chronic and communicable diseases outcomes in Malawi. They found that higher severity of disease was significantly associated with an increased likelihood of incurring OOP expenditure. Use of formal care was negatively associated with the possibility of incurring OOP expenditure. Thus, they concluded that OOP payments impose a considerable financial burden on rural households, especially among the poorest.

Raeesi *et al* (2018) investigated private health expenditures and its effect on 3 health outcomes namely infant mortality, under 5 mortality and life expectancy. Using econometric method, they found that the effect of private health expenditures on health outcomes in countries with mixed health financing system and traditional sickness fund insurance was higher than public expenditures.

Rahman, Khanam and Rahman (2018) investigated the relationship between different types of healthcare expenditures (public, private and total) and three main health status outcomes - life expectancy at birth, crude death rate and infant mortality rate - in the region. Panel data evidence showed that total health expenditure, public health expenditure and private health expenditure significantly reduced infant mortality rates, and, the extent of effect of private health expenditure was greater than that of public health expenditure. Private health expenditure also had a significant role in reducing the crude death rate. Per capita income growth and improved sanitation facilities also had significant positive roles in improving population health in the region.

Chireshe and Ocran (2020) investigated the effect of healthcare expenditure on health outcomes in sub-Saharan Africa including Nigeria. Government health expenditure was the dependent variable while communicable and non-communicable disease outcomes were captured through mortality rates and life expectancy indicators. The panel GMM estimation found that increases in public health expenditure significantly reduced communicable disease mortality, particularly from malaria and tuberculosis. However, the effect on non-communicable disease related mortality was modest and statistically insignificant.

Adeagbo (2022) studied public health expenditure, governance and health outcomes in sub-Saharan Africa. They disaggregated health outcomes into communicable and non-communicable disease indicators and used panel regression to estimate the relationship. The results showed that government health expenditure significantly decreased communicable disease burden, but its impact on non-communicable diseases was based on governance effectiveness. They asserted that increased government health expenditure alone is insufficient stressing that institutional reforms are critical for improving both communicable and non-communicable disease outcomes.

Oladosu, Chanimbe and Anaduaka (2022) studied the effect of public health expenditure on health outcomes in Nigeria and Ghana. Their study used variables such as life expectancy, infant mortality rate and disease-related mortality as variable for health outcomes with control variables such as income and demographic

distributions. They adopted panel data regression and found that government health expenditure has statistically significant and positive effect on health outcomes especially through reductions in mortality associated with communicable diseases. The impact on non-communicable disease outcomes was weaker implying inefficient targeting of chronic diseases prevention and management by government expenditure.

Singh, Bala and Kumar (2022) examines the dynamics of public and private health expenditure on health outcomes in Southeast Asia. The techniques of fixed effect, random effect and feasible generalised least squares methods were adopted in the study. They found that unlike public health expenditure, private health expenditure contributes to better health outcomes only in Brunei and Singapore but not across the countries of Southeast Asia.

A study by Dauda and Balogun (2024) examined the determinants of healthcare expenditure growth and health outcomes in West Africa. They incorporated communicable disease indicators such as child mortality and infectious diseases prevalence. Panel cointegration and error correction model was adopted. They found that increases in public health spending significantly improved communicable disease outcomes, especially child health indicators. However, the study observed that non-communicable disease outcomes were less sensitive to public spending, largely due to high out-of-pocket financing and limited public investment in chronic disease care.

Torres et al (2024) analysed the effect of healthcare expenditures in the evolution of disability-adjusted life years for non-communicable diseases in the European Union between 2000 and 2019. Econometric panel data models were used. The study found that private health expenditure did not show a significant effect on neurological and musculoskeletal disorders whereas public health expenditure did not significantly influence skin and subcutaneous diseases. However, Health both private and public health expenditure significantly decreased disability-adjusted life years for all analysed diseases.

Kalu, Arize, Okwueze and Udemezue (2025) studied the relationship between public health expenditure and health outcomes in sub-Saharan Africa. They considered variables such as income characteristics, government health expenditure as percentage of GDP, while communicable and non-communicable disease outcomes, measured by disease-specific mortality rates. Through panel-ARDL, they found that public health expenditure significantly decreased communicable disease mortality in both the short and long run. Conversely, non-communicable disease outcomes showed weaker responsiveness to government spending, particularly in lower-income countries such as Nigeria.

Ezenduka, Godwin, Ebeh and Oyediran (2025) investigated the impact of household out-of-pocket expenditure (OOPE) on health outcomes in Nigeria using time series data from 1990 to 2023. Health outcomes were measured by maternal mortality rate, infant mortality rate, and life expectancy. Using the Autoregressive Distributed Lag (ARDL), the results showed that higher OOPE significantly increases maternal mortality rate in both the short and long run, reduces infant mortality rate only in the short run, and lowers life expectancy in the long run.

Dong and Dong (2025) analyzed the relationship between out-of-pocket (OOP) expenditure levels and the disease burden of diabetes mellitus. Data on Disability-Adjusted Life Years (DALYs), obesity rates, OOP expenditure as a percentage of current health expenditure and urbanization levels were used. Regression analysis found that high OOP expenditure countries exhibited significantly higher diabetes-related Disability-Adjusted Life Years. Thus, countries with high OOP expenditure tend to experience a significantly greater disease burden of diabetes mellitus.

