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Fiscal Sustainability of Health Systems in sub-Saharan Africa: An Analytical Framework and Evidence from Zambia

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DEDICATION

To my parents, wife, children, siblings, and friends. Thank you for always being there for me.

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LIST OF ABBREVIATIONS AND ACRONYMS

ACF	Autocorrelation Function
AR	Autoregressive
ARIMA	Autoregressive Integrated Moving Average
BP-LM	Breusch-Pagan Lagrange Multiplier
CDC	America Centres for Disease Control and Prevention
CHE	Current Health Expenditure
CIH	Commission on Investing in Health
COVID-19	Coronavirus disease 2019
DAH	Development Assistance for Health
GBD	Global Burden of Disease
GDP	Gross Domestic Product
GHE	Government Health Expenditure
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
HMIS	Health Management Information System
HRH	Human Resources for Health
IHME	Institute for Health Metrics and Evaluation
LIC	Low Income Countries
LLMICs	Low and Lower-Middle Income Countries
LMIC	Lower-Middle Income Countries
MA	Moving Average
MDGs	Millennium Development Goals
MoH	Ministry of Health
NHA	National Health Accounts
OECD	Organisation for Economic Co-operation and Development
PACF	Partial Autocorrelation Function
PCSEs	Correlated Panels Corrected Standard Errors
PHC	Primary Health Care
SADC	Southern African Development Community
SDGs	Sustainable Development Goals
SHI	Social Health Insurance
SSA	Sub-Saharan Africa
TB	Tuberculosis

UHC	Universal Health Coverage
WDI	World Development Indicators
WHO	World Health Organisation
ZamStats	Zambia Statistics Agency

1. INTRODUCTION

This chapter provides a background to the literature that was reviewed and the basis upon which the study was conducted. In section 1.1, the problem statement and rationale for the study are presented. This is followed by section 1.2 which provides an overview of the contextual factors underpinning growth in health expenditures in low and lower-middle income countries (LLMICs), trends in the provision of health care services in LLMICs and progress towards achievement of universal health coverage (UHC), and fiscal sustainability of health systems in LLMICs. In section 1.3, the theoretical perspectives on the determinants of health expenditure and sustainability of health systems are provided. This includes the definitions of fiscal sustainability and fiscal space for health; supply- and demand-side theories on drivers of growth in health expenditures; approaches for analysing historical growth in health expenditure; and models for projecting future spending on health and their application. Section 1.4 presents empirical evidence from studies on growth in health expenditure in Africa. This includes a review of studies on the determinants of growth in health expenditures, methods that have been used to analyse the growth in total health expenditure in Africa, and evidence from studies on fiscal sustainability of health systems in Africa. The research gap, justification for the study, and research questions are provided in section 1.5.

1.1. Problem statement and rationale for the study

Over the past three decades, several countries around the world have experienced a rapid increase in total health expenditures. A review of health spending trends between 1995 and 2014 shows that global health spending per capita increased significantly from US$689 to US$1,279 with high-income countries adding US$2,250 per capita in spending while low and lower-middle income countries added US$69 and US$162 in per capita spending, respectively (IHME, 2007).[1] By 2020, global spending on health increased further and reached US$9 trillion due to the COVID-19 pandemic (WHO, 2022). However, the spending was highly unequal with high income countries accounting for 80% of the global spending on health. In per capita terms, health spending increased by an average of 1.7% in low-income countries in 2020 which was significantly lower than the 4.7% increase in lower-middle income countries; 3.8% in upper-middle income countries; and 5.7% in high income countries (WHO, 2022). By the mid-

[1]Spending is expressed in 2015 purchasing power parity US$

2010s, health spending had already outpaced economic growth in most of the European countries (OECD, 2015)—several years before the COVID-19 pandemic. From a fiscal sustainability perspective, this is concerning because growth in public spending (including health) is supposed to be below or in line with the economic growth in a given country (Rebba, 2014). As such, fiscal (or financial) sustainability is attained when the growth in public spending matches the growth in a nation's resource base (Rebba, 2014).

Despite its importance in health financing, fiscal sustainability has been overlooked globally and it is only from the mid-2010s that Organisation for Economic Co-operation and Development (OECD) countries started examining the constantly rising and unsustainable growth in public expenditure on health. A study by OECD (2015) concludes that public spending on health and long-term care could reach 9% of the gross domestic product (GDP) by 2030 and as much as 14% of GDP by 2060, if effective cost containment policies are not put in place. Other studies project that public spending on health for the EU-15 countries[2] could increase from 27% to 84% if action is not taken (Rebba, 2014). But while the growth in health spending in high- and middle-income countries has been driven by increases in government spending, the growth in low-income countries has mainly been driven by increases in development assistance for health (DAH) (Dieleman et al. 2017). For example, between 1995 and 2014, low and middle-income countries received US$423 billion of DAH, out of which 35.7% was disbursed to low-income countries (Dieleman et al. 2017). Countries in sub-Saharan Africa (SSA) received 27% of the US$423 billion of DAH that was disbursed between 1995 and 2014. But after a decade of significant growth in DAH associated with the Millennium Development Goals (MDGs), there has been a decline in growth in DAH since 2010. Dieleman and others (2017) observe that DAH grew at a rate of 4.6% per annum during the 1990s, 11.3% per annum between 2000 and 2009, and at 1.8% per annum since 2010.

The MDG era was also associated with notable progress in health coverage and outcomes worldwide, including considerable reductions in under-5 and maternal mortality rates (United Nations, 2015a; WHO, 2015). But despite making notable progress on the health-related MDG targets, most of the countries in SSA did not attain all the health-related MDG goals; and the SSA region is still responsible for 50% of the world's under-five deaths (United Nations,

[2] The EU 15 are: Belgium, Denmark, Germany, Finland, France, Greece, Ireland, Italy, Luxembourg, Netherlands, Austria, Portugal, Spain, the United Kingdom, and Sweden.

2015a). Further, the high rate of adolescent childbearing in SSA will increase the number of under-five deaths in future unless effective strategies and interventions are implemented to improve newborn care and to meet the reproductive health needs of young mothers (United Nations, 2015a). In addition, health service coverage and disease outcomes in most SSA countries, including the countries that met some of the MDG targets and goals, was inequitable across geographical regions within the countries and social domains (sex, age, disability, and ethnicity) (United Nations, 2015a). Therefore, there is need to complete the unfinished MDG agenda with a focus on equity, as stipulated in the Sustainable Development Goals (SDGs) (World Bank, 2016b).

In particular, SDG number 3 target 3.8 (SDG 3.8) requires all countries worldwide to "*achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all"*(United Nations, 2015b). Thus, to achieve SDG 3.8, all countries need to strengthen their health systems, and expand coverage for both communicable and non-communicable diseases. However, attaining SDG3.8 will be difficult since a large amount of resources are required. According to Stenberg and others (2017), an additional US$371 billion will be required annually for 67 LLMICs to attain SDG 3.8 by 2030 under the ambitious scenario. The expected increase is equivalent to an average of US$271 per capita per year per country or 7.5% of the GDP on average per year per country (Stenberg et al. 2017). However, increasing total health spending in LLMICs will be challenging because domestic general government health expenditure as a share of GDP is only 3% (WHO, 2023). Further, DAH—an important source of health financing in LLMICs, has been growing at a declining rate since 2010 (Dieleman et al. 2017). It is not surprising, therefore, that LLMICs are now looking for alternative ways of increasing fiscal space for health to sustain and expand coverage of health services.

While possibilities to increase fiscal space for health through DAH are limited, it is equally challenging to increase fiscal space for health by re-prioritizing health within the government budget, and through domestic resource mobilization given the poor macroeconomic and fiscal performance of most LLMICs over the past 10 years. In particular, re-prioritizing health within the government budget is difficult for some countries in SSA as health is already highly prioritized, and domestic tax generation capacity is almost maximized. For example, in Malawi, government health expenditure as a share of GDP at 2.9% is above the average for low-income countries and SSA while tax revenue as a percentage of GDP at 16.1% is above the SSA average of 15.8% (World Bank, 2017b). In Zambia, government and total health expenditures as shares of GDP were estimated at 2.5% and 6.7%, respectively, in 2021 (Ministry of Health, 2023b); while general government revenue as a percentage of GDP was estimated at 21% in 2022 (IMF, 2023a). Zambia also has a very high government gross debt as a share of the GDP, which was estimated at 110.8% of GDP in 2021 (International Monetary Fund, 2023b). Considering that a large amount of the additional national income would be devoted to debt servicing, this will make it difficult for the country to allocate more money to the health sector even if the tax generation capacity or the economy grows. Moreover, the rate of growth in both total and government spending has already exceeded GDP growth in Zambia (Chansa et al. 2015), and, therefore, future increases in government budgetary allocations to the health sector will be difficult. Henceforth, the most feasible option for increasing fiscal space for health for Zambia could potentially be through improved efficiency in resource allocation and use. This view is supported by Achoki and others (2017) who observe technical inefficiencies in the delivery of child health services in Zambia, and suggest that there is potential to expand services through efficient use of the existing resources.

While it is worthwhile to consider ways of increasing fiscal space for health through efficiency gains and domestic revenue mobilization, it is also vital to look at factors contributing to rising health expenditures. According to Xu and others (2011), rising health expenditures in LLMICs can be attributed to macroeconomic and fiscal factors, demographic structure, disease patterns, health system characteristics, and time. Specifically, this includes rapidly rising populations; epidemiological transition [from communicable diseases (HIV, TB, malaria, etc) to non-communicable diseases (cardiovascular diseases, traumas, road-related accidents, cancers etc), and/or a combination of both]; changing political and institutional contexts; level of economic growth; and graduation of countries from low to lower-middle income status (ibid). The latter triggers reduced donor funding, which in turn leads to lower fiscal space for health, and more pressure on transitioning African Governments to cover the emerging financing gap (as a result of reduced donor funding) through domestic resources.

Fiscal sustainability analysis is critical for Africa as it can enable Governments to evaluate demographic, epidemiological, and health financing transitions; and immediate and long-term expenditure commitments to achieve UHC, and how these expenditures match the available/future resources. But despite the emerging challenge of fiscal sustainability for health in Africa, there is no comprehensive study on the subject-matter. Most of the studies on fiscal sustainability have been conducted in OECD countries, and a few countries in Latin America and Asia. In Zambia and Africa as a whole, studies have been piece-meal in that they have evaluated some of the elements of financial sustainability of health systems and not the whole. The studies in Africa have looked at: (i) determinants of growth in health expenditure (Lv and Zhu, 2014; Micah et al. 2019; Okunade, 2005; Olaniyan et al. 2013; Gbesemete and Gerdtham, 1992); (ii) potential areas for increasing fiscal space for health (Okwero et al. 2010; Tandon and Cashin, 2010; Chipunza and Nhamo, 2023; Doherty et al. 2018; Barroy et al. 2016); and (iii) disease and/or program-specific financial sustainability analyses which have focused on HIV/AIDS programmes (Blecher et al. 2016; David, 2009), immunization programmes (McQuestion et al. 2011; Saxenian et al. 2024), and mother and child health programmes (Atim et al. 2020). Lack of an analytical framework for analysing fiscal sustainability in LLMICs further compounds the problem. Without comprehensive studies on financial sustainability of health systems in Africa, it is difficult to ascertain the historical health financing trajectory, and long-term implication on the financial sustainability of health systems in Africa.

In lieu of the above, this dissertation sought to fill two distinct gaps: (i) a knowledge gap on the use of decomposition methods to analyse determinants of health expenditure at national and sub-national levels within the countries; and (ii) a methodological gap by adapting an analytical framework for fiscal sustainability for LMICs and applying the devised framework in Zambia. These analyses have never been undertaken before in Zambia and any other country in Africa. The two studies in Africa (Micah et al. 2019; Tandon et al. 2018) that used decomposition analysis to track changes in the growth in health expenditures were based on cross-country comparisons.

1.2. UHC and fiscal sustainability of health systems in LLMICs

Health is one of the most fundamental human rights, and UHC is essential to ensuring that everyone has access to high quality health services without incurring financial hardship (WHO and World Bank, 2021). UHC is one of the goals on the United Nations Agenda 2030 on Sustainable Development, and it was reinforced when world leaders endorsed the declaration on UHC in September 2019 (ibid). To achieve UHC, countries around the world have committed to increasing financing to health and provision of quality health care to their citizens (WHO, 2018; National Academies of Sciences, Engineering, and Medicine, 2018); but each country must have its own unique path to achieving UHC based on the needs of its people and the resources at hand (WHO, 2023). This means that the level and composition of health spending, coverage and access to health care largely depends on economic and social conditions in each country (Nilsson et al. 2016). Ultimately, the way a health system is financed and governed usually determines the extent to which the health system can provide equitable access to essential health care, and how it can improve population health (Prakongsai et al. 2008). Therefore, attaining UHC and achieving the health-related SDG requires additional resources to expand and sustain access to high-quality health services, and to achieve financial protection (Cashin et al. 2017; Stenberg et al. 2017; World Bank, 2016b). For LLMICs, a study by Mcintyre and others (2017) suggests that government spending on health of at least 5% of GDP and/or US$86 per capita per annum is required to progress towards achieving UHC.

Since the call for countries to commit to UHC, there has been progress worldwide albeit with huge differences across international regions and countries. At global level, the UHC service coverage index (SCI) increased from an average of 45 in 2000 to 67 in 2019 with the Western Pacific region having the highest value (80), followed by the European region (79), region of the Americas (77), and the lowest value was observed in the African region (46) (WHO and World Bank, 2021). This means that despite increasing spending on health and investments in health systems in African countries over the years, much more needs to be done for countries in Africa to attain UHC. Available evidence also shows that there is a strong positive relationship between the UHC SCI and gross national income per capita (current US$) and this implies that service coverage is driven by income growth (ibid). But as households' income increased, their demand for health services also increased and this led to an increase in out-of-pocket spending on health care (WHO and World Bank, 2021). Consequently, the total population facing catastrophic health spending in lower-middle income countries increased from 197 million in 2000 to 423 million in 2017; and in Africa from 51 million in 2000 to 87 million in 2017 (ibid). Within countries, there are also persistent inequalities in service coverage and financial hardship as observed through several public expenditure reviews in different countries in Africa (World Bank, 2024; World Bank, 2020; World Bank, 2018).

But what hinders countries in Africa from attaining UHC? Foremost, available evidence suggests that epidemiological transitions, climate change, urbanisation, and globalization have led to disease outbreaks and increasing burden of health service provision (Lindahl and Grace, 2015). For example, the Ebola epidemic had devastating effects on the health care workforce in Guinea, Liberia, and Sierra Leone; and severely impacted the provision of health care services and caused setbacks in the treatment and control of other priority diseases such as tuberculosis, malaria, and HIV (CDC, 2019). For COVID-19, a study by Ahmed and others (2022) shows the COVID-19 pandemic led to decreases in the utilization of essential health service utilization in 18 countries in Africa which was associated with increases in child and maternal mortality by 3.6% and 1.5%, respectively. The COVID-19 pandemic also exacerbated the prevalence of foregone care with about 18.8% of households in 39 LLMICs reporting being unable to access health care when needed (Kakietek et al. 2022). On the other hand, the forgone economic growth in the three countries (Guinea, Liberia, and Sierra Leone) which were hit by the Ebola epidemic was estimated at more than US$1.6 billion in 2015 alone (Thomas et al. 2015); and US$53.19 billion (2014 US$) in economic and social losses over the duration of the pandemic (Huber et al. 2018). To overcome the negative impact of emerging and re-emerging diseases, the Framework for Action on UHC calls for strong health and disease surveillance systems in Africa (WHO, 2016).

But even before the Ebola epidemic and COVID-19 pandemic, progress towards UHC in Africa had been slow and most of the countries had been failing to provide basic health care to its citizens. For example, about seven million children in Africa did not receive any vaccination in 2019, and this means that chances of them dying from vaccine preventable diseases was very high (UNICEF and WHO, 2020). This could be attributed to insufficiency of immunisation budgets to cover all the children with the prescribed routine vaccines, and expansion of the immunization schedule to include new vaccine which may be much more expensive (Saxenian et al. 2024). Consequently, most of the countries in Africa are heavily dependent on Gavi and other development partners to finance their immunization programs (ibid). It is not surprising, therefore, that most of the countries in Africa failed to meet their MDG targets; and achieving the SDG targets is likely to be a significant challenge (WHO, 2016). Thus, to have stronger and responsive health systems, there is need for concerted efforts on improving the provision of quality health care, efficiency, equity of access, and sustainable health outcomes (Kieny et al. 2017). To achieve this, all the six building blocks of the health system, namely: health system financing, leadership and governance, service delivery, health workforce, medical products, vaccines and technologies, and health information systems must function effectively (WHO, 2007).

To achieve inclusive growth and shared prosperity in Africa, sustainable investments in the health systems are cardinal—and existing evidence suggests that strong economic growth has helped to reduce poverty (World Bank and WHO, 2016). However, with an already existing burden of communicable and non-communicable diseases, and rising population in Africa (Savedoff et al. 2012)—Africa faces a critical challenge of creating the foundations for long-term inclusive growth. The existing health burden and rising population coupled with the need to expand health services to reach UHC will be very difficult because of the lost income from constricted economic growth during the COVID-19 pandemic (Hanson et al. 2022). Inefficiencies in resource allocation and utilization of resources also makes it difficult to get the most out of the existing resources. This means that to achieve financial sustainability, the quality of health spending in Africa needs to improve; and this can be addressed by strengthening governance and accountability (Makuta and O'Hare, 2015). This intervention is very critical because prospects of getting additional financial resources for health will be extremely difficult given the already constricted fiscal space in most African countries. In other words, making the most out of the existing resources will be key to progress towards the attainment of UHC in Africa.

1.3. Theoretical perspectives on the determinants of health expenditure and sustainability of health systems

Understanding the drivers of growth in health care expenditure is important for: (i) understanding potential inefficiencies in health spending and how to address the problem; (ii) matching and/or mobilising additional resources for health; (iii) scenario analysis to assess how changes in policies, organization of health services, service delivery modes, treatment regimens, and so forth, could impact future spending on health care; and (iv) forecasting spending on health in the short- to long-term by component (type of expenditure, financing scheme, and financing source).