Vărzaru (2025) analyzed the relationship between healthcare expenditure and outcomes, such as healthy life years, health expectancy, and standardized death rate. Using exponential smoothing models, and ARIMA techniques, the results show that household healthcare expenditures correlate negatively with standardized death rates and substantially benefit healthy life years and health expectancy.

2.4 Gap in Literature

The empirical literature shows that most studies explicitly focused on aggregate health outcomes such as life expectancy, infant mortality and death rate without disaggregating them into communicable and non-communicable disease outcomes (Novignon et al., 2012; Makuta & O'Hare, 2015; Rahman et al., 2018). This limits understanding of how targeted health financing affects major specific disease outcomes.

Again, studies such as Chireshe and Ocran (2020), Adeagbo (2022), Kalu et al. (2025) were carried out at regional or cross-country level with limited application to country-specifics. For a country such as Nigeria,

the peculiarity of health financing structure, it calls for a study that focuses on the country's health financing and how it affects specific disease outcomes.

Furthermore, a critical examination of the literature shows that government health expenditure has received considerable attention thus making the independent roles of private health expenditure and out-of-pocket expenditure to be less examined. There is limited attention to chronic non-communicable diseases such as hypertension, cardiovascular diseases.

SECTION THREE

METHODOLOGY

3.1 Research Design

Quantitative research design within the causal research framework is adopted since the study intends to measure the impact of health financing variables on communicable and non-communicable disease outcomes in Nigeria. The cause-effect relationship justifies the choice of this research design.

3.2 Model Specification

According to the health capital theory, health outcomes depend on healthcare investments. The resource allocation theory emphasizes government allocation as essential for market failure correction while the health financing transition theory highlights the critical role of pooled financing to improve health outcomes. These justify the use of government expenditure on health, private sector health expenditure and out-of-pocket healthcare expenditure as variables in this study.

Model 1: Communicable Disease Outcomes

By modifying the specification of Chireshe and Ocran (2020), we proxy communicable disease outcomes using tuberculosis prevalence rate consistent with WHO standards, while disaggregating health financing into the three models as follows:

$CDO = f(GHE, PHE, OOP)$ [3.1]

$TB = f(GHE, PHE, OOP)$ [3.2]

$TB = \alpha_0 + \alpha_1 GHE + \alpha_2 PHE + \alpha_3 OOP + \mu_t$ [3.3]

Where:

CDO = Communicable diseases outcome

TB = Tuberculosis outcome (prevalence rate)

GHE = Government health expenditure

PHE = Private health expenditure

OOP = Out-of-pocket health expenditure

α_0 is the intercept of the model, and $\alpha_1 - \alpha_3$ are the unknown coefficients, μ_t is the stochastic error term at period 2000 – 2025.

Expected Signs:

$\alpha_1 < 0$: Increase in government health expenditure is expected to decrease TB prevalence rate.

$\alpha_2 < 0$: Increase in private sector health expenditure is expected to decrease TB prevalence rate.

$\alpha_3 > 0$: Increase in out-of-pocket health expenditure is expected to increase TB prevalence rate due to income constraints and delayed care.

Model 2: Non-Communicable Disease Outcomes

Consistent with theoretical postulations and the specification of Kalu *et al.* (2025) and Torres *et al.* (2024), we proxy non-communicable disease outcomes using hypertension/Cardiovascular Diseases mortality rate while maintaining disaggregated variables of health financing as follows:

$NCDO = f(GHE, PHE, OOP)$ [3.4]

$HCPR = f(GHE, PHE, OOP)$ [3.5]

$HCPR = \beta_0 + \beta_1 GHE + \beta_2 PHE + \beta_3 OOP + U_t$ [3.6]

Where:

NCDO = Non-Communicable Diseases Outcome

HCPR = Hypertension and Cardiovascular Disease Prevalence Rate

TB, GHE, PHE, and OOP are as previously defined

β_0 is the intercept of the model, $\beta_1 – \beta_3$ are the unknown coefficients, U_t is the stochastic error term at period 2000 – 2025.

Expected Signs:

$\beta_1 < 0$: Increase in government health expenditure is expected to decrease hypertension/cardiovascular prevalence rate.

$\beta_2 < 0$: Increase in private sector health expenditure is expected to decrease hypertension/cardiovascular prevalence rate.

$\beta_3 > 0$: Increase in out-of-pocket health expenditure is expected to increase hypertension/cardiovascular prevalence rate due to income constraints and poor continuity of care.

3.3 Sources of Data

The data are gotten from secondary sources to ensure reliability, consistency and comparability over time. Particularly, data on government health expenditure are gotten from the Central Bank of Nigeria Statistical Bulletin 2024 edition. Data on private health expenditure and out-of-pocket health expenditure are from the World Health Organization (WHO) Global Health Expenditure Database. Government health expenditure is measured as government health spending as a percentage of total government expenditure, while private health expenditure and out-of-pocket expenditure are obtained as percentages of current health expenditure.

Data on communicable disease outcomes (tuberculosis prevalence rate), and non-communicable disease outcomes (hypertension and cardiovascular mortality rate), are obtained from the World Health Organization Global Tuberculosis Database and the World Bank Non-Communicable Disease Database.

3.4 Description of Variables

Communicable disease outcomes (tuberculosis prevalence rate): Tuberculosis is a contagious disease that attacks the lungs and capable of affecting any other part of the body. It remains one of the most persistent communicable diseases in Nigeria and it is highly sensitive to public and private health interventions.

Non-Communicable disease outcomes (hypertension and cardiovascular prevalence rate): Hypertension is a leading modifiable risk factor for cardiovascular disease and it acts as the primary cause of heart attacks. This disease is highly prevalent in Nigeria and it reflects the chronic and long-term nature of non-communicable diseases, which require continuous care, access to medication, and effective health system coordination.

Government Health Expenditure: This refers to the totality of government expenditure on healthcare sector including health infrastructure, subsidized treatment, prevention and immunization. Increased government health expenditure is expected to improve health outcomes by reducing communicable disease transmission and non-communicable disease prevalence.

Private Sector Health Expenditure: This refers to the expenditure in the healthcare sector made by private firms, non-governmental organizations and private insurance schemes. Private expenditure is expected to complement public spending in decreasing communicable disease transmission and chronic non-communicable diseases prevalence.

Out-of-Pocket Health Expenditure: These are direct payments made by households at the point of service. It constitutes the largest share of health financing and increase in this variable is expected to increase

communicable disease transmission and chronic non-communicable diseases prevalence due to the rising cost of healthcare and low income level.

3.5 Method of Data Analysis

To estimate the relationship between health financing and communicable and non-communicable disease outcomes, this study employs the Toda-Yamamoto causality analysis, introduced by Toda and Yamamoto (1995). This model allows for testing of causality between variables in a level Vector Autoregression (VAR) framework without considering whether the variables are integrated of order zero I(0), order one I(1), or a combination of both. This makes this method of data analysis very unique in macroeconomic and health-related time series data such as health expenditure and disease outcomes which often display non-stationary behaviors. To put the model in clear perspective given this method of data analysis, the specification is thus:

Model 1:

$$\begin{bmatrix} TB_t \\ GHE_t \\ PHE_t \\ OOP_t \end{bmatrix} = A_0 + A_1 \begin{bmatrix} TB_{t-1} \\ GHE_{t-1} \\ PHE_{t-1} \\ OOP_{t-1} \end{bmatrix} + \cdots + A_K \begin{bmatrix} TB_{t-k} \\ GHE_{t-k} \\ PHE_{t-k} \\ OOP_{t-k} \end{bmatrix} + \varepsilon_t$$

Model 2:

$$\begin{bmatrix} HCPR_t \\ GHE_t \\ PHE_t \\ OOP_t \end{bmatrix} = B_0 + B_1 \begin{bmatrix} HCPR_{t-1} \\ GHE_{t-1} \\ PHE_{t-1} \\ OOP_{t-1} \end{bmatrix} + \cdots + B_K \begin{bmatrix} HCPR_{t-k} \\ GHE_{t-k} \\ PHE_{t-k} \\ OOP_{t-k} \end{bmatrix} + V_t$$

Where: k is the optimal lag length selected using AIC, ε_t and V_t are the vector of the residuals, 't-1' is previous period or lag of one period. Other variables as previously defined

The steps involved in Toda–Yamamoto estimation are:

1. Test stationarity (ADF unit root) to determine the maximum level of integration d_{max}
2. Select optimal lag length k using the Akaike Information Criterion (AIC).
3. Estimate augmented VAR using ($k + d_{max}$) in levels.
4. Test for Granger non-causality using the VAR Granger Causality/Block Exogeneity test only on the first k lags.

For the hypotheses test, the probability value associated with the t-statistic from the Toda-Yamamoto estimates. The null hypothesis is rejected if the probability value is less than 0.05 critical value, otherwise, we accept the null hypothesis.

SECTION FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION OF RESULTS

4.1 Data Presentation

The time series data are shown in Appendix of this research. However, for the purpose of clarity, the trends of the data are discussed here-under:

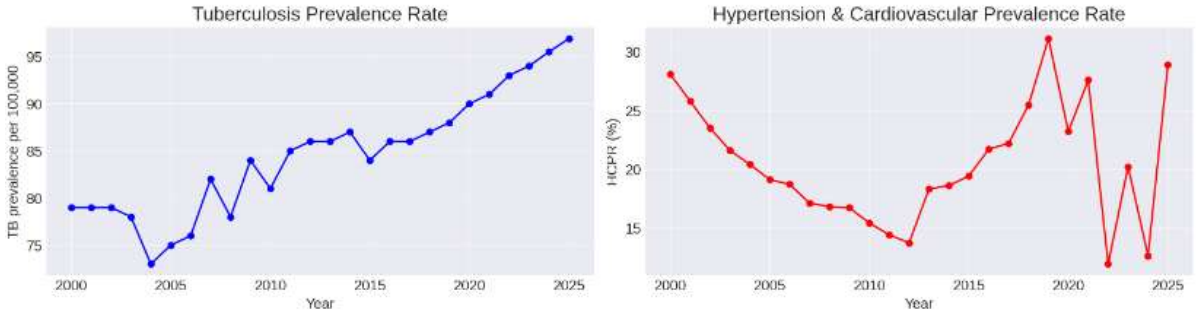

Figure 4.1: Trend of tuberculosis and hypertension prevalence rate. 2000-2025

Tuberculosis prevalence rate is measured by tuberculosis treatment success rate as percentage of total cases. The data in figure 4.1 shows rapid fluctuations rising from 79 per cent to 96.9 per cent per 100,000 population. This shows that tuberculosis has been effectively controlled given the high success treatment rate.