1.3.1 Definitions of fiscal sustainability and fiscal space for health

Heller (2005) defines fiscal sustainability as "the capacity of a government, at least in the future, to finance its desired expenditure programs, to service any debt obligations (including those that may arise if the created fiscal space arises from government borrowing), and to ensure its solvency." This definition is corroborated by Rebba (2014) who defines fiscal sustainability as 'the extent to which public spending growth matches growth in a society's resource base.' Rebba (2014) then applies the concept to the health sector and explains that a health system could become financially unsustainable when a government is unable to finance the existing level of health services. Therefore, one of the most fundamental aspects of fiscal sustainability relates to the ability of a government to maintain the provision of the same set of policies indefinitely without becoming insolvent (Burnside, 2005). Therefore, in a sustainably financed health system, health programmes are continuously provided and adapted to changing circumstances without a decline in their quality or coverage. Fiscal sustainability is closely related to fiscal space which is defined as "the availability of budgetary room that allows a government to provide resources for a desired purpose without any prejudice to the sustainability of a government's financial position" (Heller, 2005). Tandon and Cashin (2010) build on Heller's work on fiscal space by highlighting five avenues through which fiscal space for health could be increased. These are: (i) having conducive macroeconomic conditions, (ii) reprioritizing health within the government budget, (iii) increasing health sector-specific funds through health taxes and earmarking funds to the health sector, (iv) mobilising external funds for health-specific programmes, and (v) increasing value-for-money through improved allocative and technical efficiency (Tandon and Cashin, 2010). However, Heller (2005) observes that fiscal space should not be regarded as strictly associated with a specific sector because overall government spending is influenced by competing demands from other sectors.

1.3.2 Supply- and demand-side theories on drivers of growth in health expenditures

A continuous increase in health expenditure can threaten the fiscal sustainability of a health system. Therefore, understanding theories on the supply and demand for health care is pivotal for gauging health expenditure growth and the financial sustainability of a health system (Kibasi et al. 2012). From the *supply-side,* factors that have been cited to influence the growth in health expenditure are rooted on Wagner's law of increasing state activity and Baumol's cost-disease effect theory. According to Wagner, there is a long-run propensity for government expenditure to grow relative to national income (Wagner, 1892). Wagner's key argument is that industrialization triggers an increase in the real per capita income of a nation which eventually leads to an increase in public spending because governments: (i) expand the provision of traditional services (i.e. defence, justice, law and order); (ii) starts providing new services to increase the well-being of the citizens (i.e. education, public health, housing, and social protection programmes); and (iii) expand the sphere of public goods. As such, Wagner is of the view that public spending is an endogenous factor that is contingent on the growth of national income. Wagner further observes that demand- and supply-side factors can influence public sector activities, and this subsequently affects the level of public spending (ibid).

Wagner's law has been tested and corroborated through several studies in both developed and developing countries; and most of the studies have attested to its validity in analysing the relationship between growth in national income and public spending including health (Peters, 1996; Bird, 1971; Ghazy et al. 2021). In India, a study by Ranjan and Chintu (2013) covering the period 1970-2010 also validated Wagner's law. Wagner's law is now widely accepted, and after confirming the applicability of Wagner's law in four diverse countries (United States, Thailand, Barbados, and Haiti) over the period 1948-1995, Peters (1996) and concludes that Wagner's law is "more universal than Wagner himself intended it to be." However, some studies have found contrary results. A study by Abizadeh and Gray (1985) categorized 53 countries into three levels of development—poor, developing, and developed—using a quality of life index and examined Wagner's law over the period from 1963 to 1979. Their conclusion was that Wagner's law only holds for developing countries but not for poor and developed countries. A study by Huang (2006) which applied Wagner's law in China and Taiwan over the period 1979-2002 concluded that there was no long-run relationship between government expenditures and output in China and Taiwan.

The other supply-side theory on the determinants of health care expenditure that is widely acclaimed is Baumol's cost-disease theory. The theory suggests that there is a tendency for wages in jobs that experience relatively low productivity growth to rise in response to rising wages in other jobs that experience higher productivity growth (Baumol, 1967; Baumol, 1993). The underlying reason is that productivity of labour is relatively stagnant in the health sector because health workers can only see a limited number of patients in a day. However, as wages rise in sectors experiencing productivity growth, there is pressure to also increase wages in the health sector (in order to attract and retain the health workers) and this causes a rise in health expenditures (Baumol, 1967; Baumol, 1993). Based on Baumol's theory, Xu and others (2011) explains that "prices of some services tend to increase vis-à-vis other goods and services in the economy, which leads to a negative productivity differential and equalization of wages across sectors." The key assumption here is that prices for health services will continue to rise relative to other prices due to the limited elasticity of demand for health care i.e. people continue to buy health care services despite an increase in the price of health care services (Hartwig, 2008). Baumol's theory has been examined by a number of scholars and most of them conclude that it provides a theoretical foundation for research on the determinants of health care expenditure—particularly the role of labour prices in driving health care expenditure (Hartwig, 2008; Wang and Chen, 2021; Bates and Santerre, 2013; Hartwig and Sturm, 2014). However, a study by Rossen and Faroque (2016) shows that technical progress in health care and growth in per capita incomes are the biggest contributors to growth in health care expenditure in Canada.

Given increasing innovations and advances in medical technology over the years, Hartwig (2008) argues that future applicability of Baumol's cost-disease theory is dim because the rise in health expenditure is likely to be influenced by technological advancements. Rightly so, several studies have concluded that the adoption of new medical technologies is a major contributor to the growth in health expenditures (Weisbrod, 1991; Chernew and Newhouse, 2011; Willemé and Dumont, 2015). A comprehensive review of the literature on the impact of technological advances on health expenditure growth by Marino and Lorenzoni (2019) shows that across most of the studies which had been evaluated, the impact ranged from 25% to 50% of the annual growth in health expenditure. While new technologies can improve health outcomes, they are often more expensive than existing treatments and unaffordable to most citizens (Kumar, 2011). Further, even with new medical technologies, wages for health workers continue to increase. Marino and Lorenzoni (2019) explains this phenomenon by arguing that new technologies have several effects; and as a driver of productivity increases, technology is also a causal driver of several factors associated with growth in health care expenditure.

Case-in-point is the price and wage effect (Baumol's cost disease theory) which is also highly related to technological change (ibid). For instance, a new medical equipment is associated with: (i) a capital cost (purchase price); and (ii) operating costs to implement it. The operating costs which include the costs for health workers, training, insurance, supplies, and routine maintenance are often much higher than the purchase price for the new equipment (Neumann and Weinstein, 1991). Thus, while new technologies can enhance efficiency and effectiveness of health spending, the overall effect of new technology on health expenditure is regarded to be cost-increasing and generally outweigh cost-savings (Atella and Kopinska, 2019). Given the continued dependency on technology and increasing health care costs, Neumann and Weinstein (1991) have advocated for optimal diffusion of new technology based on the cost-effectiveness principle; Marino and Lorenzoni (2019) suggest that Health Technology Assessments could help to determine the impact of introducing new technologies on health spending and value for money; and (Atella and Kopinska, 2019) call for policymakers to desist from adoption of ineffective, unnecessary, and inappropriate technologies.

The other factor that can influence growth in health expenditures is the way a health system is organized and financed. Generally, countries where health insurance is the predominant mode of financing the health system spend much more on health than those primarily financed through tax revenues from the government. A study by Wagstaff (2009) examined the transition from tax-financed to social health insurance (SHI) in the OECD countries over the period 1960-2006 to assess among other things, the effect of introducing SHI on per capita health spending. The results show that introducing SHI increases per capita health spending by 3-4 percent and has no significant impact on amenable mortality (Wagstaff, 2009). A study by Morgan and others (2022) corroborates these findings by concluding that the United States spends much more on health than other high-income countries because of the complex financing and organizational structure of health care provision in the United States. About 50% of the health care funding in the United States is from private health insurance while most of the health systems in other developed countries are mainly financed by the governments through general tax revenues and/or government-financed health insurance schemes (Morgan et al. 2022). Furthermore, certain provider payment mechanisms such as fee-for-service can lead to over-provision of services, and thereby increase health care expenditures. Li and others (2022) used a controlled laboratory experiment to study how 210 physicians provided medical services for different patient types under fee-for-service, diagnosis-related-groups, and mixed payment systems. The results show over-provision and under-provision of services under fee-for-service and diagnosis-related-groups payment schemes, respectively. For mixed payment schemes which combined fee-for-service and diagnosis-related-groups payment schemes, over-provision and under-provision of services decreased (Li et al. 2022).

The other interrelated factors that can influence growth in health expenditures are: (i) Political and institutional structures, and (ii) Global influences. Given that resource allocation requires the distribution of scarce resources between sectors and geographical locations within a country, financing is a political matter. As such, Hanson and others (2022) observe that financing is political and requires competent political leadership and long-term commitments far beyond technical considerations. Therefore, the political party in power, health policies that are implemented, and the degree of government involvement in the stewardship of the health system can determine the levels of public expenditures and health care benefits coverage

(Navarro and Shi, 2001). A review of political regimes in developed countries shows that social democratic countries (Sweden, Norway, Denmark, Finland, and Austria) had the largest public expenditures on health care during the period 1960-1990, followed by the Christian democratic countries (Belgium, Netherlands, Germany, France, Italy, Switzerland) (Navarro and Shi, 2001). Consequently, political economy considerations are important determinants of growth in health care expenditure. For example, a country's commitment to global and regional aspirations on spending on health such as the SDGs, international standards on quality of health care, medicines and medical commodities, and human resources for health (HRH) staffing norms can influence the country's overall expenditure on health. For instance, the Global Health 2035 report by the Commission on Investing in Health (CIH) outlines an ambitious roadmap for achieving improvements in health in LLMICs in 20 years through enhanced health sector investments (Kruk et al. 2016; Jamison et al. 2013). This would cost around US$70 billion annually, which is far above the current health spending in LLMICs (US$25 billion per year in LICs and US$45 billion per year in LMICs) (Jamison et al. 2013). The expectation is that the additional funds will be mobilized from domestic and external sources, but this seems like an impossible task.

The theoretical foundation of research on the *demand-side determinants of health care expenditure* is rooted in the demand function for health as provided in Grossman's theory on demand for health (Grossman, 1972). According to Grossman (1972), individuals do not derive utility directly from health care, but from "good health." He explains that when patients purchase medical services, they do not necessarily purchase the services or health care but "good health." Grossman treats "good health" as a durable item (or capital stock) which is demanded by consumers for two reasons: (i) as a form of human capital or investment commodity that enables individuals to be more productive including earning incomes; and (ii) as a consumption commodity that is used by individuals to derive utility from their preferences including leisure (Grossman, 1972). The level of health of an individual also depends on the resources allocated to its production, and this includes: time, medical care, diet, exercise, housing, and education. It is also assumed that the initial stock of health that an individual has depreciates overtime, but it can be increased through investments in more health (ibid). The importance of Grossman's theory is that it enables policy makers to analyse the impact of policy shifts on the demand for health, and how these lead to demand for health care and growth in health care expenditures. This is extremely important because economists have focused on the demand for medical care at the expense of the demand for health (Grossman, 1972).

Wagstaff (1993) proposes an alternative formulation of Grossman's theoretical model which he then applied empirically. The results from the new formulation are consistent with the predictions of Grossman's theoretical model.

As previously presented, individuals and nations tend to respond to rising incomes by demanding more health care services and this is one of the major reasons for the growth in health spending. In this respect, Grossman's theory takes centre-stage because the demand for health services is derived from the demand for health (Grossman, 1972). The interpretation of this is that an increase in income at individual level can lead to increased aggregate demand and consumption of health care at national level as individuals seek to maintain their health stock. This eventually leads to an aggregate increase in total health spending. This is possible because the income elasticity of health spending is positive and less than one (Fan and Savedoff, 2014). This view is supported by Fogel (2008) who observes that people tend to place higher value on health and want to spend a larger share of their income on improving their health when they become richer. These results are corroborated by Fan and Savedoff (2014) and Gbesemete and Gerdtham (1992). Therefore, there is consensus that individuals and countries respond to rising income by demanding more health care services. Despite worldwide approval of Grossman's theory by economists, some scholars like Zweifel (2012) criticizes the theory because it assumes "a fixed ratio between individuals health care expenditure and the cost of their own health-enhancing efforts regardless of their state of health." However, a follow-up review by Laporte (2014) concludes that the criticisms levelled at Grossman's theory do not suggest that there is a fundamental flaw in the theoretical structure of the model.

The other demand-side drivers of health care expenditure are demographic factors which include the size and age-structure of the population (De la Maisonneuve and Martins, 2013a). The underlying argument on demographic drivers of health care expenditures centre on the "healthy ageing" hypothesis which is described by Beard and others (2016) as "the process of developing and maintaining the functional ability that enables wellbeing in older age." Therefore, with regards to size, a growing population is expected to lead to a rise in total health care expenditure because there would be an increase in the number of people demanding and utilising health care services (Keegan et al. 2020). On the other hand, in line with the "healthy ageing" hypothesis, the age-structure of a nation's population affects health care expenditure because the demand and consumption of health services are expected to increase when people get older (De la Maisonneuve and Martins, 2013a). This is underscored by Lindberg and McCarthy (2021) who describe additional health care expenditures associated with a growing and ageing population as demographic-cost pressures. The “healthy ageing” hypothesis was tested by Yang and others (2003) in the USA by looking at health care expenditure data covering the period 1992–1998 grouped by age and time-to-death for 25,994 elderly persons. They concluded that time-to-death and aging were associated with high inpatient and long-term care expenditures, respectively. And while a study by Seshamani and Gray (2004) reveals that both proximity to death and ageing had a significant effect on health care expenditure, they concluded that ageing had a much smaller effect than proximity to death. However, a study by Colombier and Weber (2011) refutes these results and concludes that population ageing rather than proximity to death was the most important driver of health care expenditure.

Closely related to the demographic drivers of health care expenditure is the increasing demand for health care due to an increasing burden of disease. Countries with a higher burden of disease and/or those that are vulnerable to disease outbreaks spend more on the provision of health care services and this leads to high health expenditures. For example, the burden of chronic diseases in the USA affects about 50% of the population and 86% of the health care expenditures are on chronic diseases (Holman, 2020). Prince and others (2015) also reveal that globally, the disorders in elderly people aged 60 years and above, presents disabilities which require long-term care whose cost is much higher than the available health funding. The epidemiological transition, which refers to the change in disease profiles (Gribble and Preston, 1993), has increased the disease burden, and consequently, countries have been finding it hard to provide an expanded range of quality health care services for existing diseases and tackle the rising prevalence of non-communicable diseases (Savedoff et al. 2012).

In developing countries, the epidemiological transition started some time back and has been straining the financial position of the health systems in developing countries (Gribble and Preston, 1993). For instance, changes in the disease burden in Brazil had led to an increase in the public budget on curative care as a share of the total public budget on health from 36% in 1965 to 85% in 1980. Furthermore, Kruk and others (2018) observe that as the burden of disease shifts to complex conditions, quality of care will become a significant driver of population health. The underlying drivers of the growth in health care expenditures are: (i) consumer preferences among the educated and informed segments of the population who demand for quality health care services (Cetină et al. 2009); and (ii) market imperfections and information asymmetry in the health care market (Arrow, 1963).

1.3.3 Approaches for analysing historical growth in health expenditure

The main techniques for analysing supply- and demand-side factors associated with past growth in health expenditure are either cross-sectional or time dimensional. The choice of using a cross-sectional or time dimensional analysis mainly depends on two things: (i) the available data (cross-sectional, time-series, or panel/longitudinal), and (ii) the required scope of the analysis. Wooldridge and others (2017) define a cross-sectional data set as one that has observations on a variable or variables taken at a single point in time while a time-series data set has observations on a variable or variables over time. Considering that cross-sectional studies only allow for single point in time analyses, dynamic changes over time are not captured and this can make it difficult to interpret the associations and direction of associations (Setia, 2016). Subsequently, time-series and panel data analytical techniques are better than cross-sectional analyses (Angko, 2013; Xu et al. 2011) because they allow for a dynamic review of the relationships across the variables of interest. Using stochastic time series models, Lee and Miller (2002) examined the growth in health expenditures in the United States of America's medicare system with a focus on historical variations in fertility, mortality, and per capita health spending. The outputs were then used to generate stochastic simulations of the growth of medicare expenditures (Lee and Miller, 2002).

A panel dataset combines both cross-sectional and time-series dimensions by having a series of observations and entities over multiple periods of time (Baltagi, 2021; Wooldridge et al. 2017). Over the past decade, there has been a preference for panel data models because they can account for "unobserved heterogeneity, temporal persistence, and cross-section dependence" (Baltagi et al. 2017). Furthermore, panel data models are suitable for studying the dynamics of adjustment that are not possible in cross-sectional and time-series data (Baltagi, 2021). Panel data models are also superior to cross-section models even if cross-sections are repeated (Xu et al. 2011). Subsequently, most of the recent studies that have been conducted in high-income countries on the determinants of health expenditures have used panel techniques (Fan and Savedoff, 2014; Xu et al. 2011; van Elk et al. 2009; Hosoya, 2014). Albouy et al. (2010) use panel data to estimate outpatient expenditures; and they conclude that "panel models highly improve descriptions of the correlation of dependent variables in the-times series dimension without damaging the distributions in the cross-sections." However, even when panel data is used, there can be differences in the results when linear panel regression models are used rather than quantile regression models (Tian et al. 2018; Wang, 2011).

The research objective, scope of the analysis, and availability of data are critical to determining a suitable analytical model for examining historical growth in health expenditure. An econometric model describing the relationship of the variables in the data is then constructed by using mathematical equations (Baltagi, 2021). According to Gerdtham and Jonsson (2000) the first generation of studies on the growth in health expenditure based their arguments on the standard demand theory, and used cross-section bivariate regression analyses to examine the relationship between per capita health expenditure and per capita GDP. This was pioneered through the works of Newhouse (1977) who concluded that health care is a luxury good and that its demand is related more to caring than to curing. These finding are corroborated by Gerdtham and Jönsson (1991) and Culyer (1988). Leu (1986) went further by attempting to address the potential bias in the income coefficient due to omitted variables in the bivariate regression analyses by using a cross-section multivariate regression model to analyse 1974 health expenditure data for 19 OECD countries. The study included variables on income, age, urbanisation, time and travel, public sector provision of health services, national health service, and democracy. The study concludes that income had the most significant effect on health expenditures (Leu, 1986). However, Gerdtham and Jönsson (1991) tried to replicate the findings by Leu (1986) but could not do so.

The second generation of studies on growth in health expenditure use panel-data regression techniques to analyse several variables (Gerdtham and Jonsson, 2000; Wang, 2011; Albouy et al. 2010; Tian et al. 2018). Results from panel data analysis can only be valid if data covering an extended period of time is used because a large dataset reduces co-linearity among the explanatory variables and increases the precision (Bhat and Jain, 2004). Therefore, when undertaking panel data analysis, tests for cross-sectional dependence, unit roots, and autocorrelation are conducted to get better estimates (Angko, 2013; Fan and Savedoff, 2014; Hosoya, 2014; van Elk et al. 2009). Within a country, analysing determinants of health care expenditures at sub-national level can provide deeper insights on the relationship between health care expenditures and their determinants (Bhat and Jain, 2004). Further, in order to satisfy the assumption that demand and consumption of health care at individual level is linked to growth in total health spending at national level, some studies have added analyses of income elasticity of health care expenditure (Baltagi et al. 2017; Bhat and Jain, 2004). The results from these analyses have enhanced interpretation of the observed trends. In this regard, per capita health care expenditure is assumed to be a function of per capita GDP (Bhat and Jain, 2004). The results on income elasticity of health care expenditure from multi-country studies often show that the size of the income elasticity is associated with the income status of a nation—with poorer countries having higher elasticity (Baltagi et al. 2017). Lastly, for panel-data regression techniques, Gluzmann and Panigo (2015) have developed an automatic model-selection technique for cross-section, time-series, and panel-data regressions. The algorithm in the model (gsreg) is said to avoid path-dependency of standard approaches, and is able to: (i) guarantee optimality with out-of-sample selection criteria; (ii) allow residual testing for each alternative; and (iii) provide a full-information dataset with outcome statistics for every alternative model (Gluzmann and Panigo, 2015).