Hypertension prevalence is measured using hypertension mortality rate per 100,000 population. The data in figure 4.1 show initial decline from 2000-2012 but sharp rise after 2013 reaching 28.9 per cent in 2025. This reflects growing burden of non-communicable disease likely due to limited chronic care infrastructure and low government funding.

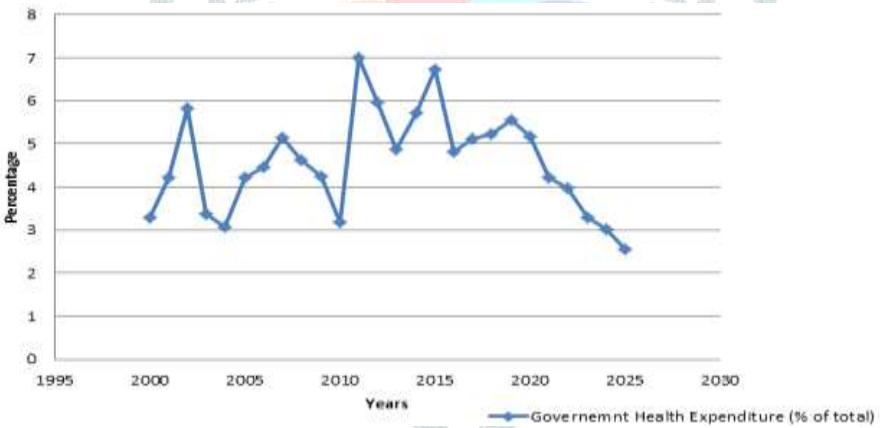

Figure 4.2: Trend of government health expenditure as percentage of total expenditure, 2000-2025

The data presented in figure 4.2 shows how government health expenditure has progressed over the years from 2000 to 2025. Nigeria recorded 3.3 per cent to 6.99 per cent of health expenditure as percentage of total over the period. The highest was in 2011 with 6.99% of total expenditure allocated to health sector. The lowest was in 2025 with only 2.56 per cent.

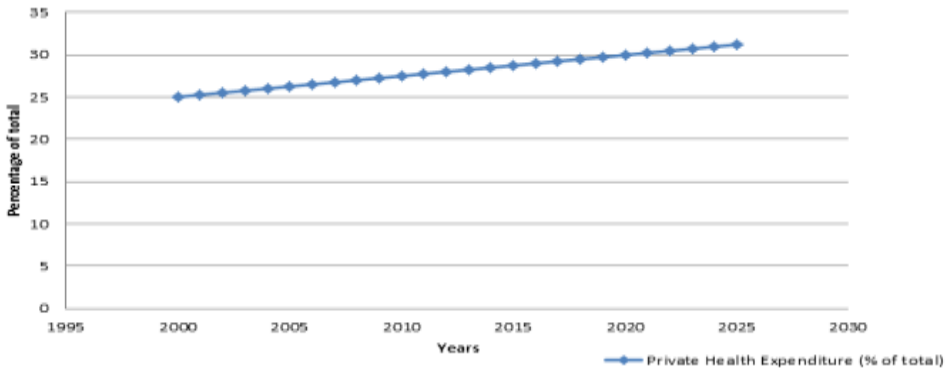

Figure 4.3: Trend of private health expenditure as percentage of total health expenditure, 2000-2025

Private health expenditure pattern is shown in figure 4.3 above. The data show steady increase from 25 per cent in 2000 to 31.2 per cent of total health expenditure in 2025 reflecting rising role of private sector in healthcare provision in Nigeria.

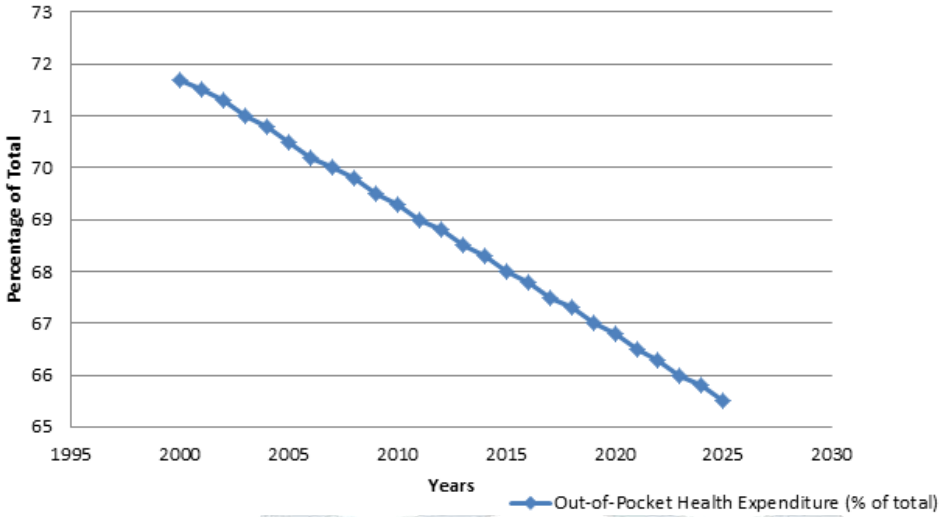

Figure 4.4: Trend of out-of-pocket health expenditure as percentage of total health expenditure, 2000-2025

Figure 4.4 show that out-of-pocket health expenditure gradually declined from 71.7 per cent of total health expenditure in 2000 to 65.5 per cent in 2025 representing the dominant source of health financing in Nigeria. Even though it showed steady decline, it still dominated health financing.