The third generation of studies on growth in health expenditure go beyond understanding the relationships between health expenditure and its determinants by adding decomposition analyses which breaks down the growth in expenditure by components to account for changes in the distribution and impact of the characteristics on expenditures (Rice and Aragon, 2018). Alcalde-Unzu and others (2009) use an extended version of Theil's decomposition method to examine the sources of the differences in per capita health-care expenditure in 21 OECD countries over the period 1975-2003. The results revealed that health care spending as a share of GDP and labour productivity were the main determinants of the differences in per capita health care expenditure across the countries. Dormont and others (2006) use a modified version of the Oaxaca-Blinder decomposition method (Oaxaca, 1973; Blinder, 1973) to decompose the growth in health care expenditure in France over the period 1992–2000. They concluded that changes in practices for a given morbidity (as measured by the coefficients that quantify the impact of morbidity on health care utilization) had a greater impact on growth in health care expenditure than ageing. These results are corroborated by Rice and Aragon (2018) who used a similar methodology to analyse the growth in expenditure in hospitals in the United Kingdom over the period 2007/08 to 2014/15. They concluded that structural changes in the distribution of characteristics were the major causes of the growth in expenditure.

The two studies highlighted above (Dormont et al. 2006; Rice and Aragon, 2018) analysed the average changes in the growth in health care expenditure and not the marginal changes in the entire distribution. This gap is addressed by de Meijer and others (2013) who used counterfactual decomposition (distributional regression) to analyse the growth in hospital expenditure in the Netherlands over the period 1998-2004. They concluded that the 'growth rate of hospital expenditures is greatest at the middle of the distribution and is driven by changes in the distributions of determinants'(de Meijer et al. 2013). However, using the same method, a study on growth in hospital expenditure in the United Kingdom over the period 2007/08 to 2014/15 by Rice and Aragon (2018) shows slightly different results. The study observed the largest increases in the growth rate in expenditure in hospitals at the top of the distribution, and a decreasing rate in expenditure at the bottom two quintiles of the distribution.

Recent studies on growth in health care expenditures have advocated for more information on disease treatment such as changes in disease prevalence, prices of health services, costs of treatment, and service utilization (Berndt et al. 2000; Dunn et al. 2018). Analysing these factors can provide a comprehension understanding of the growth in health care expenditure, and how to contain the growth and/or associated costs (Dunn et al. 2018). To fill this gap, Dunn and others (2018) assess the sources of growth in medical care expenditure in the USA by decomposing 2003-2007 medical care expenditure data into: prices of the service, service utilization, prevalence-of-treated-disease, and demographic shifts. They conclude that growth in the prices of the services and prevalence of treated diseases were the main contributors to the increase in the growth in medical care expenditure. Zhai and others (2017) used Das Gupta's decomposition method to breakdown the growth in health expenditure in China over the period 1993-2012. They concluded that expenditure per prevalent case was the main driver of the growth in health expenditure in China. This analysis was repeated by Zhai and others (2020) who made the same conclusion. A study by Stucki and others (2023) also uses Das Gupta's decomposition method to analyse the main drivers of health care spending in Switzerland between 2012 and 2017. They conclude that the growth in health care spending in Switzerland was mainly due to increases in spending per patient with the underlying cause being an increase in the intensity of treatment.

In summary, the third generation of studies on growth in health care expenditure use decomposition analyses to determine the magnitude of change in the determinants of health care expenditures (for both variables and covariates); and to deduce whether the contribution of the change across the distribution is constant (or not) (de Meijer et al. 2013). Secondly, adding data on changes in disease prevalence, prices of health services, costs of treatment, and service utilization can enrich the analysis and help to identify measures to contain the rising expenditures (Dunn et al. 2018).

1.3.4 Models for projecting future spending on health and their application

There are three main approaches for forecasting health expenditures. There are: (i) Micro-simulation models, (ii) Component-based models, and (iii) Macro-level (Astolfi et al. 2012a; Astolfi et al. 2012b; Marino et al. 2017). The main differences across the three models are: (i) level of aggregation of the units of analysis i.e. individual, groups of individuals, or population as a whole; (ii) level of aggregation of health expenditure to be projected (i.e. individual, disease-specific, private, public or total expenditure); and (iii) time horizon (short, medium, or long-term focus) (Astolfi et al. 2012a).

Micro-simulation models use individuals as units of analysis to produce characteristics of the population of interest (Astolfi et al. 2012b). For a micro-simulation model to be representative of the population, large amounts of data are required to assemble it. In component-based models, individuals and/or segments of health expenditure are grouped by key characteristics (Astolfi et al. 2012a). The construct of the groups in component-based models can take any form depending on the research interests. For instance, a component-based model analysing the growth in health expenditure could contain information on health spending broken down by major spending categories, sex, age, geographical region, race, disease prevalence, financing agents, health providers, utilisation of health services, etc (Astolfi et al. 2012b). In macro-level models, the population is used as the unit of analysis to examine aggregate or total health expenditure (Astolfi et al. 2012a; Marino et al. 2017).

With regards to use, micro-level models have an advantage of being able to accommodate detailed information on behaviours at the individual level. However, they are data-intensive and incorporation of health system characteristics, provision of health care services, and the broader economic environment in micro-level model can be difficult (Marino et al. 2017). Using micro-level modelling, Glassman and Zoloa (2014) projected long-term health spending patterns in Brazil, Chile, and Mexico. Compared to micro-level models, component-based models are less complex and less data-intensive, and their implementation and maintenance are generally simpler and more cost-effective. For this reason, most of the studies on fiscal sustainability that have been conducted in OECD countries use component-based modelling approaches (Angelis et al. 2017; De la Maisonneuve and Martins, 2013a; Astolfi et al. 2012b).

Astolfi and others (2012a) conclude that component-based models are widely used to project health expenditure because they can incorporate most of the key drivers of health expenditure, and that they can be integrated with other models on social security spending. Marino and others (2017) add that component-based models can be used to analyse the impact of policy changes. For macro-level models, they require the least amount of data and are relatively easy to design and implement. However, they are mostly appropriate for short-term projections (Astolfi et al. 2012a; Glassman and Zoloa, 2014). If there are breaks in the time-series or trend, and other structural breaks; macro-level models are not suitable (Marino et al. 2017).

Notwithstanding the above, forecasting has some inherent limitations. Relying on past trends in economic and non-economic variables to predict the future could be spurious if historical patterns do not persist in the future (Zhao, 2015). It is not certain that things will remain the same or change, and even when change is predicted, there are doubts on when or how the change will occur (National Research Council, 2010). Further, projection models do not capture "unknown uncertainty"[3] into the resulting estimates (Clements and Hendry, 2011). Astolfi and others (2012a) are also of the view that none of the three models can be considered superior to the others as the policy question to be answered dictates the model to use. Furthermore, the amount of time, resources, and data available to design and apply the model are also key. Therefore, the starting point should be formulation of the policy question; reviewing the available resources, time, and data; understanding and measuring drivers of health expenditure growth; selecting the appropriate forecasting model; and modelling.

1.4. Empirical evidence from studies on growth in health expenditure in Africa

1.4.1 Studies on determinants of growth in health expenditures in Africa

Several studies have examined the determinants of health expenditures in high-income countries but such studies are rare in LLMICs, particularly in SSA and Africa. An extensive review of the existing literature showed a growing and but small number of studies on the determinants of health expenditures in Africa. A total of 21 studies on income and non-income determinants of growth in health expenditure in Africa were reviewed (Angko, 2013; Gbesemete and Gerdtham, 1992; Lu et al. 2010; Okunade, 2005; Olaniyan et al. 2013; Rono, 2013; Farag et al. 2012; Baltagi et al. 2017; Murthy and Okunade, 2009; Bakare and Olubokun, 2011; Kouassi et al. 2018; Modibbo and Saidu, 2020; Khadaroo and Jaunky, 2008; Sinha, 2021;

[3] Unknown uncertainty refers to things beyond human cognition or which have not yet been discovered, and hence cannot be incorporated into the projection model.

Udeorah et al. 2018; Yusufu et al. 2022; Aboubacar and Xu, 2017; Lv and Zhu, 2014; Micah et al. 2019; Odhiambo, 2021; Tandon et al. 2018).

Most of the studies conclude that growth in health care expenditure in Africa is associated with a rise in a country's income (expressed in GDP per capita); and that the income elasticity of total health expenditure is less than one (Angko, 2013; Gbesemete and Gerdtham, 1992; Okunade, 2005; Olaniyan et al. 2013; Farag et al. 2012; Baltagi et al. 2017; Murthy and Okunade, 2009; Kouassi et al. 2018; Sinha, 2021; Aboubacar and Xu, 2017; Lv and Zhu, 2014; Micah et al. 2019). This means that health care is a necessity in Africa. However, two studies (Khadaroo and Jaunky, 2008; Tandon et al. 2018) found an income elasticity of public expenditure on health of more than one which suggests that health care is a luxury good. The high figure in the study by Tandon and others (2018) could be because a mathematical method (Das Gupta's decomposition method), rather than regression analysis, was used in the analysis. As such, quality checks for non-stationarity, serial correlation, cross-section dependence, and heteroskedasticity were not done.

While all the studies concluded that the relationship between health expenditure and economic growth was bi-directional, Odhiambo (2021) found an unidirectional causality between health expenditure and economic growth that was dependant on the source of health expenditure (public or private) and level of economic development of each country in SSA. Further, a study by Udeorah and others (2018) revealed that expenditure on education rather than on health care had a positive impact on economic growth in Nigeria. Other than economic growth, some studies have established that the other determinants of growth in health expenditure are: external/foreign aid (Gbesemete and Gerdtham, 1992; Micah et al. 2019; Modibbo and Saidu, 2020; Murthy and Okunade, 2009); private health expenditure and share of the working population (Olaniyan et al. 2013); foreign direct investment and gross domestic savings (Aboubacar and Xu, 2017); and government spending as a share of GDP, and tax revenue as a share of GDP (Micah et al. 2019).

In contrast, some studies have found an inverse relationship between growth in health expenditure and external/foreign aid (Rono, 2013; Lu et al. 2010); and an inverse relationship between income inequity and health care spending (Okunade, 2005). The negative relationship between total health expenditure and external financing is because African governments tend to reduce domestic funding for health when there is an increase in external funding (Rono, 2013). These results are consistent with evidence from Xu and others (2011) which show that an increase in external resources for health is associated with reduced government spending on health in LLMICs. Meanwhile, the negative relationship is not statistically significant in lower-middle income countries (LMICs) when a dynamic model is used (Xu et al. 2011). Meanwhile, the negative relationship between income inequity and health care spending could be due to forgone health care for poor and vulnerable households.

Other than income, growth in total health expenditure in LLMICs can be explained by non-income factors such as the share of the population over 60 years, prevalence of tuberculosis, and time (Xu et al. 2011). In Africa, several demographic and health factors have been found to be positively associated with growth in health expenditures. These are: population growth (Modibbo and Saidu, 2020), share of the population aged more than 15 (Okunade, 2005), share of the population aged more than 65 (Farag et al. 2012), overall population age structure (Rono, 2013), ratio of the dependant population (Micah et al. 2019; Aboubacar and Xu, 2017), population health status (Angko, 2013), and life expectancy at birth (Olaniyan et al. 2013).

In some studies, contrasting results have been found whereby some of the demographic and health factors highlighted above are negatively associated with growth in health expenditures in Africa. These are: share of the population aged less than 15 and more than 65 (Angko, 2013), ratio of the dependant population (Olaniyan et al. 2013), infant mortality rate per 1,000 live births (Lv and Zhu, 2014), and life expectancy at birth (Yusufu et al. 2022). The other non-income factors that are positively associated with growth in health expenditures in Africa are: internal conflicts or heightened military spending (Okunade, 2005), technological progress (Rono, 2013), percentage of births attended by health staff (Gbesemete and Gerdtham, 1992), and country-specific characteristics and good governance in the public sector (Micah et al. 2019). A study in Kenya shows that population age structure has a positive impact on health care expenditure (Rono, 2013) while in Ghana the population age structure (has a negative impact on health care expenditure (Angko, 2013). However, these differences could be attributed to how the 'age structure' is captured in the two studies. For example, while Angko (2013) uses the proportion of the population below 15 years and above 65 years, the age structure that was used by Rono (2013) is not clear.

1.4.2 Methods used to analyse the growth in total health expenditure in Africa

In sub-section 1.3.3, it was established that panel data analytical models are ideal for the analysis of determinants of health expenditures (Baltagi et al. 2017). In Africa, earlier studies on the determinants of health care expenditure used cross-sectional techniques (Okunade, 2005; Gbesemete and Gerdtham, 1992; Murthy and Okunade, 2009) with latter studies adopting time-series analysis (Bakare and Olubokun, 2011; Angko, 2013; Rono, 2013; Udeorah et al. 2018; Sinha, 2021) and panel data analytical methods (Khadaroo and Jaunky, 2008; Lu et al. 2010; Farag et al. 2012; Olaniyan et al. 2013; Lv and Zhu, 2014; Aboubacar and Xu, 2017; Baltagi et al. 2017; Kouassi et al. 2018; Micah et al. 2019; Modibbo and Saidu, 2020; Odhiambo, 2021; Yusufu et al. 2022).

Secondly, while decomposition analyses are critical to examining the magnitude of change in the determinants of health care expenditures (de Meijer et al. 2013); there are only two studies that have used this technique in Africa (Tandon et al. 2018; Micah et al. 2019). The study by Micah and others (2019) used panel-regression analysis and the Shapley decomposition method to assess: (i) factors associated with growth in government health spending, and (ii) to quantify the size of the change in each of the main determinants of growth in government health spending over time. Panel data covering the period 1995-2015 from 46 countries in SSA was used to undertake the study. The results shows that growth in government health spending was positively associated with national income (GDP per capita), good governance (perception on corruption), and government spending as a share of GDP. The results from the decomposition analysis revealed that country-specific characteristics explained 41.4% of the variations in government health spending followed by national income 28.8%, dependency ratio 9.4%, government spending as a share of GDP and tax revenue as a share of GDP 9.0%, good governance in the public sector 8.4%, and development assistance for health 2.2% (Micah et al. 2019).

The study by Tandon and others (2018) uses Das Gupta's decomposition method to analyse the proportion of the change that each factor associated with growth in public spending on health accounts for by decomposing panel data from 151 countries globally over the period 2000 to 2015. Their premise was that growth in public financing for health overtime can be examined by looking at: (i) changes in macro-fiscal factors (economic growth [GDP per capita], total public spending as a share of GDP, and health's share in total public spending [prioritization of health]); and (ii) changes in the composition of three sources of health financing (on-budget external financing for health, SHI, and domestic government revenue) (Tandon et al. 2018). The results show that in SSA, growth in government health spending was driven by economic growth which accounted for 46% of the increase in public spending on health, followed by government domestic spending on health at 31%, and reprioritization at 21% (Tandon et al. 2018). With regards to the financing sources, the study shows that in SSA, increase in domestic government revenue was the largest contributor to the increase in public spending on health at 56%, followed by on-budget external financing at 40%, and SHI at 4% (Tandon et al. 2018). The study by Tandon and others (2018) differs in approach from the study by Micah and others (2019) because it only focuses on income factors associated with public spending on health. Secondly, two of the three macro-fiscal factors which were used in the model by Tandon and others (2018) (public spending on health and prioritization of health) are very closely related and this can lead to invalid results.

In other areas of health financing, some studies in Africa that have used decomposition analysis applied it on catastrophic health expenditure (Njagi et al. 2020; Edoka et al. 2017; Edeh, 2022; Mulaga et al. 2022; Setshegetso, 2020) and not on overall health care expenditure or health financing sources. In other words, these studies focus on equity because they seek to identify and quantify the factors associated with catastrophic health expenditures. For example, Njagi and others (2020) use an Oaxaca-type decomposition method proposed by Wagstaff and colleagues (Wagstaff et al. 1991; Owen et al. 2007) to examine changes in inequalities in catastrophic health care expenditure in Kenya between 2007 and 2013. Edeh (2022) uses the same method to assess factors associated with catastrophic health care expenditure in Nigeria over the period 2010/2011 to 2015/2016. The same decomposition method is used by (Mulaga et al. 2022) who looked at socio-economic inequalities in catastrophic health expenditures in Malawi using data from the 2016/2017 national household survey. Meanwhile, Edoka and others (2017) uses 2003 and 2011 household survey data to assess changes in catastrophic health expenditure in Sierra Leone by using the Oaxaca-Blinder decomposition method. A study on equity in out-of-pocket health payments in South Africa over the period 1995 to 2010/11 also uses the Oaxaca-Blinder decomposition method (Setshegetso, 2020).

Lastly, some scholars (Berndt et al. 2000; Dunn et al. 2018) have called for the inclusion of data on disease prevalence, prices of health services, costs of treatment, and service utilization when analysing the growth in total health expenditure. This data is important in obtaining a comprehensive understanding of the growth in health care expenditure overtime. After a comprehensive literature review, I observed that no study in Africa has looked at how these changes affects the growth in total health expenditure.

1.4.3 Studies on fiscal sustainability of health systems in Africa

Based on the available literature, South Africa is the only country in SSA where a fiscal sustainability of the health system has been conducted. This was part of a study that was undertaken by De la Maisonneuve and Martins (2013b) to determine historical and future projections of public spending on health and long-term care for OECD and BRIICS[4] countries. The study showed that between 1995 and 2009, the annual average change in the real per capita public spending on health (US$PPP 2005) in South Africa was 3.1% of which 1.6 percentage points was due to income, 1.2 percentage points as a result of residual growth, and 0.4 percentage points because of demographic factors (ibid). This means that income was the main driver of the growth in public expenditure on health in South Africa over the period 1995-2009. Using these results, De la Maisonneuve and Martins (2013b) then looked at the future sustainability of the health system in South Africa by projecting the total spending on health and long-term care over a period of 50 years (2010-2060) by using two scenarios: cost-pressure (business-as-usual) and cost-containment.

The results show that under the cost-pressure scenario, total spending on health and long-term care in South Africa will increase from 3.4% of the GDP on average over the period 2006-2010 to 9.2% of the GDP in 2060. However, if cost-containment measures implemented, total spending on health and long-term care in South Africa will only increase from 3.4% of the GDP on average over the period 2006-2010 to 5.1% of the GDP in 2060 (De la Maisonneuve and Martins, 2013b). These results convey a clear message that even if cost-containment measures are implemented, there will be a growth in public spending on health and long-term care in South Africa. Therefore, the government of South Africa needs to increase funding to the health sector while also implementing the cost-containment measures. The good thing though is that they can use the results from the fiscal sustainability analysis to implement cost-containment measures. In this regard, assessment of the fiscal sustainability of a health system is very important.

[4] Brazil, Russia, India, Indonesia, China and South Africa

While interest in financial sustainability has been increasing, the studies that have conducted in SSA have only examined the determinants of growth in health expenditure (see above); areas for increasing fiscal space for health (Chipunza and Nhamo, 2023; Barroy et al. 2016; Doherty et al. 2018; Tandon and Cashin, 2010; Okwero et al. 2010; World Bank, 2017b; Asamani et al. 2022); and financial sustainability of HIV/AIDS programmes (Blecher et al. 2016; David, 2009; Remme et al. 2016), immunization programmes (McQuestion et al. 2011; Griffiths et al. 2016; Saxenian et al. 2024), and mother and child health programmes (Atim et al. 2020). While these studies are within the realm of fiscal sustainability for health system analyses, they are only part of the full spectra of what is required to fully understand if a health system is financially sustainable. In Zambia, there is no comprehensive study on fiscal sustainability of the health system. The only available studies looked at the fiscal sustainability of the HIV/AIDS programme (Fagan and Zeng, 2015) and the immunization programme (Government of Zambia, 2004; Griffiths et al. 2016); and not fiscal sustainability of the entire health system. Lack of studies on fiscal sustainability of the health system in Zambia and other SSA countries could be attributed to the lack of an appropriate analytical framework.

1.5. Research gaps and justification for the study

1.5.1 Research gaps

Motivated by knowledge and methodological gaps in the existing literature, this study has: (i) assessed the main drivers of changes in total and public expenditure on health in Zambia by looking at macro-fiscal factors and funding sources, demographic and health factors at national level; and the main determinants of government health expenditure at sub-national (provincial) level; (ii) devised a framework for analysing fiscal sustainability of health systems in LLMICs; and (iii) applied the framework by looking at the fiscal sustainability of the health system in Zambia. The study also addresses knowledge gaps on the use of decomposition methods to quantify changes in health expenditures at national and sub-national levels.

Firstly, despite the critical importance of fiscal sustainability analysis of health systems in determining the longevity of financing of health systems, programme implementation, futuristic planning, and achievement of better health outcomes; there is a dearth of research on the subject-matter. Most of the available evidence on fiscal sustainability analysis of health systems have been undertaken in OECD countries (Kibasi et al. 2012; OECD, 2015; Marino et al. 2017; Lorenzoni et al. 2019; Lorenzoni et al. 2023; Rebba, 2014); and only one study in

South Africa (De la Maisonneuve and Martins, 2013b)—an upper middle-income country in SSA. Fiscal sustainability analysis is critical for LLMICs in Africa as it can enable countries to identify factors driving growth in past health expenditures, to develop efficiency-enhancing measures to reduce costs, to quantify the short- to long-term expenditure commitments to achieve UHC, and to match the required spending with the available and/or projected funding. In the case of Zambia and other LLMICs in SSA, there has been no comprehensive study on fiscal sustainability analysis of health systems.

Secondly, while several studies in Africa have attempted to fulfil one of the requirements for a fiscal sustainability for health analysis by investigating the determinants of health spending; they have not used decomposition methods to analyse the growth in health expenditures. To quantify the magnitude of the change in the determinants of health care expenditures, and whether the change across the distribution is constant (or not); de Meijer and others (2013) have recommended the use of decomposition methods when analysing the growth in health expenditures. In SSA, only two studies (Tandon et al. 2018; Micah et al. 2019) have used decomposition methods. However, these studies were based on international comparison of several countries and not for a specific country and/or across the sub-regions within a country. *This study filled this knowledge gap by: (a) decomposing public expenditure on health by macro-fiscal factors and funding sources, (b) decomposing total health expenditure by key demographic factors and nine major diseases, (c) applying panel regression to determine the main determinants of government health expenditure at sub-national (provincial) level in Zambia, and (d) decomposing government health expenditure at provincial level in Zambia to quantify the magnitude of change.* These analyses have never been done before in Africa.

Thirdly, there is a paucity of studies on fiscal sustainability of the health systems in SSA. This can be attributed to: (i) inadequate understanding of the subject matter, and (ii) lack of an appropriate analytical framework. The thinking of most policy makers, program managers, and researchers is that fiscal sustainability of the health system can be achieved by expanding fiscal space for health. As such, most studies on fiscal sustainability of health systems in LLMICs have been piecemeal in that they have mainly focused on analysing economic or income-related determinants of total health expenditures; and exploring potential areas for increasing fiscal space for health. Some of the studies have looked at program-specific financial sustainability analyses on HIV/AIDS, immunization, and mother and child health programmes and not at system level. I postulate that fiscal sustainability of a health system is a combination of several activities that must be implemented consistently to achieve financial sustainability. This includes diagnosis of the health system by looking at past determinants of health, scenario planning, and implementation of mitigation strategies.

The activities can be conceived in detail in an analytical framework which countries in SSA could use to undertake a comprehensive short- to long-term fiscal sustainability assessment of their health systems. However, there is no suitable framework for analysing fiscal sustainability of health systems in LLMICs. The existing fiscal sustainability framework that has been applied in OECD countries is insufficient to meet the needs of LLMICs. This is due to differences in the modalities of health financing and service provision in countries at different levels of development; and this requires development of delivery models that are context-specific (Hsiao, 2017). For example, certain factors such as the high disease burdens, high public debt, external financing, and out-of-pocket spending on health may be relevant to LLMICs and not OECD countries. *To address this methodological gap, this study adapted an analytical framework for fiscal sustainability of health system in LLMICs. Further, the framework was applied in Zambia by looking at the fiscal sustainability of the health system.*

1.5.2 Research question

This study sought to answer the following research question: To what extent is the Zambian health system financially sustainable?

<u>Specific objectives</u>

(i) To assess the main drivers of the changes in total and public expenditure on health in Zambia
(ii) To assess the fiscal sustainability of the health system in Zambia

The objectives of the study were broken down into specific tasks as provided in Table 1 below.

Table 1: Specific Objectives and Tasks

Specific Objectives	Tasks
1. To assess the main drivers of the growth in total and public expenditure on health	Task 1: Decompose public expenditure on health by macro-fiscal factors and funding sources
	Task 2: Decompose total health expenditure by key demographic and health factors in Zambia
	Task 3: Assess the main determinants of government health expenditure at sub-national (provincial) level in Zambia, and decomposition of the main determinants
2. To assess the fiscal sustainability of the health system in Zambia	Task 4: Adapt an analytical framework for fiscal sustainability analysis of health systems in LLMICs
	Task 5: Conduct a fiscal sustainability analysis of the health system in Zambia.

2. METHODS AND MATERIALS

Presented in this chapter are the methods and materials employed in the study. Section 2.1 describes the study location and context, while section 2.2 describes the conceptual framework for the study. Based on existing theories and empirical studies on fiscal sustainability of health systems, a conceptual framework was developed to provide an understanding of fiscal sustainability of health systems in LLMICs. Existing theories and empirical studies on the topic guided the development of the conceptual framework. Detailed explanations of the data, variables, analytical approach, and empirical analyses which were used to answer the two research questions are provided in sections 2.3 and 2.4. Finally, section 2.5 provides information on the ethical clearances and authorisations that were obtained prior to conducting the study.

2.1. Study location and context

Zambia is a landlocked country located in Southern Africa neighbouring eight countries namely: Angola, Democratic Republic of Congo, Botswana, Malawi, Mozambique, Namibia, Tanzania, and Zimbabwe. Zambia has a total surface area of about 752,612 square kilometres and is administered through 10 provinces and 116 districts (Zambia Statistics Agency, 2022) (Figure 1). Zambia's population was estimated at 19.6 million in 2022 with 60% the population residing in rural areas and 51% female. The population has been growing at a fast pace, rising from 4.1 million in 1969 to 19.6 million in 2022—almost a fourfold (383%) increase (ibid). Over the period 2010-2022, the population grew at an average annual rate of 3.4% which is higher than the annual average growth rate of 2.8% over the period 2000-2010 (Zambia Statistics Agency, 2022). In terms of demographic structure, half of Zambia's population is below 17 years old. This population is expected to grow further in the future as cohorts of youths enter reproductive age. Notwithstanding the growing population, relative to its vast land area, Zambia's population is still low. Consequently, Zambia is sparsely populated, with an average of about 26.1 people per square kilometre nationwide. Lusaka province is the most densely populated area in the country with 140.1 people per square kilometre (Zambia Statistics Agency, 2022). Due to the sparse population, health service delivery is challenging and expensive in Zambia.

Figure 1: Map of Zambia by Provinces

Source: Zambia Statistics Agency (2022)

With regards to the macro-fiscal environment, Zambia was classified as a LMIC in 2011 due to high economic growth and increased GDP per capita at that time. Between 2004 and 2014, Zambia's economy grew at an annual rate of 7.4% on average but came under intense pressure in 2015 and 2016 when growth fell to 2.9% and 3.3%, respectively (World Bank, 2017a). This was mainly attributed to falling copper prices, depreciation of the Zambian Kwacha against the US dollar by 62% between 2015 and 2016, power outages (due to reduced hydro-electric power generation), and a decline of 7.7% in agricultural output in 2015 as compared to 2014 due to late and low rains in the 2014/15 agricultural season (World Bank, 2016a). Another drought was experienced in 2018/19 which negatively affected the production of agricultural goods and energy; and led to a further decline in the annual GDP growth rate to 1.4% in 2019 (African Development Bank, 2022). Outbreak of the COVID-19 in 2020 in Zambia worsened the already weak macro-fiscal position, and this led to a recession whereby economic growth declined by 3.0% (African Development Bank, 2022).

To sustain the provision of public services, the Zambian government borrowed heavily from domestic and external sources, leading to an increase in the total general government gross debt as a share of the GDP from 20.8% in 2011 to 110.8% in 2021 (International Monetary Fund, 2023b); and an increase in the overall fiscal balance as a share of the GDP from 2.8% in 2012 to 8.1% in 2021 (World Bank, n.d.). Following several years of reduced economic growth, the GDP per capita was negatively affected, and subsequently, Zambia was re-classified from LMIC to LIC in 2021 (World Bank, 2022). Zambia's re-classification to LIC demonstrates the vulnerability of SSA countries to internal and external pressures.

It is also worth noting that the distribution of wealth across different income groups and geographical locations in Zambia has continually favoured the better-off. Though the overall national Gini coefficient improved slightly from 0.55 in 2015 to 0.51 in 2022, it remained at the same level (0.44) in both rural and urban areas (Zambia Statistics Agency, 2023) with lesser opportunities in rural areas. Poverty levels are also high with 54.4% of the population living below the national poverty line[5] in 2015 (76.6% in rural areas and 23.4% in urban areas), rising to 60% in 2022 (78.8% in rural areas and 31.9% in urban areas) (Zambia Statistics Agency, 2023). The increase in the incidence of poverty could be attributed to the COVID-19 pandemic. Across the 10 regions (provinces) of Zambia, poverty levels are higher than the national average and by 2022, the level of poverty was lowest in Lusaka (27%) and highest in Muchinga (82.6%) (ibid).

Despite limited progress in reducing income-related measures of poverty, Zambia has recorded notable gains in non-income related measures of poverty. In particular, there has been increased coverage for key maternal, child health and nutrition services (Ministry of Health, 2017b); and this has contributed to improved health outcomes (Zambia Statistics Agency et al. 2019). Nonetheless, Zambia did not fully achieve the health-related MDGs even though some of the targets were met. Specifically, MDGs indicators on maternal and infant mortality, prevalence of underweight children, and births attended by skilled health personnel were below the 2015 targets. The main challenge is that coverage of essential services is still low, while the quality is poor for the services that are provided (Ministry of Health, 2017b). There are also inequities in covering key services, particularly by sex, economic status, education, and urban-rural settings (Ministry of Health, 2017b). For instance, only 57.5% of the rural population resides within a 5 kilometres radius of a nearby health facility as compared to 97.6% for the urban

[5] Zambia uses the cost of basic needs approach to measure poverty. Thus, the national poverty line comprises food and non-food items, and specifies the amount of money that is required to purchase these items to meet a minimum standard of living. The poverty line per adult equivalent per month was estimated at ZMW214 in 2015 and ZMW517.6 per month in 2022 (Source: Zambia Statistics Agency, 2023).

population (Central Statistical Office, 2016). Therefore, as Zambia strives to achieve the SDGs, concerted effort is required. Brault and others (2020) examined factors associated with child mortality in Kenya, Liberia, Zambia, and Zimbabwe during the MDG era, and recommended specific services that need to be scaled-up to boost chances of achieving the health-related SDGs. These are: access to primary care, emergency obstetric and neonatal care, and improvement in general management. Provision of these services at scale requires adequate, and equitable and efficient health funding.

Zambia's ambition to reach UHC is enshrined in its national health policy which underscores Government's commitment to "provision of equitable access to cost effective and quality health services as close to the family as possible in a caring, competent and clean environment (Ministry of Health, 2012). To achieve this ambition, Zambia has a four-tier public health delivery system which constitutes: (i) health posts at community level; (ii) health centres and district hospitals at district level; (iii) general or second-level hospitals at provincial level; and (iv) tertiary or third-level hospitals at national level (Ministry of Health, 2018a). Health services through the public health system are provided free of charge at all primary health care (PHC) facilities (health posts, health centres and district hospitals); while patients referred from PHC facilities to secondary and tertiary level hospitals are also treated free of charge if they have a referral letter (Ministry of Health, 2007). With the Zambian government owning 87% of the total number of health facilities in Zambia (Ministry of Health, 2018a), the free health care policy that was introduced in 2006 (with modifications in 2007 and 2012) is designed to promote equity of access to health care. It is also important to highlight that between 1991 and 2016, Zambia has implemented six major institutional and financing reforms focusing on various aspects of the health system building block with a view of improving service delivery and health outcomes (Chilufya and Kamanga, 2018).

With regards to the overall level of spending on health, in nominal terms, Zambia's total current health expenditure per capita increased from US$23.3 in 2002 to US$92.6 in 2013 after which it dropped to US$61.3 in 2016 (Ministry of Health, 2018b); and then rose slightly to US$73.4 in 2021 (Ministry of Health, 2023b). This is lower than the recommended US$86 per capita per annum (expressed in 2012 US$ terms) for countries like Zambia to have a fully functioning health system (Mcintyre et al. 2017). Further, it is worth noting that a huge portion of total current health expenditure comes from donors who contributed 41% in 2016 while government and households contributed 41% and 12%, respectively (Ministry of Health, 2018b). By 2021, the contribution of the donors to the total current health expenditure increased to 50.7% while the contributions from the government and households dropped to 37.5% and 7.3%, respectively (Ministry of Health, 2023b). However, a large part of donor funds is earmarked for HIV/AIDS, which reduces government's flexibility in resource allocation and ability to re-prioritize funding to other emergent needs (Ministry of Health, 2018b).

The other challenge with health financing in Zambia is sub-optimal allocation of resources across levels of the health system and provinces. For instance, affluent and urban provinces (Lusaka, Copperbelt, and Southern) have higher health expenditures than the other seven poor provinces despite having lower disease burdens (World Bank, 2018). Some of the variations can be explained by urbanisation and population density but no study has examined this relationship. Comparing health benefits to "need" for health care is important and is rooted in the standard definition of health equity, which requires access to health services to be aligned to health needs (Gwatkin et al. 2004). Across the provinces of Zambia, there is a disconnect between health spending and health outcomes, leading to high rates of morbidity and mortality in already under-performing and hard-to-reach areas (World Bank, 2018).

As earlier stated, Zambia transitioned from a LIC to a LMIC in 2011 and from a LIMC to a LIC in 2021. Fiscal space at the macro level shrunk over the years due to the poor performance of the economy and a high public debt. Therefore, it will be difficult for the Zambian government to reprioritize the national budget to accommodate more health spending. Furthermore, with about 68.6% of the total employed persons in Zambia being in informal employment (Zambia Statistics Agency and Ministry of Labour and Social Security, 2020), the tax base is narrow. This suggests that chances of mobilising significant funding for health through contributory avenues (through a health insurance scheme) are narrow. However, the Zambian government could explore ways of increasing fiscal space for health through efficiency gains.

This study uses a single case design because it is useful in determining whether a theory's propositions are correct or when alternative explanations are warranted (Yin, 1994). Zambia has been chosen as a single case study because the developments (both successes and challenges) in the health sector are similar to other LLMICs in SSA. Just like Zambia, other LLMICs have also been experiencing fluctuations in economic growth coupled with fiscal deficits and rising public debt; national food insecurity due to reduced agriculture production as a consequence of regular floods and droughts; high levels of poverty albeit some gains in non-income measures of poverty; poor quality and inequities in coverage of maternal, newborn and child health and nutrition services; large inefficiencies and sub-optimal allocation of resources at different levels of the health system and sub-national level; and fluctuating total per capita health expenditure.

In most LLMICs, maintaining or increasing the existing domestically financed public spending on health is difficult due to poor macroeconomic and fiscal conditions. In a few cases, the health sector is already highly prioritised in relation to other sectors (Cashin et al. 2017; Durairaj and Evans, 2010). And considering that some of the LICs have in the past 10 years become LMICs (and vice-versa), most of the traditional donors are in the course of exiting. This could further reduce fiscal space for health in the affected countries. While most of the macro and health systems characteristics in Zambia are similar to other LLMICs, Zambia has the advantage of having a wealth of data that can be readily accessed to do the proposed analyses.

2.2. Conceptual framework

The conceptual thinking in this study is guided by existing theories and empirical studies on three aspects: (a) effect of income and non-income factors on health expenditure, (ii) prerequisites and conditions for a financially sustainable health system, and (iii) data needs and process for undertaking a comprehensive fiscal sustainability analysis of health systems in LLMICs. Firstly, the study conceptualised theories on income and non-income factors associated with growth in health expenditures. On income, Wagner, postulates that there is a long-run propensity for government expenditure to grow relative to national income (Wagner, 1892). In the health sectors in Africa, these findings have been proven by several researchers (Gbesemete and Gerdtham, 1992; Okunade, 2005; Olaniyan et al. 2013; Baltagi et al. 2017; Murthy and Okunade, 2009; Lv and Zhu, 2014; Micah et al. 2019).