4.2 Data Analysis

Table 4.1: Summary of the Descriptive Statistics

	TB	HCPR	GHE	PHE	OOP
Mean	84.59231	20.48115	4.575755	28.10385	68.64231
Median	85.50000	19.80000	4.558396	28.10000	68.65000
Maximum	96.90000	31.13000	6.993485	31.20000	71.70000
Minimum	73.00000	11.90000	2.559496	25.00000	65.50000
Std. Dev.	6.426627	5.164776	1.165793	1.906721	1.904137
Skewness	0.131003	0.290030	0.197429	-0.000128	-0.009216
Kurtosis	2.233596	2.302833	2.328228	1.799246	1.795545
Jarque-Bera	0.710690	0.891055	0.657790	1.561962	1.571973
Probability	0.700932	0.640486	0.719719	0.457957	0.455670

Table 4.1 reveals that on the average, tuberculosis treatment success rate was 84.59% which represents Nigeria's persistence in eradicating communicable diseases. The mean for hypertension mortality rate is 20.48 which reflect the fact that non-communicable diseases constitute a substantial public health challenge. Government health expenditure has mean value of 4.58% which is considered low hence the insufficiency of government health expenditure. Private health expenditure on the other hand averaged 28.1% while out-of-pocket health expenditure averaged 68.64% underscoring the country's heavy reliance on private and household financing of healthcare.

Furthermore, tuberculosis treatment success rate has standard deviation of 6.43 indicating fluctuations but relatively stable over time. Noticeable variability is noticed for hypertension prevalence with standard deviation of 5.16%. Private health expenditure and out-of-pocket expenditure have relatively low standard deviations of 1.91 and 1.90. The Jarque Bera probability values across the variables are all greater than 0.05 critical value indicating that the variables exhibits normal distribution confirming their suitability for the analysis without logging the data.

Table 4.2: Summary of the Unit Root Test

Variable(s)	ADF Test Statistics			Order Of Integration
	At Level	At 1st Difference	Decision	
TB	0.67909 [0.9890]	-8.04299* [0.0000]	Stationary at 1st difference	I(1)
HCPR	-2.87388 [0.0640]	-3.12931* [0.0396]	Stationary at 1st difference	I(1)
GHE	-2.91394 [0.0579]	-6.21318* [0.0000]	Stationary at 1st difference	I(1)
PHE	2.08069 [0.9997]	-7.14558* [0.0000]	Stationary at 1st difference	I(1)
OOP	0.16578 [0.9628]	-6.38963* [0.0000]	Stationary at 1st difference	I(1)

The unit root test above show that all the variables achieved stationarity after first difference. That is to say that, the variables are all integrated at order one I(1). Evidently, the maximum order of integration is one i.e. $d_{max} = 1$.

Table 4.3: Summary of the Johansen Cointegration and Lag Length Selection

Hypothesized No of CEs (Model 1)	Trace Statistic	*p-value*		Hypothesized No of CEs (Model 2)	Trace Statistic	*p-value*
None*	82.55282	0.0000		None	65.74428	0.0000
At most 1	20.65255	0.1339		At most 1	16.08705	0.3733
At most 2	5.925282	0.4452		At most 2	5.339025	0.5209
At most 3	0.428286	0.5763		At most 3	0.081096	0.8151
Lag	**AIC**			**Lag**	**AIC**	
0	8.677662*			0	10.15072*	
1	-43.05916			1	-41.31485	

Looking at Table 4.3, the model has long run relationship given that there is only one cointegrating equation based on the probability value of the Trace statistic. Again, the model has maximum lag of zero (0) based on the AIC criterion. Hence, the Toda Yamamoto estimation has $k + d_{max}$ where k is the maximum lag which is zero and d_{max} is the maximum order of integration one.

Table 4.4: Toda-Yamamoto Estimates for Model One (Communicable Diseases)

Variables	TB	GHE	PHE	OOP
TB	--	1.0339	0.7839	2.4341
		(0.3093)	(0.3759)	(0.1187)
GHE	0.2164	--	0.0025	0.1664
	(0.6418)		(0.9599)	(0.6833)
PHE	0.0020	0.0073	--	6.7134
	(0.9640)	(0.9321)		(0.0000)*
OOP	0.0317	0.0018	29.8176	--
	(0.8587)	(0.9661)	(0.0000)*	

For model one, the causality analysis reveals that government health expenditure does not granger cause tuberculosis prevalence based on the probability value of 0.6418. Thus, changes in public health expenditure do not translate into immediate changes in tuberculosis prevalence. Nevertheless, the findings demonstrate that out-of-pocket expenditure and the expenditure on health privately exhibit strong bidirectional causality. In particular, out-of-pocket expenditure Granger-caused by private health expenditure significantly (*p-value* = 0.0000) and the vice versa (*p-value* = 0.0000). This shows that it has a reinforcing relationship between the more the private sector is active the greater the household spending and the more the out-of-pocket payments the more it spurs the use of the healthcare by the private. The described dynamic highlights the fact that Nigeria heavily depends on market-based healthcare financing as opposed to pooled public financing.

Table 4.5: Toda-Yamamoto Estimates for Model Two (Non-Communicable Diseases)

Variables	HCPR	GHE	PHE	OOP
HCPR	--	0.1445	0.0251	1.7996
		(0.7039)	(0.8740)	(0.1798)
GHE	0.0549	--	0.0026	0.1514
	(0.8148)		(0.9591)	(0.6972)
PHE	3.8552	0.1579	--	12.7822
	(0.0496)	(0.6910)		(0.0000)*
OOP	3.7692	0.1746	26.1273	--
	(0.0422)	(0.6761)	(0.0000)	

For model two, government health expenditure does not also granger cause hypertension and cardiovascular disease prevalence implying that public health expenditure has not been sufficient in regards to the growing burden of non-communicable diseases. Conversely, non-communicable disease outcomes are Granger-caused by the private health expenditure significantly (*p-value* = 0.0496). This implies that the fluctuations in the expenditure of health privates are directly associated with the fluctuations in hypertension and cardiovascular diseases prevalence given the fact that the former is mostly dominated by the former in terms of the diagnosis and treatment of chronic diseases in Nigeria.

On the same note, out of pocket expenditure on health has a statistically significant causal relationship with outcomes relating to non-communicable diseases (*p-value* = 0.0422). It means that household healthcare expenditures have a direct effect on the outcomes of non-communicable diseases, presumably, by posing a delay in treatment, inadequate medication adherence, and continuity of treatment because of financial limitations.

As was the case in the first model, out-of-pocket expenditure is also Granger-caused by private health expenditure (*p-value* = 0.0000), and out-of-pocket expenditure is also Granger-caused by private health expenditure (*p-value* = 0.0000). This supports the fact that the non-communicable disease burden in Nigeria is highly linked with a health financing scheme that is based on private provision and household payments.

Table 4.6: Test of Hypotheses

Hypothesis One:

H_{01}: There is no significant relationship government health expenditure and communicable and non-communicable diseases outcomes in Nigeria.

Model one $\chi^2 = 0.2164$ (*p-value* = 0.6418) = Not significant

Model two $\chi^2 = 0.0549$ (*p-value* = 0.8148) = Not significant

Decision Rule: In both models, the probability values exceed the 5 percent level of significance. Thus, the null hypothesis is accepted. This implies that there is no significant relationship government health expenditure and communicable and non-communicable diseases outcomes in Nigeria.

Hypothesis Two:

H_{02}: Private sector health expenditure has no significant relationship with communicable and non-communicable diseases outcomes.

Model one $\chi^2 = 0.0020$ (*p-value* = 0.9640) = Not significant

Model two $\chi^2 = 3.8552$ (*p-value* = 0.0496) = Significant

Decision Rule: In the first model, the probability value exceeds the 5 percent level of significance. However, in the second model, the probability value is within the 5% threshold. Therefore, the null hypothesis is partially rejected. This implies that private sector health expenditure has no significant relationship with communicable but has significant relationship with non-communicable diseases outcomes.

Hypothesis Three:

H_{03}: Out-of-pocket health expenditure has no significant relationship with communicable and non-communicable diseases outcomes in Nigeria.

Model one $\chi^2 = 0.0317$ (*p-value* = 0.8587) = Not significant

Model two $\chi^2 = 3.7692$ (*p-value* = 0.0422) = Significant

Decision Rule: In the first model, the probability value exceeds the 5 percent level of significance. However, in the second model, the probability value is below the 5% threshold. Therefore, the null hypothesis is partially rejected. This implies that out-of-pocket health expenditure has no significant relationship with communicable but has significant relationship with non-communicable diseases outcomes in Nigeria.

4.3 Discussion of Findings

The study examined the relationship between health financing and disease outcomes in Nigeria. Disease outcome was disaggregated into communicable and non-communicable diseases. While tuberculosis treatment success rate was used as proxy for communicable disease prevalence, hypertension and cardiovascular disease mortality rate was used to represent non-communicable disease outcome. Three dimensions of heslth financing was identified namely government health expenditure, private sector health expenditure and out-of-pocket health expenditure. Toda-Yamamoto was us4ed in analyzing the model and the data and the results are discussed in line with the specific objectives.

The first objective sought to determine the extent to which government health expenditure impacts communicable and non-communicable diseases outcomes in Nigeria. The results indicated that government health expenditure did not have a statistically significant relationship with either communicable or non-communicable disease outcomes in Nigeria. This is in contrast with the finding of Novignon et al (2012), Makuta and O'hare 92015), Chireshe and OCran (2020), Adeagbo (2022) and Kalu et al (2025). These studies generally found that increased public health spending improves health outcomes significantly especially for communicable diseases. However, the finding agrees with the study of Dauda and Balogun (2024) who emphasized that effectiveness of government health expenditure critically depends on governance quality and efficiency. Thus, Nigerian government expenditure on health is largely insignificant and has not had the desired effect in reducing both communicable and non-communicable disease outcomes in the country.

The second objective analyzed the impact of private sector health expenditure on communicable and non-communicable diseases outcomes in Nigeria. The result revealed that private health expenditure did not significantly affect communicable disease outcome but had significant relationship with non-communicable disease outcomes in Nigeria. This corroborates the earlier finding of Raeesi *et al*. (2018), Rahman *et al.* (2018), and Singh *et al.* (2022) who concluded that private health spending is growing in importance in terms of its effect in improving health outcomes. The importance of private health spending in relation to non-communicable diseases is consistent with Torres et al. (2024), who show that both the government and individual expenditure are able to decrease the disability-adjusted life years of chronic diseases. Hypertension and cardiovascular conditions are non-communicable diseases in Nigeria that are largely dealt with by the private care facilities, hence the identified cause and effect relationship.