On non-income factors, one of the underlying theories is the “healthy ageing” hypothesis which is described by Beard and others (2016). Its main assumption is that the age-structure of a nation’s population affects health care expenditure because the demand and consumption of health services are expected to increase when people get older. These findings have been empirically proven in Africa by (Okunade, 2005; Farag et al. 2012; Rono, 2013). This suggests that both income and non-income factors should be part of the conceptual and analytical frameworks for analysing fiscal sustainability of health systems in LLMICs in Africa. But while there is agreement on some of the elements that are required for the diagnosis, there is limited understanding of what constitutes a financially sustainable health system. Further, the literature doesn't provide the requirements and process for undertaking a comprehensive fiscal sustainability analysis of health systems in LLMICs.

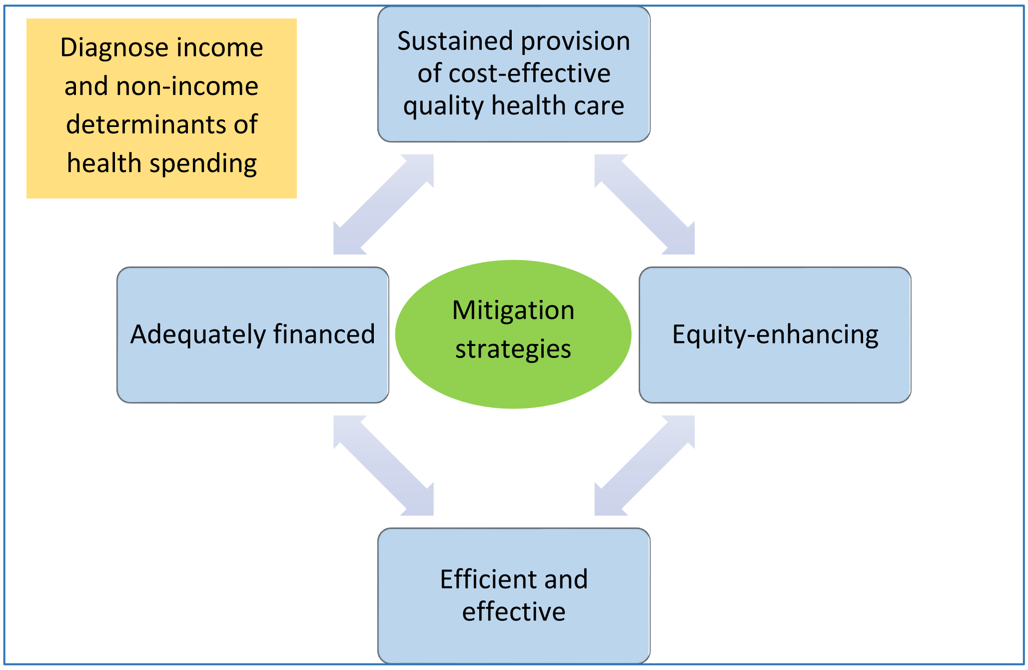
To come up with a conceptual framework that describes a financially sustainable health system, reference was made to conceptual frameworks that have been developed by Scheirer and Dearing (2011) and Birch and others (2014). On close examination, these frameworks were deemed insufficient. To begin with, the conceptual framework by Scheirer and Dearing (2011) focuses on the sustainability of public health programs and not the entire health system. Further, it does not include a diagnostic tool for measuring growth in expenditure (and inefficiencies); and focuses on inputs and operational processes, resource mobilisation, and outcome level program outcomes. On the other hand, the conceptual framework by Birch and others (2014) incorporates a tool for measuring growth in expenditure and it places financial sustainability within the framework instead of placing it outside. In other words, financial sustainability is the outcome of interest rather than one of the determining factors within the framework. Therefore, the conceptual framework that was conceived for the study used the theories on determinants of health expenditure as provided above; and the definition by Rebba (2014) that fiscal sustainability of a health system requires an alignment of growth in public spending with the growth in a nation's resource base. This framework is presented in Figure 2.

As shown in Figure 2, a financially sustainable health system is one that is: (a) adequately financed, (b) efficient and effective in transforming available inputs and services into better health outcomes; (e) equity-enhancing; and (d) able to sustain provision of cost-effective quality health care in the long-term, ideally for a minimum of 10 years. Each of these components is interdependent and crucial for the financial sustainability of a health system. Adequate financing is needed to implement efficient and effective programmes and activities, and these are in turn necessary to provide equitable and high-quality health care. At the same time, focusing on cost-effectiveness and quality ensures that the system remains financially viable in the short- to long-term. Furthermore, considering the dynamic nature of the factors that influence health spending; there is need for continuous diagnosis and re-diagnosis; and adaptation and mitigation of potential threats. The diagnosis and re-diagnosis include determination of health care needs, cost drivers, and opportunities for improving performance and/or generating additional resources to reach sufficiency levels. For the diagnosis, analysis of income and non-income determinants of health expenditures, as described in several parts of this paper, are used.

Having conceived what constitutes a financially sustainable health system, as provided in the conceptual framework in Figure 2, the other challenge is that there is no comprehensive framework for analysing fiscal sustainability of health systems in LLMICs. Thus, the premise of the study is that a systematic framework for assessing threats and opportunities in health spending is required to gauge the financial sustainability of health systems in LLMICs. To address this gap, the study utilized existing literature to adapt an analytical framework for fiscal sustainability of health systems in LLMICs. The methodology section details the steps that were taken to develop the framework.

The diagnostic component of the conceptual framework (Figure 2) was tested in Zambia. The fundamental hypothesis of the study is that a financially sustainable health system should meet four criteria: (a) adequate finances, (a) efficiency and effectiveness, (c) equity in financing and use, and (d) sustained provision of cost-effective quality health care. In this study (thesis), it is assumed that the foundation of a financially sustainable health system is adequate financing. Adequate financing ensures that there are enough funds to cover the costs of health care services; and that this financing can come from various sources, including government domestic funding, development partners, health insurance, and out-of-pocket payments by patients. However, mobilising these funds and delivery of health services can be influenced by several income and non-income factors (demographic, population health status, health system characteristics, internal conflict, urbanisation, time, etc). Therefore, it is critical to constantly look at factors contributing to rising health expenditures. In this regard, the starting point of the study was to carefully examine the drivers of health expenditure at national and sub-national (provincial) levels in Zambia.

Figure 2: Conceptual Framework - Financial Sustainability of a Health System



Source: Developed by the author using existing literature

The other main challenge underlying financial sustainability is that there are competing demands between health and other sectors for the limited available resources. While some studies have estimated the level of funding that is required to achieve UHC and meet the SDGs (Stenberg et al. 2017; Mcintyre et al. 2017; Watkins et al. 2017), the estimates are often far beyond the available resources in LLMICs in Africa. Further, the existing criteria for measuring and tracking the level of spending have been questioned (Piatti-Fünfkirchen et al. 2018). On the other hand, Jowett and others (2016) observe that there is no 'magic' spending number because all countries (even countries with low levels of spending on health) can make progress towards UHC if they use available resources prudently. Therefore, what is clear is that available health spending must be used efficiently to achieve desired outcomes. Given that 20-40% of the total health spending in LLMICs is wasted through human resources, medicines, hospitals, leakages, and interventions mixes (Chisholm and Evans, 2010), regular monitoring is required to identify and reduce wastage. Henceforth, soliciting for additional funding for health without mitigating for losses simply perpetuates existing inefficiencies. Improving efficiency could promote financial sustainability by increasing the sufficiency of current and future health spending, which in turn can lead to the provision of more health services.

2.3. Research objective one

Sub-objective 2.3.1: Decompose public expenditure on health by macro-fiscal factors and funding sources

The analysis was undertaken in three parts: (a) Descriptive analysis, (b) Analysis of income elasticity of health spending by financing sources (government, donor, and household), and (c) a decomposition analysis of the drivers of past changes in public spending for health by looking at macro-fiscal factors and financing sources.

2.3.1.1 Data and sources

The data was obtained from the Zambia National Health Accounts (NHA) survey datasets, annual government financial reports, and from the World Bank's world development indicators (WDI) online database, and the United Nations Population Division. From the NHA datasets, health expenditure by the main financing sources (government, donors, households, and employers) covering the period 1995-2018 was collected. This was the only available NHA data at the time of the study. NHA data was complemented with data from annual government financial reports. The annual government financial reports were also the source for total government expenditure. Income data (GDP) was also obtained from government financial reports and triangulated with similar data from the WDI database. To covert the GDP figures to per capita, population data from the United Nations Population Division was used.

2.3.1.2 Study variables

Several health financing indicators and variables were used to undertake this part of the study. Firstly, health financing indicators were used for the descriptive analysis. These were GDP per capita and domestic government health expenditure as a share of the total government expenditure. Secondly, to calculate the income elasticity of health expenditures, the main variable was total health expenditure. This was then broken down by financing source. Looking at the overall spending and sources of health spending is critical in understanding the responsiveness of health expenditures from each financier to changes in income (GDP). Thirdly, for the decomposition analysis, six variables classified in two main factors were used. There were: (a) macro-fiscal factors with three variables (economic growth [GDP per capita], total public spending as a share of GDP, and health's share in total public spending [prioritization of health]); and (b) health financing sources with three variables (domestic government spending on health, on-budget external (donor) spending on health, and expenditure on SHI). The main outcome of interest in the decomposition analysis was public spending on health which is a combination of domestic government health expenditure and on-budget external (donor) expenditure on health.

2.3.1.3 Analytical approach

The study conceptualised that total health expenditure can be influenced by economic growth (national income), contributions from various sources of financing (including SHI), changes in the volume of the overall government spending, and prioritization of health in government spending. Considering that Zambia did not have a SHI scheme during the period under review, there were no SHI contributions. To assess the impact of changes in national income on health spending, the elasticities of health expenditures by different financing sources were calculated. The working definition for income elasticity of health expenditure was drawn from (Di Matteo, 2003) who defined it as "the percentage change in health expenditures in response to a given percentage change in income." The key consideration is that if the elasticity is greater than one, then health expenditures are growing faster than the growth in the national income (GDP). If it is less than one, then the growth in the health expenditures is much lower than GDP growth (Di Matteo, 2003). The income elasticity of health spending (η) can be mathematically expressed as:

$$\eta = \frac{\text{\% Change in Health Spending}}{\text{\% Change in Income}} = \frac{\Delta Q/Q}{\Delta I/I}$$

Where:

- η = Income elasticity of health spending
- ΔQ = Change in health spending
- Q = Initial health spending
- ΔI = Change in income
- I = Initial income

To breakdown macro-fiscal factors and health financing sources, Das Guptas' decomposition method (Gupta, 1991) was used. Specifically, the study uses a technique that was employed by Tandon and others (2018) which postulates that contributions to changes in per capita public spending on health in any country for a given year (t) can be denoted as:

$$PEH_t = H_t * G_t * Y_t = D_t + E_t + S_t$$

where PEH_t is per capita public spending on health in year t in real values; H_t is spending on health as a share of total public spending in year t; G_t is total public expenditure as a share of the GDP in year t; Y_t is per capita GDP in year t; D_t is domestic government spending on health in year t; E_t is on-budget external spending on health in year t; and S_t is SHI contributions in year t.

2.3.1.4 Empirical analysis

The first part of this component of the study is a descriptive analysis of the growth in GDP per capita (proxy for economic growth), and growth in domestic government health expenditure as a share of the total government expenditure (proxy for prioritisation). This is followed by an analysis of income elasticity of health spending. Lastly, similar to (Tandon et al. 2018), a decomposition analysis was undertaken. The key assumption was that the growth rate of public spending on health over a given period can be fully accounted for by looking at changes in: (a) national income (per capita GDP), (b) total public expenditure as a share of the GDP, and (c) spending on health as a share of total public spending. The analysis was done by using the rdecompose function in Stata 18.0 (Li, 2017).

Sub-objective 2.3.2: Decompose total health expenditure by key demographic and health factors in Zambia

2.3.2.1 Data and sources

This component of the study assessed changes in the total health expenditures at national level in Zambia by looking at demographic and health factors. Demographic factors were population growth and population age structure while health was represented by nine level two diseases and conditions that have been categorised by the Institute for Health Metrics and Evaluation (IHME) in the global burden of disease (GBD) database.[6] See Table 2 for the list of the nine level two diseases and conditions. Secondary data was collected from NHA survey datasets for Zambia, the Health Management Information System (HMIS), the IHME online database, and the United Nations Population Division. The years 2013 and 2018 were examined. The year 2013 was chosen because it is the earliest year for which disease-specific NHA data for Zambia

[6] https://www.healthdata.org/research-analysis/gbd

is available for all level two IHME GBD diseases and conditions. The year 2018 was selected because it was the most recent year with disease-specific NHA data during the study.

2.3.2.2 Study variables

The main outcome of interest was total health expenditure. The study hypothesized that changes in the total health expenditure in Zambia were being influenced by four factors: (a) population growth; (b) population age structure (0-4, 5-14, 15-49, 50-69, and 70+) i.e. number of people in each age group as a share of the total population; (c) disease prevalence rate (expressed as the total number of cases per disease per 100,000 population); and (d) expenditure per prevalence case (defined as the amount of money spent per prevalent case by disease and age group expressed in real values [constant 2010 US$]). The variables were selected because several studies that have been undertaken in Africa have concluded that the variables influence growth in health expenditures. A decomposition study on the main drivers of health expenditure growth in China between 1993 and 2012 also concluded that real expenditure per prevalent case was a key driver (Zhai et al. 2017). Therefore, in my study, I used the same variables to investigate if they can have a similar effect in Zambia.

2.3.2.3 Analytical approach

Das Guptas' decomposition method (Gupta, 1991) was used to conduct the analysis using the years 2013 and 2018. A similar approach was taken by Zhai and others (2017) but in my study, excess health price inflation was not included because a health price index for Zambia is not available. To account for general inflation, the values were adjusted from nominal to real terms to cater for changes in the value of money over the years. Therefore, although data on health price inflation was unavailable, the analysis was conducted using constant prices. This approach partially mitigates the impact of health price inflation by accounting for changes in general prices over time.

In line with the study variables, the functional model for the total health expenditure at time t for the ith disease group and jth age group can be expressed as a product of the demographic and health factors as follows:

$$Exp_t = \sum_{i=1}^{n}\sum_{j=1}^{m} Popn_t \times Pops_{ijt} \times Prev_{ijt} \times Eprev_{ijt}$$

Where Exp_t denotes the real total health expenditure at time t, $Popn_t$ is the total population at time t, $Pops_{ijt}$ is the share of the population of disease i in age group j at time t, $Prev_{ijt}$ is the prevalence rate of disease i in age group j at time t, and $Eprev_{ijt}$ is the expenditure per prevalent case in constant prices of disease i in age group j at time t. The difference of health expenditure (Exp_d) for disease i at time t and T is then expressed as follows:

$$
\begin{aligned}
Exp_d = Exp_{iT} - Exp_{it} \\
&= Population\ growth\ effect + Ageing\ effect \\
&+ Disease\ prevalance\ rate\ effect \\
&+ Expenditure\ per\ prevelent\ case\ effect
\end{aligned}
$$

Where Exp_{it} denotes the real health expenditure on disease i at time t and Exp_{iT} represents the real health expenditure on disease i at time T. In my study, the base year t is 2013 and the end year T is 2018.

2.3.2.4 Empirical analysis

The first step was conversion of the data to rates. The prevalence rates of diseases for each age group were expressed as the number of cases per 100,000 individuals. Expenditure data was converted from nominal to real values (constant 2010 US$) and then used to calculate the expenditure per prevalence case for each disease and age group. Secondly, to understand the basic patterns, trends, and distribution of the data on the nine level two diseases and conditions from the IHME GBD database for Zambia, a descriptive analysis was conducted. After the descriptive analysis, Das Gupta's decomposition method (Gupta, 1991; Zhai et al. 2017), was used to identify the main factors associated with the changes in total health expenditures in Zambia between 2013 and 2018. The analysis was done by using the rdecompose function in Stata 18.0 (Li, 2017). To show the contribution to health expenditures by each of the nine diseases and five age groups, the "detail" option was used. Further, the "transform" option was also used to convert absolute population numbers into proportions. The results from the decomposition analysis were then depicted in a bar chart to provide more insights into the percentage contribution of each factor to changes in total health expenditure.

Sub-objective 2.3.3: Assess the main determinants of government health expenditure at sub-national (provincial) level in Zambia, and decomposition of the main determinants

2.3.3.1 Data and sources

The aim of this component of the study was to assess the main determinants of government health expenditures at provincial level. This is followed by a decomposition analysis of the main determinants to quantify the magnitude of the effect. Therefore, secondary data on income and non-income factors that can affect health expenditures at provincial level were collected. The data sources were the Ministry of Health (MoH) financial reports, annual government financial reports, Zambia Statistics Agency (ZamStats) reports and bulletins, HMIS, and the United Nations Population Division. Subsequently, annual data covering the period 2014-2019 for all the research variables (see Table 2) for all the 10 provinces in Zambia (Central, Copperbelt, Eastern, Luapula, Lusaka, Muchinga, Northern, Northwestern, Southern, and Western) was collected. This formed a rich panel of data that was used to conduct panel regression and decomposition analyses.

2.3.3.2 Study variables

To adequately conduct the sub-national analyses, 10 variables—the dependant and nine independent variables—were assessed (Table 2). The dependent variable (main outcome of interest) was provincial per capita government health expenditure while the nine independent variables represented five broad income and non-income factors that can affect government per capita health spending at provincial level in Zambia. The five factors are: economic growth, demographic, institutional, population health status, and social (Table 2). The five factors were arrived at based on several studies that have been undertaken in Africa on the determinants of health expenditure. The study used nine independent variables related to the five factors, namely: provincial GDP per capita (income-related); population density, population under 15, population over 65 (demographic); availability of health facilities, availability of skilled health workers (institutional); outpatient attendance and inpatient admissions, TB notification (population health status); and urbanisation (social). The definitions of these variables are provided in Table 2. Using these variables, descriptive, panel regression, and decomposition analyses were conducted. The analytical approaches are described below.

2.3.3.3 Analytical approach - Assess the main determinants of government health expenditure at provincial level in Zambia

The study hypothesised that the nine independent variables provided in Table 2 were the main determinants of per capita government health expenditures across the 10 provinces of Zambia. This hypothesis was examined by estimating an econometric model using panel data from the 10 provinces covering the period 2014–2019. The analytical approach was guided by a study by Pan and Liu (2012) who used a similar approach to examine the key determinants of real per capita provincial government health expenditure in China. In line with the study variables, the functional model representing provincial government health expenditure per capita (GHE) was:

$$GHE_{it} = f(GDP_{it}, Popden_{it}, U15_{it}, O65_{it}, Totalhfs_{it}, Skilled_{it}, OPD\_IP_{it}, TB_{it}, Urban_{it})$$

Where i is the province subscript, and t is the time subscript. The independent variables are: *GDP* representing provincial GDP per capita; *Ponden* is population density; *U15* is the percentage of the population aged below 15; *O65* is the percentage of the population aged above 65; *Totalhfs* is the number of health facilities per 10,000 population; *Skilled* is the number of skilled health providers per 10,000 population; *OPD_IP* is the number of outpatient attendances and inpatient admissions per 10,000 population; *TB* is the number of TB notifications per 10,000 people; and *Urban* is the share of the population in urban parts of each province. The functional model can be transformed into an econometric model as follows:

$$GHE_{it} = X_{it}\beta + a_i + u_{it}$$

Where i is the province subscript; t is the time subscript; *X* is a vector of independent variables as outlined above (varying by i and t); β is a vector of coefficients representing the magnitude of change or elasticities for each of the independent variables; a_t is the unobserved time invariant characteristic; and u_{it} is the idiosyncratic error term.