In the third objective, the study sought to examine the relationship between out-of-pocket health expenditure and communicable and non-communicable diseases outcomes in Nigeria. The result revealed that out-of-pocket health expenditure did not significantly affect communicable disease outcome but has significant causal relationship with non-communicable disease outcomes. This observation is extremely consistent with available empirical findings. It is shown by Wang *et al*. (2015) and Ezenduka *et al.* (2025) that excessive use of out-of-pocket payments creates financial challenges, which negatively impact health-seeking behavior and the health outcomes in the long term. Equally, Dong and Dong (2025) are able to discover that a higher amount of out-of-pocket spending is linked to increased disease burden among chronic diseases, including diabetes, using disability-adjusted life years. Out-of-pocket spend on non-communicable diseases is important because of the chronic and lifelong nature of the conditions, which need lifelong medication and management and in Nigeria the money is usually provided directly by households. The absence of the meaningful association between out-of-pocket spending and communicable diseases could be due to the availability of donor-funded programs and government intervention of such diseases like tuberculosis and malaria that partially protect households by not exposing them to direct financial costs.

SECTION FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

1. There was no significant relationship government health expenditure and communicable and non-communicable diseases outcomes in Nigeria.
2. Private sector health expenditure showed no significant relationship with communicable disease outcome but has significant relationship with non-communicable diseases outcomes.
3. Out-of-pocket health expenditure had no significant relationship with communicable disease outcome but showed significant relationship with non-communicable diseases outcomes in Nigeria.

5.2 Conclusion

The study concludes that Nigeria's public expenditure on health has remained sub-optimal in addressing communicable and non-communicable disease outcomes over time. The prevalence of tuberculosis is not being tamed by government spending likewise the prevalence of hypertension and cardiovascular diseases. Out-of-pocket health expenditure dominates Nigeria's healthcare financing due to limited government spending while private sector has continued to finance the management of hypertension and cardiovascular diseases thus reducing their prevalence rate.

5.3 Recommendations

Based on the findings and conclusions drawn, the study recommends as follows:

1. Nigerian government needs to substantially increase public health expenditure to be at par with global best practices such as the Abuja declaration of 15 per cent allocation to health sector. This can go a very long way in the management of pressing communicable diseases such as tuberculosis and non-communicable diseases such as hypertension and cardiovascular diseases.
2. The private sector needs to be brought into national health strategies in order to complement government efforts. Public-private partnership in healthcare delivery especially in the treatment and management of communicable and non-communicable diseases is encouraged.
3. Policies that reduce out-of-pocket health expenditure should be prioritized by the government. These can come in the form of subsidizing essential medications for chronic diseases and strengthening primary healthcare systems for early diagnosis.

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Appendices

Null Hypothesis: TB has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.679087	0.9890
Test critical values:	1% level	-3.737853	
	5% level	-2.991878	
	10% level	-2.635542	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(TB) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.042994	0.0000
Test critical values:	1% level	-3.737853	
	5% level	-2.991878	
	10% level	-2.635542	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: HCPR has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.873881	0.0640
Test critical values:	1% level	-3.752946	
	5% level	-2.998064	
	10% level	-2.638752	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(HCPR) has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.129312	0.0396
Test critical values:	1% level	-3.788030	
	5% level	-3.012363	
	10% level	-2.646119	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: GHE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.913937	0.0579
Test critical values:	1% level	-3.724070	
	5% level	-2.986225	
	10% level	-2.632604	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GHE) has a unit root
Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.213178	0.0000
Test critical values:	1% level	-3.737853	
	5% level	-2.991878	
	10% level	-2.635542	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: PHE has a unit root
Exogenous: Constant
Lag Length: 5 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		2.080695	0.9997
Test critical values:	1% level	-3.808546	
	5% level	-3.020686	
	10% level	-2.650413	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(PHE) has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.145579	0.0000
Test critical values:	1% level	-3.808546	
	5% level	-3.020686	
	10% level	-2.650413	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: OOP has a unit root
Exogenous: Constant
Lag Length: 5 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.165777	0.9628
Test critical values:	1% level	-3.808546	
	5% level	-3.020686	
	10% level	-2.650413	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(OOP) has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.389626	0.0000
Test critical values:	1% level	-3.808546	
	5% level	-3.020686	
	10% level	-2.650413	

*MacKinnon (1996) one-sided p-values.

Date: 01/25/26 Time: 20:16
Sample (adjusted): 2002 2025
Included observations: 24 after adjustments
Trend assumption: No deterministic trend
Series: TB GHE PHE OOP
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.924164	82.55282	40.17493	0.0000
At most 1	0.458621	20.65255	24.27596	0.1339
At most 2	0.204704	5.925282	12.32090	0.4452
At most 3	0.017687	0.428286	4.129906	0.5763

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.924164	61.90026	24.15921	0.0000
At most 1	0.458621	14.72727	17.79730	0.1366
At most 2	0.204704	5.496996	11.22480	0.4104
At most 3	0.017687	0.428286	4.129906	0.5763

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Date: 01/25/26 Time: 20:16
Sample (adjusted): 2002 2025
Included observations: 24 after adjustments
Trend assumption: No deterministic trend
Series: HCPR GHE PHE OOP
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.873694	65.74428	40.17493	0.0000
At most 1	0.360989	16.08705	24.27596	0.3733
At most 2	0.196743	5.339025	12.32090	0.5209
At most 3	0.003373	0.081096	4.129906	0.8151

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.873694	49.65723	24.15921	0.0000
At most 1	0.360989	10.74802	17.79730	0.4095
At most 2	0.196743	5.257929	11.22480	0.4418
At most 3	0.003373	0.081096	4.129906	0.8151

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

VAR Lag Order Selection Criteria
Endogenous variables: TB GHE PHE OOP
Exogenous variables: C
Date: 01/25/26 Time: 20:19
Sample: 2000 2025
Included observations: 25

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-104.4708	NA	0.068998	8.677662*	8.872682*	8.731752
1	558.2396	1060.337*	2.39e-24*	-43.05916	-42.08406	-42.78871*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

VAR Lag Order Selection Criteria
Endogenous variables: HCPR GHE PHE OOP
Exogenous variables: C
Date: 01/25/26 Time: 20:19
Sample: 2000 2025
Included observations: 25

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-122.8840	NA	0.301007	10.15072*	10.34574	10.20481
1	536.4356	1054.911*	1.37e-23*	-41.31485	-40.33975*	-41.04440*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 01/25/26 Time: 20:32
Sample: 2000 2025
Included observations: 25

Dependent variable: TB

Excluded	Chi-sq	df	Prob.
GHE	0.216413	1	0.6418
PHE	0.002032	1	0.9640
OOP	0.031683	1	0.8587
All	11.33751	3	0.0100

Dependent variable: GHE

Excluded	Chi-sq	df	Prob.
TB	1.033859	1	0.3093
PHE	0.007270	1	0.9321
OOP	0.001807	1	0.9661
All	1.811823	3	0.6124

Dependent variable: PHE

Excluded	Chi-sq	df	Prob.
TB	0.783970	1	0.3759
GHE	0.002532	1	0.9599

OOP	29.81755	1	0.0000
All	30.43899	3	0.0000

Dependent variable: OOP

Excluded	Chi-sq	df	Prob.
TB	2.434137	1	0.1187
GHE	0.166402	1	0.6833
PHE	6.713420	1	0.0000
All	8.064820	3	0.0000

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 01/25/26 Time: 20:32
Sample: 2000 2025
Included observations: 25

Dependent variable: HCPR

Excluded	Chi-sq	df	Prob.
GHE	0.054887	1	0.8148
PHE	3.855222	1	0.0496
OOP	3.769176	1	0.0422
All	4.527439	3	0.2099

Dependent variable: GHE

Excluded	Chi-sq	df	Prob.
HCPR	0.144460	1	0.7039
PHE	0.157968	1	0.6910
OOP	0.174603	1	0.6761
All	0.889529	3	0.8280

Dependent variable: PHE

Excluded	Chi-sq	df	Prob.
HCPR	0.025145	1	0.8740
GHE	0.002628	1	0.9591
OOP	26.12734	1	0.0000
All	28.59746	3	0.0000

Dependent variable: OOP

Excluded	Chi-sq	df	Prob.
HCPR	1.799616	1	0.1798
GHE	0.151375	1	0.6972
PHE	12.78221	1	0.0000
All	14.73321	3	0.0000

Table Showing the Time Series Data

Year	Tuberculosis Treatment Success Rate %	Hypertension Mortality Rate %	Government Health Expenditure (% of total)	Private Health Expenditure (% of total)	Out-of-Pocket Health Expenditure (% of total)
2000	79	28.1	3.296812	25	71.7
2001	79	25.8	4.233087	25.2	71.5
2002	79	23.5	5.82971	25.5	71.3
2003	78	21.6	3.379862	25.7	71
2004	73	20.4	3.078862	26	70.8
2005	75	19.1	4.215545	26.3	70.5
2006	76	18.7	4.478034	26.5	70.2
2007	82	17.1	5.153899	26.7	70
2008	78	16.8	4.638759	27	69.8
2009	84	16.7	4.238789	27.2	69.5
2010	81	15.4	3.187072	27.5	69.3
2011	85	14.4	6.993485	27.7	69
2012	86	13.7	5.9516	28	68.8
2013	86	18.3	4.879239	28.2	68.5
2014	87	18.6	5.718709	28.5	68.3
2015	84	19.4	6.725039	28.7	68
2016	86	21.7	4.827377	29	67.8
2017	86	22.2	5.129468	29.2	67.5
2018	87	25.47	5.223477	29.5	67.3
2019	88	31.13	5.550325	29.7	67
2020	90	23.21	5.169613	30	66.8
2021	91	27.6	4.223486	30.2	66.5
2022	93	11.9	3.976632	30.5	66.3
2023	94	20.2	3.280047	30.7	66
2024	95.5	12.6	3.031216	31	65.8
2025	96.9	28.9	2.559496	31.2	65.5

Sources: Central Bank of Nigeria Statistical Bulletin 2024 edition
World Health Organization (WHO) Global Health Expenditure Database.
World Health Organization Global Tuberculosis Database and the World Bank Non-Communicable Disease Database.