2.3.3.4 Empirical analysis - Assess the main determinants of government health expenditure at provincial level in Zambia

The income variables GHE and GDP were first converted to real values by using the consumer price index (2010 = 100) and then divided by provincial populations to get per capita values. For the demographic variables, population densities for each province were calculated by dividing provincial populations by the total area (in square kilometres) in each province. The populations under 15 and over 65 were expressed as shares of the total populations in each province. Similarly, the social variable (urbanisation) was expressed as the share of the total provincial populations in urban parts of the province. All the institutional and health variables were expressed as rates per 10,000 people to mitigate the effect of varying population sizes across the provinces. Using this data, descriptive analysis was conducted to highlight the basic characteristics of the variables (number of obversions, mean, and standard deviations). The trends by province in the income variables (GHE and GDP) over the period 2014-2019 were also analysed. In addition, data on the provincial government health budget was collected and compared to the provincial GHE to assess the performance of the budget.

Robustness checks

For the panel regression analysis, all the variables were converted to logarithms to reduce skewness and to take care of heteroskedasticity. Earlier studies have used the log-log functional form to analyse determinants of health expenditures at provincial level in China (Wang and Chen, 2021; Hou et al. 2020). After the data was transformed to logarithms, the prescribed steps for using panel data to conduct fixed and random effects analyses in Stata (Torres-Reyna, 2007) were followed. To assess the credibility, reliability, and generalizability of the findings from panel regression analysis, several robustness tests were undertaken. The tests that were done are: (a) the Hausman test to evaluate the suitability of using a random or fixed effects model, (b) the testparm test for time-fixed effects, (c) the Breusch-Pagan Lagrange Multiplier (BP-LM) test for random effects, (d) the BP-LM test for cross-sectional dependence, (e) the Pasaran CD test for cross-sectional dependence, (f) the Modified Wald test for groupwise heteroskedasticity, and (g) the Wooldridge test for autocorrelation in Panel Data. The results from the robustness checks are provided in Appendix 5.

In summary, results from the robustness checks revealed the following: (a) the fixed-effects model was ideal for the analysis, (b) there is no cross-sectional dependence in the model, (c) there was groupwise heteroskedasticity in the model, and (d) there is no first-order autocorrelation in the panel data. See Appendix 5 for the actual results from all the tests. To control for heteroskedasticity, the variables were converted to logarithms and the “robust” function in Stata was used. In addition, a model with inbuilt capabilities to address heteroskedasticity was also used. This is the correlated panels corrected standard errors (PCSEs) regression model. The PCSE model is useful when there is heteroskedasticity and autocorrelation within panels, but the panels themselves are independent of each other. Ultimately, three models were used for the panel regression analysis (fixed, random, and PCSE) to enable cross-comparison and sensitivity analysis.

2.3.3.5 Analytical approach - Decompose the main determinants of government health expenditure at provincial level in Zambia

After identifying the key factors influencing per capita government health expenditures at the provincial level, the next step in the sub-national analysis was to measure the magnitude of their impact. To do this, a provincial level decomposition analysis was done by using Das Guptas' decomposition method (Gupta, 1991). Based on the results from the panel regression analysis in sub-section 2.3.3.3, the independent variables that exhibited a relationship with per capita government health expenditure were examined further. These are: provincial GDP per capita, number of health facilities per 10,000 people, number of TB notifications per 10,000 people, and urbanisation (share of the provincial population in urban residence). The underlying assumption is that provincial government health expenditure per capita at time t for the ith province can be expressed as a product of the four variables as follows:

$$GHE_t = \sum_{i=1}^{n} GDP_{it} \times Totalhfs_{it} \times TB_{it} \times Urban_{it}$$

Where GHE_t denotes the real provincial per capita government health expenditure at time t; GDP_{it} is the real GDP per capita for province i at time t; $Totalhfs_{it}$ is the number of health facilities per 10,000 population for province i at time t; TB_{it} is the number of TB notifications per 10,000 people for province i at time t, and $Urban_{it}$ is the share of the population in urban areas for province i at time t. The difference in the real provincial per capita government health expenditures (Exp_d) for province i at time t and T is then expressed as follows:

$$\begin{aligned} Exp_d = Exp_{iT} - Exp_{it} \\ &= Provincial\ real\ GDP\ per\ capita \\ &+ Number\ of\ health\ facilities\ per\ 10{,}000\ people \\ &+ Number\ of\ TB\ notifications\ per\ 10{,}000\ people \\ &+ Share\ of\ the\ population\ in\ urban\ areas \end{aligned}$$

Where Exp_{it} denotes the real provincial government per capita health expenditure in province i at time t and Exp_{iT} represents the real provincial government per capita health expenditure in province i at time T. Considering that the Das Gupta decomposition method only requires two timelines to examine the changes, the years 2014 and 2019 were utilised. In my study, the base year t is 2014 and the end year T is 2019. These years represent the furthest ends of the provincial level data that were available during the provincial level study.

2.3.3.6 Empirical analysis - Decompose the main determinants of government health expenditure at provincial level in Zambia

The goal of the Das Gupta decomposition method is to linearly decompose absolute differences into outcomes of interest between populations and years (Li, 2017). Therefore, it is essential for the data to be in rates or shares of a populations. The Provincial GDP per capita (constant 2010 US$), number of health facilities per 10,000 people, number of TB notifications per 10,000 people, and urbanisation (share of the provincial population in urban residence) were used in the analysis. The rdecompose command in Stata 18.0 was used to run the analysis (Li, 2017). To show each variable's contribution to changes in government health expenditures per capita by province, the "detail" option in Stata 18.0 was used. The results from the decomposition analysis were then presented in tables and bar charts to provide more insights into the percentage contribution of each variable to changes in per capita government health expenditure by province.

Table 2: Variables and Data Sources – Research Objective One

Sub-objective 2.3.1: Decompose public expenditure on health by macro-fiscal factors and funding sources			
Variable	***Type of Variable***	***Description of Variable***	***Data Sources***
Total public spending	Dependent	Donor and domestic government health expenditures (constant 2010 US$)	NHA, annual government financial reports, WDI, United Nations Population Division
National income	Independent	GDP per capita (constant 2010 US$)	
Prioritization of health in national spending	Independent	Domestic government health expenditure as a share of the total government expenditure	
On-budget external financing for health	Independent	Total per capita on-budget donor spending on health (constant 2010 US$)	
SHI contributions	Independent	Total per capita SHI contributions (constant 2010 US$)	
Sub-objective 2.3.2: Decompose total health expenditure by key demographic and health factors in Zambia			
Variable	***Type of Variable***	***Description of Variable***	***Data Sources***
Total health expenditure	Dependent	Total health expenditure per capita (constant 2010 US$)	NHA, IHME
Population growth	Independent	Population growth by age group	United Nations Population Division
Population age structure *0-4* *5-14* *15-49* *50-69* *70+*	Independent	Number of people in each age group as a share of the total population	
Disease prevalence rate	Independent	Disease prevalence rate by age group for the level two GBD IHME diseases and conditions. For Zambia, there are nine diseases and conditions at level two as provided below. • *HIV/AIDS and sexually transmitted infections* • *Injuries* • *Malaria and neglected tropical diseases* • *Maternal and neonatal disorders* • *Non-communicable diseases* • *Nutritional deficiencies* • *Respiratory infections and tuberculosis* • *Other infectious diseases* • *Other unspecified diseases and conditions*	HMIS, IHME
Expenditure per prevalent case	Independent	This is the amount of money spent per prevalent case by disease and age group expressed in constant 2010 US$	
Sub-objective 2.3.3a: Assess the main determinants of government health expenditure at provincial level in Zambia			
Variable	***Type of Variable***	***Description of Variable***	***Source of Data***
Provincial government health expenditure per capita	Dependent	Annual government expenditure on health by province expressed in real values and per capita terms	MoH financial reports, annual government financial reports
Provincial GDP per capita	Independent	GDP by province expressed in real values and per capita terms	ZamStats
Population density	Independent	Number of people per square kilometre by province	ZamStats
Population under 15	Independent	Percentage of the population under the age of 15 by province	United Nations Population Division
Population over 65	Independent	Percentage of the population over the age of 65 by province	

No. of health facilities per 10,000 population	Independent	Number of government health centres and first, second, and third level hospitals per 10,000 population by province	HMIS
No. of skilled health providers per 10,000 population	Independent	Staffing levels for doctors, clinical officers, nurses, and midwives per 10,000 population by province	
Outpatient and inpatient attendances	Independent	Number of first outpatient attendances and inpatient admissions per 10,000 population at all government health facilities by province	
TB notifications	Independent	Number of TB notifications per 10,000 population at all government health facilities by province	
Urbanisation	Independent	Share of the population in urban parts of the province	ZamStats
Time	Independent	Time variable	
Sub-objective 2.3.3b: Decompose the main determinants of government health expenditure at provincial level in Zambia			
Variable	***Type of Variable***	***Description of Variable***	***Source of Data***
Provincial government health expenditure per capita	Dependent	Annual government expenditure on health by province expressed in real values and per capita terms	MoH financial reports, annual government financial reports
Provincial GDP per capita	Independent	GDP by province expressed in real values and per capita terms	ZamStats
No. of health facilities per 10,000 population	Independent	Number of government health centres and first, second, and third level hospitals per 10,000 population by province	HMIS
TB notifications	Independent	Number of TB notifications per 10,000 population at all government health facilities by province	
Urbanisation	Independent	Share of the population in urban parts of the province	ZamStats

Note: HMIS=Health Management Information System, IHME= Institute for Health Metrics and Evaluation, MoH=Ministry of Health, NHA=National Health Accounts, WDI=World Development Indicators, and ZamStats=Zambia Statistics Agency.

2.4. Research objective two

Sub-objective 2.4.1: Adaption of an analytical framework for fiscal sustainability analysis of health systems in LLMICs

To adapt the analytical framework, an extensive scoping review of the literature was conducted. The reason for using a scoping review methodology is because scoping reviews are suitable for mapping key concepts (Arksey and O'malley, 2005) and for synthesizing ideas from emerging topics because they can address questions on the effectiveness of interventions (Peters et al. 2015). The review was undertaken in four steps, namely: (a) Identification of the research objective, (b) Search strategy, (c) Selection of the studies, and (d) Extracting, summarizing, and adaptation of the framework.

2.4.1.1 Identification of the research objective

The objective of this component of the study is already provided in sub-section 1.5 (research gaps and justification) and is also outlined in the conceptual framework for the study (Figure 2). Just to recap, based on the literature view, it was observed that there is no analytical framework for analysing fiscal sustainability of health systems in LLMICs. It was then conceived that this could be the reason why there are no comprehensive studies on fiscal sustainability of health systems in LLMICs. Therefore, this study sought to fill this gap by adapting an analytical framework for fiscal sustainability of health systems in LLMICs. In this context, "adapting" means to modify or adjust an existing analytical framework for fiscal sustainability of health systems to make it suitable for application in LLMICs. It is anticipated that availability of such a framework would enhance the understanding of fiscal sustainability of health systems in LLMICs. The framework will also outline the requirements and processes for conducting analyses on fiscal sustainability of health systems, thereby encouraging more studies on the subject matter in LLMICs.

2.4.1.2 Search strategy

I searched for studies and reports on fiscal sustainability from PubMed, Academic Search Complete (EBSCO), Scopus, BioMed Central, Semantic Scholar, Google Scholar, and Bing. The World Bank and World Health Organization platforms were also searched for relevant reports and materials. Further, snowballing was used to identify relevant works. The search was undertaken from May 2018 to December 2023. The search involved using the following words and terms, both individually and in various combinations: fiscal policy, fiscal/financial sustainability, fiscal/financial sustainability of health systems, fiscal/financial sustainability of health programmes, technical/institutional/impact sustainability of health/health programs/health systems, fiscal space for health, and health systems resilience.

2.4.1.3 Study selection

Through the search, 32 studies were identified out of which 13 were assessed to determine if the analytical framework presented in the papers was practically applicable for evaluating fiscal sustainability of health systems in LLMICs. The 19 studies that were not retrieved were those that focused on either broad or narrow aspects of fiscal sustainability. Studies on fiscal policy sustainability and resilience were broad, examining entire economies. Conversely, other studies were narrow, focusing on fiscal sustainability of HIV/AIDS programs, immunization, fiscal space for health, and the sufficiency of health spending to achieve health-related SDGs.

Nonetheless, for purposes of material and content extraction, some of the broad and narrowly focused studies were retrieved and reviewed comprehensively. In total, 13 studies were comprehensively reviewed. This includes 10 broad and narrowly focused studies, and three focused (eligible) studies. The 10 broad and narrowly focused studies were vital for a deeper understanding of the concept of fiscal sustainability from an economic, social, health, and institutional perspective.

The three focused (eligible) studies contained frameworks for analysing fiscal sustainability at public health programme level (Scheirer and Dearing, 2011) and at health systems level (Birch et al. 2014; OECD, 2015). The ideas and concepts from these studies, together with the concepts from the broad and narrow studies, and existing theories on the determinants of health expenditure were used to adapt the framework.

2.4.1.4 Extracting, summarizing, and adaptation of the framework

To facilitate the review process, a data extraction sheet was developed and used during the review. The sheet was aligned to the main themes on fiscal sustainability of health systems from the literature review. The broad themes were diagnosis, mitigation/treatment, and forecasting. These themes were established at the beginning of the study after the initial literature review. As more papers were reviewed, sub-themes were identified and grouped under the three main themes.

For the sub-themes, the conceptual thinking was guided by existing theories and empirical studies on income and non-income determinants of health expenditure; supply- and demand-side measures for achieving efficiency, cost-effectiveness, and equity in the allocation and use of available resources; avenues for expanding fiscal space for health (Heller, 2006; Tandon and Cashin, 2010); and description of a financially sustainable health system as guided by Rebba (2014),. Birch and others (2014), and OECD (2015). For the sub-themes on forecasting, reference was made to studies by Astolfi and others (2012a; 2012b) and Marino and others (2017). The health system building blocks (WHO, 2007) was also used to assign concepts to the themes and to structure the analysis.

Though there was no singular framework in the literature that fully met the requirements for fiscal sustainability analysis of health systems in LMICs, frameworks from three studies (Birch et al. 2014; OECD, 2015; Scheirer and Dearing, 2011) were reviewed extensively because they contained details that were relevant to the needs of LLMICs. These include: high disease burdens, high public debt, high external financing and out-of-pocket spending on health, public financial management issues, etc.

2.4.1.5 Validation and proof of concept

As provided above, through content analysis and detailed mapping of key concepts and perspectives, an analytical framework for fiscal sustainability of health systems in LLMICs was adapted. Validation and proof of concept was achieved by applying the devised framework to the health system in Zambia.

Sub-objective 2.4.2: Conduct a fiscal sustainability analysis of the health system in Zambia

2.4.2.1 Study variables

The main variables of interest were: (a) total expected (pledged/committed) per capita funding on health, (b) total health financing need in per capita terms, and (c) total anticipated actual per capita spending on health. The total expected per capita funding on health is the pledged, committed, and budgeted amount of money from the Zambian government, external development partners, households, and employers over the period 2025-2030. The total health financing need is the total amount of health funds (in per capita terms) that is required to achieve the desired health outcomes in Zambia over the period 2025-2030. The anticipated total per capita spending on health is the actual amount of money (in per capita terms) that is likely to be spent on health in Zambia over the period 2025-2030.

2.4.2.2 Data and sources

For the total expected per capita funding on health, data on the pledges, commitments, and budgets from the Zambian government and external development partners was extracted from the 2023-2027 resource mapping survey report (Ministry of Health, 2023a), the Zambia National Health Strategic Plan: 2022-2026 (Ministry of Health, 2022), and the medium-term expenditure framework budgets from the Ministry of Finance and National Planning. A summary of the data that was extracted is provided in Table 3. It shows that over the period 2023-2027, about 29% of the total expected health funds will come from donors and 63% from the Zambian government. Further, between 2025 and 2027, a total of about US$1.8 million to US$1.9 million is expected from all the four main sources of health financing in Zambia.

For the total health financing need, data was extracted from the Zambia National Health Strategic Plan: 2022-2026 (Ministry of Health, 2022). An ingredient approach was employed to cost the strategic plan. This involved a meticulous bottom-up costing of specific inputs that are required for each priority health intervention. By carefully identifying and costing each intervention and component, a comprehensive estimate of the national health financing need was obtained. In my study, I used the costs from the strategic plan as a proxy for the total health financing need. A summary of the data that was extracted is provided in Table 4. The results show that US$2.8 million was required to fund the priority health programmes in Zambia in 2024 and the amount will increase to US$3.4 million in 2026 (Table 4).

For the anticipated total per capita spending on health, this was estimated by looking at historical trends in health financing for all the main health financing sources. Data was extracted from NHA survey reports (Ministry of Health, 2017a; Ministry of Health, 2018b; Ministry of Health, 2023b). Based on historical trends, the projected spending for the period 2025-2030 was calculated.

Table 3: Expected Health Funding by Source (US$ '000)

	2023	2024	2025	2026	2027	Share
Donors (external)	488,841	495,731	497,358	500,017	505,062	29%
Government of Zambia	798,043	952,383	1,184,486	1,239,560	1,283,401	63%
Households	104,232	104,232	104,232	104,232	104,232	6%
Employers	47,151	47,151	47,151	47,151	47,151	3%
Total	**1,438,267**	**1,599,496**	**1,833,227**	**1,890,959**	**1,939,845**	100%

Source: Author's construction from (Ministry of Health, 2023b; Ministry of Health, 2023a; Ministry of Health, 2018b). Future funding from households and employers assumed to remain constant at the 2019-2021 annual average spending level

Table 4: Cost of Priority Programmes (US$ '000)

	Program	**2022**	**2023**	**2024**	**2025**	**2026**
1.	Primary Health Care	58	82	91	77	84
2.	Reproductive, Maternal, Neonatal, Child and Adolescent Health	326,439	357,387	393,882	432,306	478,181
3.	Communicable Diseases	386,661	404,505	414,885	457,815	499,729
4.	Non-Communicable Diseases	101,832	111,887	123,561	134,898	148,922
5.	Other Public Health Priorities	2,834	3,254	3,613	4,013	4,316
6.	Clinical Care and Diagnostic Services	622,143	679,411	676,052	732,090	787,325
7.	Integrated Health Support Systems	874,027	1,030,173	1,154,481	1,291,732	1,455,858
	Total	**2,313,994**	**2,586,699**	**2,766,565**	**3,052,931**	**3,374,415**

Source: Zambia National Health Strategic Plan: 2022-2026

2.4.2.3 Setup and analytical approach – ARIMA Model

For the anticipated per capita spending, an Autoregressive Integrated Moving Average (ARIMA) 1,0,1 model in Stata 18.0 was used to predict historical and futuristic spending. The ARIMA forecasting method has been used to predict health expenditures in Iran (Ramezanian et al. 2019), in China (Zheng et al. 2020), and for the BRICS (Brazil, Russia, India, China and South Africa) countries (Jakovljevic et al. 2022). An ARIMA model has parameters p,d,q where: p is the number of autoregressive terms, d is the number of differences needed for stationarity, and q is the number of lagged forecasted errors in the prediction equation (Box and Jenkins, 1970). The formula is:

$$y_t^* = \mu + \underbrace{\sum_{i=1}^{p} \phi_i y_{t-i}^*}_{\text{AR}} + \underbrace{\sum_{i=1}^{q} \theta_i \epsilon_{t-i}}_{\text{MA}} + \epsilon_t$$

y_t^* is the differenced time series d; μ is a constant term; and ϵ_t is the error term at time t. AR is the autoregressive component of the model, where p is the number of lags included in the model; and MA represents the moving average component, where q is the number of lagged forecasted errors in the prediction equation.

For this study, data on total per capita spending on health covering the period 1995-2021 was extracted from previous national health accounts survey reports (Ministry of Health, 2017a; Ministry of Health, 2018b; Ministry of Health, 2023b). This data was entered into Stata after which the Box and Jenkins (Box and Jenkins, 1970) three-step ARIMA process, namely: identification, estimation, and diagnosis and forecasting was applied. This was important because the underlying assumptions of stationarity and invertibility that are required for ARIMA models need to be fully satisfied. As part of the identification process, the augmented Dickey-Fuller and Phillip Perron tests for stationarity were conducted. The results (See Appendix 6) showed that the variable "chepc" (per capita spending) was stationary which meant that no differentiation was required. As such, the parameter for *(d)* was set at 0. Thereafter, plots from the Partial Autocorrelation Function (PACF) and the Autocorrelation Function (ACF) were used to identify the ARIMA parameters for *(p)* and *(q)*, respectively. Based on the plots, there were two possible models: 1,0,0 and 1,0,1. These two models were run (estimated) and then the Akaike and the Bayesian tests were conducted. Based on all the results from the identification and estimation processes, the values for the autoregressive *(p)*, differentiation *(d)*, and moving average *(q)* components of the ARIMA model were set at 1,0,1, respectively.

To gauge if the ARIMA 1,0,1 model was suitable, post-estimation tests for white noise and stationarity were conducted. This includes the portmanteau (Ljung-Box) test for white noise and the autoregressive roots (aroots) test to see if the AR and MA parts of the model were stationary and invertible, respectively, i.e. if they were inside the unit circle. The 1,0,1 model met all the underlying assumptions of stationarity and invertibility that are required for ARIMA models. See Appendix 6 for more details. The ARIMA 1,0,1 model was then used to predict per capita spending from 1995 to 2030. For the study, the figures for the period 2025-2030 were used to answer the research question.

2.4.2.4 Empirical analysis

Firstly, a descriptive analysis of the health financing situation in Zambia, and efficiency and effectiveness of overall health spending were conducted. This was followed by the financing need and gap analyses. The actual and forecasted results for per capita spending on health covering the period 1995-2030 were entered in Stata. For expected per capita funding, estimates from the 2023-2027 resource mapping survey (Ministry of Health, 2023a) were used. For 2028 to 2030, an overall growth of 10% was assumed. This was based on historical precedence. For the financing need, estimates from the costed National Health Strategic Plan: 2022-2026 (Ministry of Health, 2022) were used. For the period 2027 to 2030, the 2026 amount of US$151 per capita was held constant. This is because the health need is not expected to reduce. A time series trend line for the four variables was then plotted. The four variables are: actual per capita spending, predicated per capita spending, expected per capita spending, and per capita financing need.

Using data on the four variables, the total financing, commitment, and ‘effective’ health financing gaps were calculated. The *financing gap* is the difference between the total expected (pledged/committed) health funding and the total health financing need; the *commitment gap* is the difference between the total expected (pledged/committed) health funds and the total actual health funding; and the *‘effective’ financing gap* is the difference between the total actual health funding and the total health financing need. The terms *commitment gap and 'effective' financing gap* have been coined by the author in this study.

2.5. Ethical considerations

The study utilised secondary data that was completely anonymized. Therefore, the research does not pose any ethical challenges. Prior to commencing the study, official authorization was acquired from the Zambia Ministry of Health through a letter dated 10th February, 2017 (ref: MH/101/67/1). Furthermore, ethical clearance (ref: HSSREC 2018-JUNE-045) was obtained from the research ethics committee of the University of Zambia, School of Humanities and Social Sciences on 8th November 2018. Additionally, permission to conduct the research was granted by the Zambia National Health Research Authority on 23rd November 2018. Lastly, based on a letter from the Ethics Committee of the Medical Faculty at the University of Heidelberg dated 9th October 2018, it was determined that formal clearance from the University of Heidelberg was not required. The reason for this is that the study solely focused on the collection and analysis of anonymized data.

3. RESULTS

In this chapter, the main results from the study are presented. The results are aligned to the two main objectives of the study through five sub-sections. Sub-sections 3.1, 3.2, and 3.3 present results from analyses of the main drivers of the growth in total and public expenditure on health in Zambia while sub-sections 3.4 and 3.5 present results from a fiscal sustainability analysis of the health system in Zambia. Specifically, results from a decomposition analysis of the growth in public expenditure on health by funding sources in Zambia are provided in sub-section 3.1. This is followed by results from a national level decomposition analysis of the changes in total health expenditure by key demographic and health factors in Zambia in sub-section 3.2. Thereafter, results from a sub-national (provincial) level analysis of the main determinants of government health expenditures in Zambia are provided in sub-section 3.3. In sub-section 3.4, a framework for analysing fiscal sustainability of health systems that was adapted for the study is presented. Lastly, in sub-section 3.5, results from a fiscal sustainability analysis of the health system in Zambia are provided.

3.1. Decomposition of public expenditure on health by macro-fiscal factors and funding sources

This section presents results on the drivers of past changes in public spending for health by looking at: (a) three macro-fiscal factors (economic growth, total public spending, and prioritization of health in national spending), and (b) three financing sources (on-budget external financing for health, expenditure on SHI, and government spending on health from domestic sources).

3.1.1 Descriptive analysis

The first part of the analysis looked at the growth in GDP per capita (proxy for economic growth), growth in domestic government health expenditure as a share of the total government expenditure (proxy for prioritisation), and trends in income elasticity of health spending. The results show that the GDP per capita (constant 2010 US$) in Zambia grew steadily from US$419 in 1995 to US$1,516 in 2018 (Figure 3). This increase represents an average annual growth of 7.1% per year. Meanwhile, there were fluctuations in the domestic government health expenditure as a share of the total government expenditure over the period 1995-2018, and ultimately, there was a decreased from 8.1% in 1995 to 7% in 2018 (Figure 4). This implies that even though there was a growth in GDP per capita over the period 1995-2018, this did not lead to an increase in the share of the domestic government spending on health. In other words, there was low prioritisation of health by the Zambian government during the period 1995-2018.

Figure 3: GDP per capita

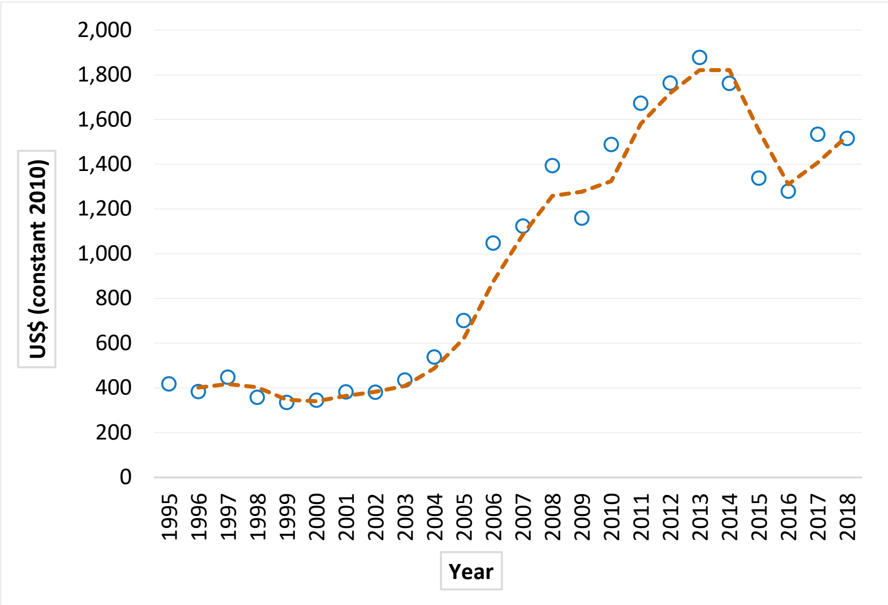
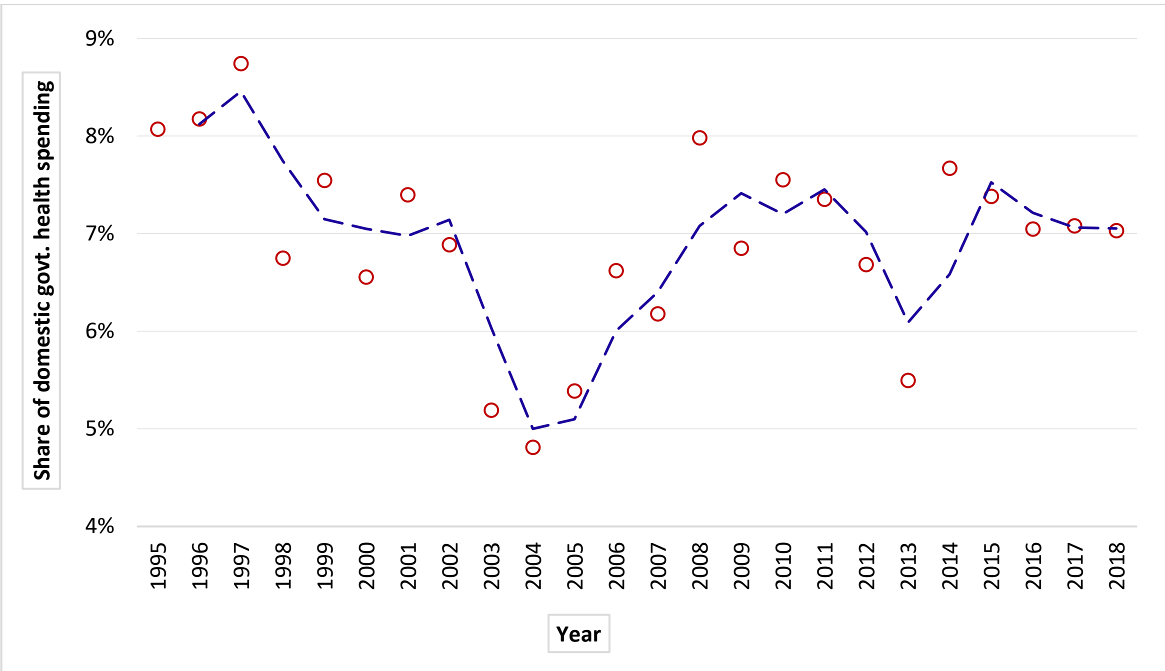


Figure 4: Domestic Government Health Expenditure as % Total Government Expenditure



3.1.2 Income elasticity of health spending

To assess the responsiveness of total health expenditure to GDP growth by financing sources (government, donor, and household), an income elasticity analysis was conducted (Figures 5 and 6). The results show that over the period 1996-2018, the income elasticity of total health expenditure in Zambia was 2.1 (Figure 5). This means that on average, a one percent increase in GDP growth yields a 2.1 percent increase in total health spending. A breakdown of total health expenditure by funding sources shows that the income elasticity of spending by households, government, and donors were 0.8, 1.1, and 5.8, respectively (Figure 6). This means that donor spending on health was positively responsive to increased national income (GDP growth) than the other sources of funding in Zambia. In other words, donor funding tends to increase as Zambia's GDP grows.

Figure 5: Trends in Income Elasticity of Government and Donor Spending on Health

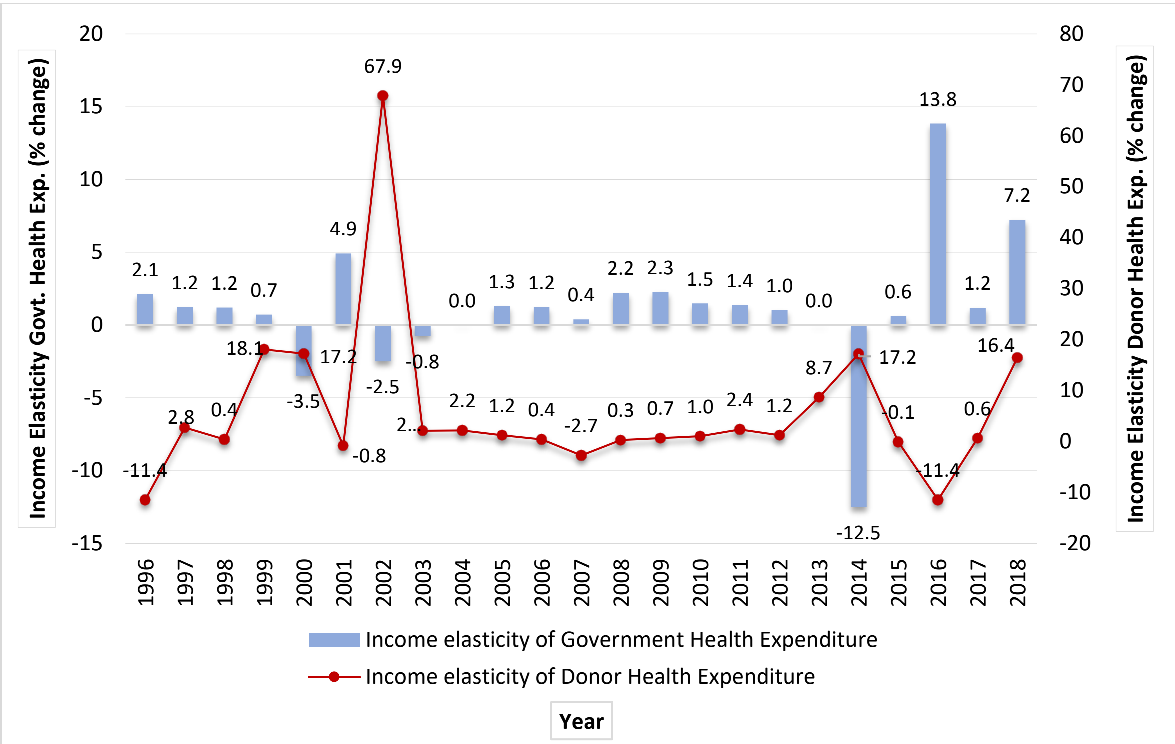
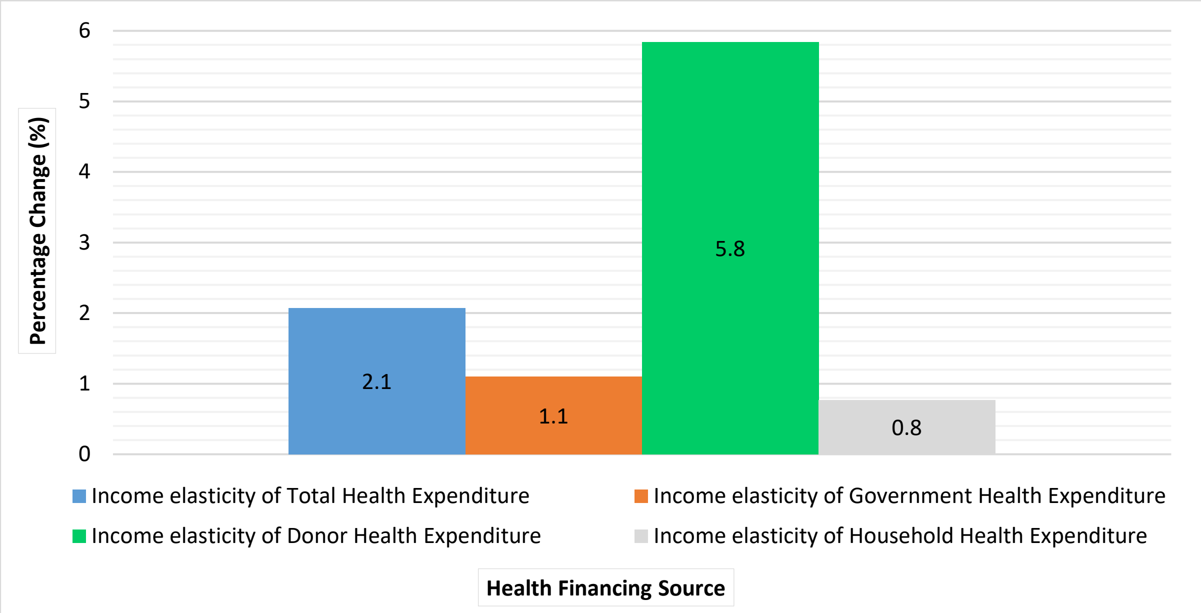


Figure 6: Average Income Elasticity of Health Spending by Financing Sources, 1996-2018



3.1.3 Decomposition of public expenditure on health

To quantify changes in per capita public expenditure on health, the Das Gupta decomposition method (Gupta, 1991;1994) was used to analyse data covering the period 2000-2018. The results are presented in Figure 7. Changes in the macro-fiscal drivers are presented on the left-hand side while the changes in the contribution of the three financing sources are presented on the right-hand side. The results show that the increase in per capita public spending that was observed between 2000 and 2018 in Zambia was mainly due to economic growth and increases in total government spending (left panel). Health de-prioritization (i.e. declining health share of general government spending) occurred during the same period and was the only factor that placed downward pressure on per capita public spending on health in Zambia (left panel). Looking closely at the financing sources (right panel), de-prioritization of health by the Zambia government is reflected in the negligible contribution of the domestic government spending on health to the overall increase in per capita public spending on health in Zambia. As such, the main sources of the growth in per capita public expenditure on health in Zambia over the period 2000-2018 was from on-budget external (donor) funding.

Figure 7: Growth in Public Spending on Health and its Decomposition, 2000-2018

3.2. Decomposition of total health expenditure by key demographic and health factors – a national level analysis

3.2.1 Descriptive analysis

Results from the descriptive analysis are provided in Table 5. The results show that the population increased between 2013 and 2018 as well as the prevalence rate for injuries, non-communicable diseases, and maternal and neonatal disorders. The largest increase in the prevalence rate was for non-communicable diseases. Meanwhile, the prevalence rate for HIV/AIDS and sexually transmitted infections, malaria and neglected tropical diseases, nutritional deficiencies, respiratory infections and tuberculosis, and other infectious diseases went down. Between 2013 and 2018, absolute spending (constant 2010 US$) dropped significantly for nearly all nine level two diseases and conditions. Notably, spending on HIV/AIDS and sexually transmitted infections fell by 46%, malaria and neglected tropical diseases by 45%, and nutritional deficiencies by 35%. Similarly, expenditure per prevalent case reduced between 2013 and 2018 for all the diseases and conditions, particularly for HIV/AIDS and sexually transmitted infections (54%), malaria and neglected tropical diseases (52%), nutritional deficiencies (44%), and non-communicable diseases (36%).

Table 5: Descriptive Statistics - National Level Analysis

Disease	**Population (millions)**		**No. of cases (millions)**		**Prevalence rate**		**Expenditure (US$ millions)**		**Expenditure per prevalent case**		**Changes in expenditure**	**Change in expenditure per prevalent case**
	2013	**2018**	**2013**	**2018**	**2013**	**2018**	**2013**	**2018**	**2013**	**2018**		
HIV/AIDS and sexually transmitted infections	14.9	17.4	4.7	5.4	31,377	31,261	489.57	262.91	32.80	15.15	-46%	-54%
Injuries	14.9	17.4	1.2	1.5	7,783	8,689	27.04	26.54	1.81	1.53	-2%	-16%
Malaria and neglected tropical diseases	14.9	17.4	7.0	6.5	46,827	37,739	192.12	106.34	12.87	6.13	-45%	-52%
Maternal and neonatal disorders	14.9	17.4	0.4	0.4	2,351	2,497	111.11	98.95	7.44	5.70	-11%	-23%
Non-communicable diseases	14.9	17.4	28.7	34.1	191,945	196,574	95.98	71.09	6.43	4.10	-26%	-36%
Nutritional deficiencies	14.9	17.4	4.6	5.3	30,569	30,430	12.63	8.22	0.85	0.47	-35%	-44%
Respiratory infections and tuberculosis	14.9	17.4	3.9	4.0	26,208	22,944	5.05	4.38	0.34	0.25	-13%	-25%
Other infectious diseases	14.9	17.4	0.7	0.7	4,438	4,294	118.55	90.15	7.94	5.20	-24%	-35%
Other unspecified diseases and conditions	14.9	17.4	0.8	1.0	5,368	5,595	32.03	35.48	2.15	2.04	11%	-5%

Prevalence rate=Total number of cases per 100,000 population. Spending is expressed in real US$ values (consumer price index, 2010 = 100).

3.2.2 Decomposition analysis

Four factors (expressed as components) were examined, namely: population growth, changes in the age structure, changes in the prevalence rates, and changes in the expenditure per prevalence case. The results show absolute increases in the population and shifts in the age structure between 2013 and 2018 (Table 6). On the other hand, the disease prevalence rates and expenditure per prevalent case reduced. Expenditure per prevalent case explained 101.7% of the reduction in total health expenditures between 2013 and 2018 in Zambia. Thus, it was by far the main determinant of changes in health expenditures. This was followed by prevalence rates which explained 6.95% of the reduction in total health expenditures. Population growth and shifts in the age structure were inversely associated with the changes in the total health expenditures in Zambia between 2013 and 2018. This means that they mitigated the decline in the total health expenditures by 4.3% each (Table 6). A visual illustration of these results is presented in Figure 8.

Decomposition of the four factors by diseases shows that expenditure per prevalent case caused most of the reduction in spending on HIV/AIDS and sexually transmitted infections (58.4%), followed by non-communicable diseases (25.9%), and malaria and neglected tropical diseases (15.8%) (Table 7). Furthermore, decomposition of the four factors by age group (Table 8) shows that the 15-49 age group accounted for 90.4% of the reduction in the expenditure per prevalent case, followed by the 5-14 age group (7.5%), the 50-69 age group (2.3%), the 0-4 age group (1.4%), and the over 70 age group (0.1%).

Table 6: Decomposition of total health expenditure by Components - 2013 vs 2018

Component	Absolute Difference	Proportion (%)
Population growth	3,252	-4.31
Age structure	3,256	-4.32
Prevalence rate	-5,238	6.95
Expenditure per prevalent case	-76,666	101.68
Total	**-75,396**	**100**

Figure 8: Decomposition of total health expenditure by Components - 2013 vs 2018

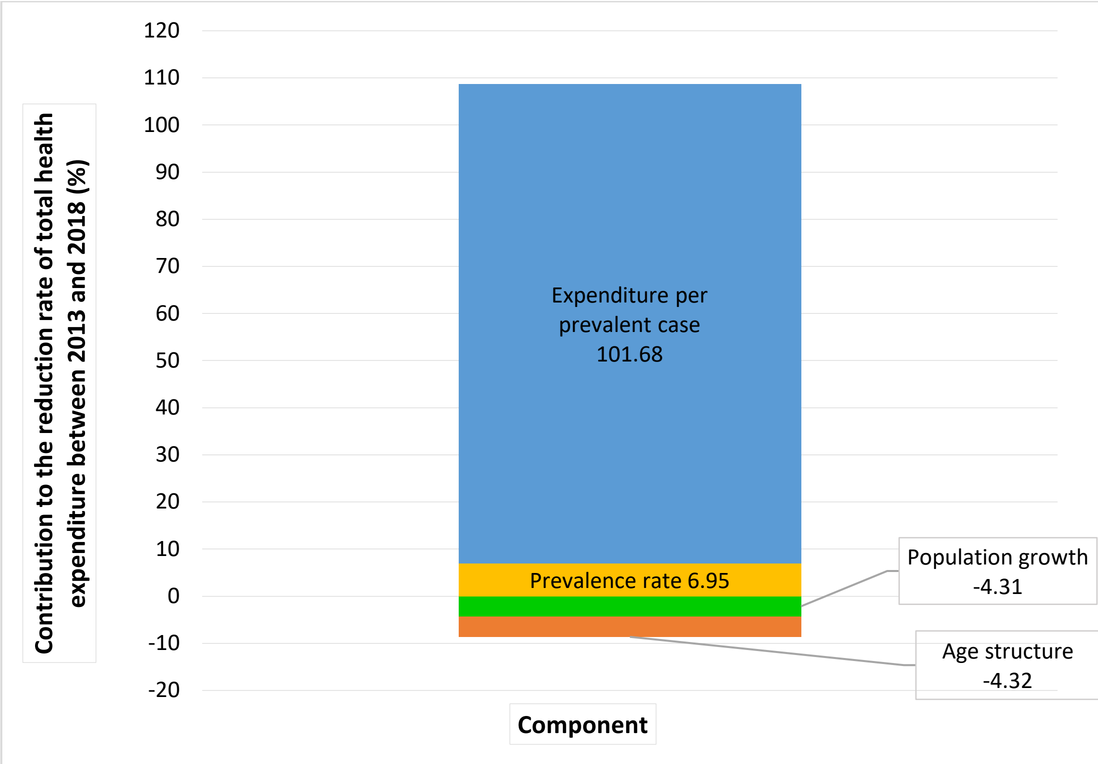


Table 7: Decomposition of Components by Diseases and Conditions - 2013 vs 2018

Disease	**Component**	**Absolute Difference**	**Proportion (%)**	**Rank**
HIV/AIDS and sexually transmitted infections	Population	1,889	-2.51	**1**
	Age structure	1,892	-2.51	
	Prevalence rate	-2,115	2.8	
	Expenditure per prevalent case	**-44,027**	**58.39**	
Injuries	Population	21	-0.03	**7**
	Age structure	21	-0.03	
	Prevalence rate	55.6	-0.07	
	Expenditure per prevalent case	**-130**	**0.17**	
Malaria and neglected tropical diseases	Population	243	-0.32	**3**
	Age structure	243	-0.32	
	Prevalence rate	-3,739	4.96	
	Expenditure per prevalent case	**-11,916**	**15.8**	
Maternal and neonatal disorders	Population	6.49	-0.01	**6**
	Age structure	6.52	-0.01	
	Prevalence rate	32.9	-0.04	
	Expenditure per prevalent case	**-190**	**0.25**	
Non-communicable diseases	Population	1,075	-1.43	**2**
	Age structure	1,075	-1.43	
	Prevalence rate	580	-0.77	
	Expenditure per prevalent case	**-19,509**	**25.88**	
Nutritional deficiencies	Population	-5.07	0.01	**5**
	Age structure	-5.1	0.01	
	Prevalence rate	4.32	-0.01	
	Expenditure per prevalent case	**-360**	**0.48**	
Other infectious diseases	Population	-12.9	0.02	**4**
	Age structure	-13	0.02	
	Prevalence rate	-21.4	0.03	
	Expenditure per prevalent case	**-367**	**0.49**	
Other unspecified diseases and conditions	Population	29	-0.04	**9**
	Age structure	29.1	-0.04	
	Prevalence rate	11.1	-0.01	
	Expenditure per prevalent case	**-69.9**	**0.09**	
Respiratory infections and tuberculosis	Population	6.98	-0.01	**8**
	Age structure	6.99	-0.01	
	Prevalence rate	-46.8	0.06	
	Expenditure per prevalent case	**-95.6**	**0.13**	
Overall		**-75,396**	**100.0**	

Table 8: Decomposition of Components by Age-groups, 2013 vs 2018

Age Group	Component	Absolute Difference	Proportion (%)	Rank
0-4	Population	-141	0.19	4
	Age structure	-141	0.19	
	Prevalence rate	-138	0.18	
	Expenditure per prevalent case	**-1,060**	**1.41**	
5-14	Population	-216	0.29	2
	Age structure	-217	0.29	
	Prevalence rate	-1,002	1.33	
	Expenditure per prevalent case	**-5,629**	**7.47**	
15-49	Population	3,463	-4.59	1
	Age structure	3,470	-4.60	
	Prevalence rate	-4,166	5.52	
	Expenditure per prevalent case	**-68,153**	**90.39**	
50-69	Population	143	-0.19	3
	Age structure	142	-0.19	
	Prevalence rate	65.6	-0.09	
	Expenditure per prevalent case	**-1,718**	**2.28**	
70+	Population	3.13	0.00	5
	Age structure	1.72	0.00	
	Prevalence rate	1.66	0.00	
	Expenditure per prevalent case	**-106**	**0.14**	
Total		**-75,396**	**100**	

3.3. Main determinants of government health expenditure at provincial level in Zambia

3.3.1 Descriptive analysis

Table 9 provides the basic characteristics of the variables that were used in the analysis before they were converted into logarithms. On average, per capita provincial government health expenditure was ZMW129.69 but there is a wide variation, ranging from ZMW74.54 to ZMW204.30. Further, as shown in Figure 9, per capita government health expenditure was constantly declining in all the provinces over the period 2014 and 2019; and it was always below the per capita government health budget. There are also wide variations in the provincial GDP per capita across the 10 provinces. The provincial GDP per capita was consistently higher in three provinces (Northwestern, Lusaka, and Copperbelt) as compared to the other provinces (Figure 10). However, except for Northwestern province where the provincial GDP per capita increased and declined over the period 2014 to 2019, it remained relatively consistent in almost all the other provinces (Figure 10). For the non-income variables, wide variations were also observed (Table 9).

Table 9: Descriptive Statistics - Provincial Level Analysis

Variables	Obs	Mean	Std. dev.	Min	Max
Dependent variable					
Provincial per capita government health expenditure (ZMW)	60	129.69	35.03	74.54	204.3
Economic growth (Income variable)					
Provincial GDP per capita (ZMW)	60	7,442.21	4,841.81	3,047.7	20,632
Demographic (Non-income variable)					
Population density (No. of people per sq. km)	60	35.57	38.97	6.45	147.9
Population under 15	60	48.74	2.57	41.42	52.22
Population over 65	60	2.79	0.55	1.62	3.87
Institutional (Non-income variable)					
No. of health facilities per 10,000 population	40	1.38	0.54	0.52	2.76
No. of skilled health providers per 10,000 population	60	12.22	4.25	5.2	22.4
Population health status (Non-income variable)					
Outpatient and inpatient attendances per 10,000 population	60	14,826.8	4,294.62	6,050	24,317
TB notifications per 10,000 people	60	20.14	13.25	5.91	61.02
Social (Non-income variable)					
Urbanisation (share of the population in urban residence)	60	34.00	26.07	12	86.1

Obs=observations; Std. dev.=standard deviation; Min=minimum; Max=maximum

Figure 9: Per capita Government Budget and Expenditure by Province: 2014-2019

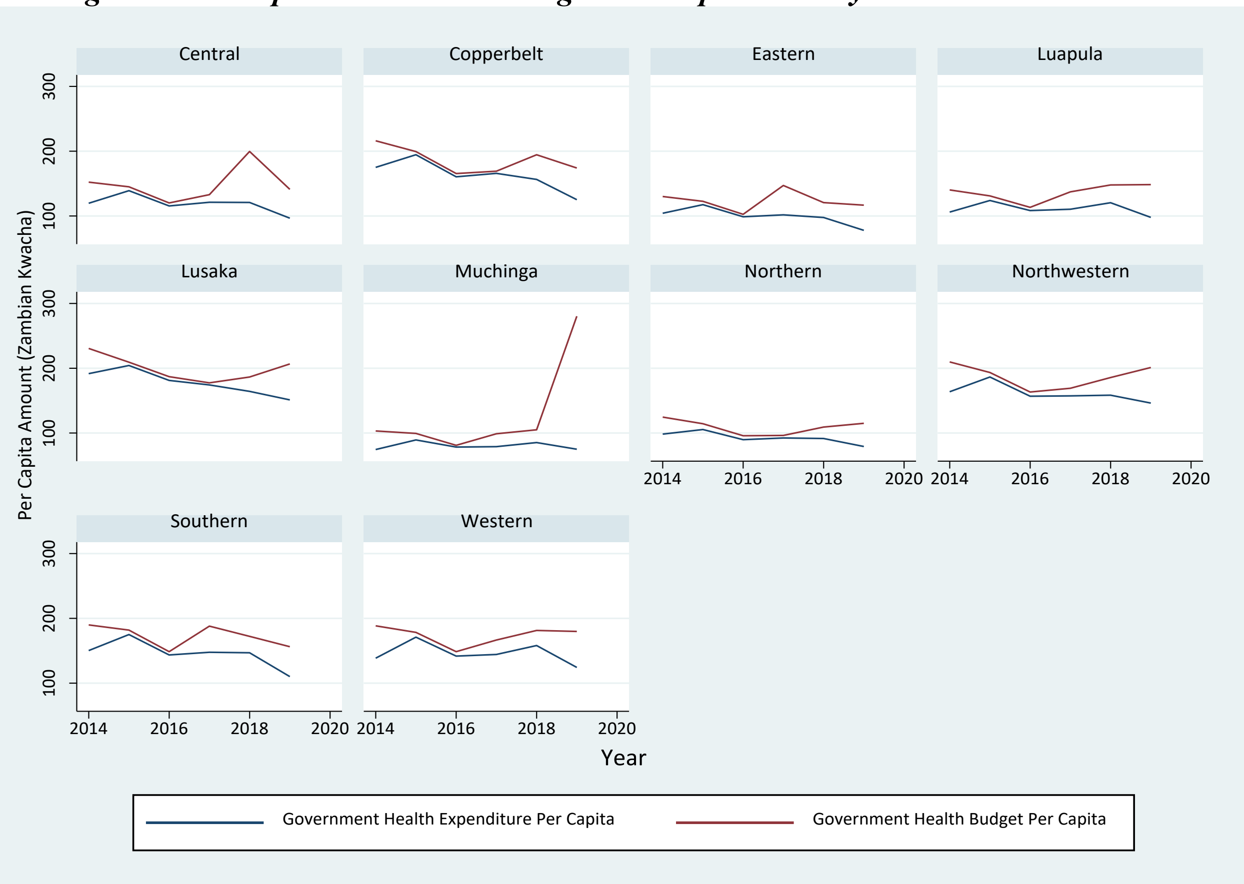
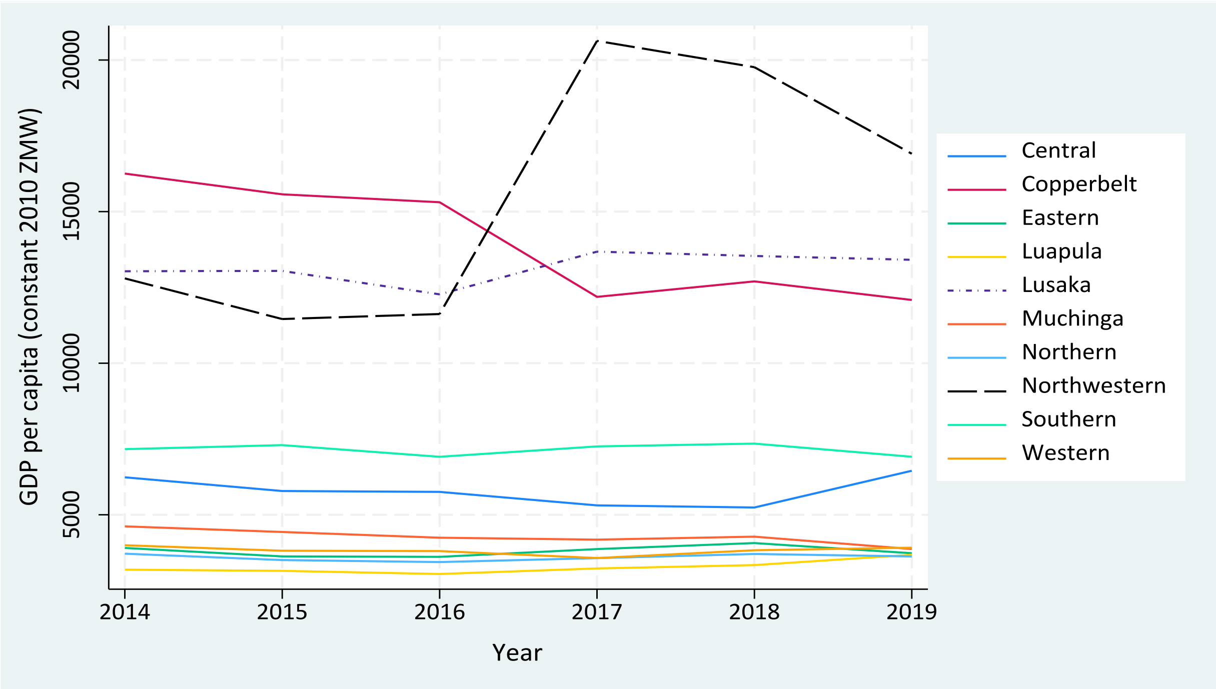
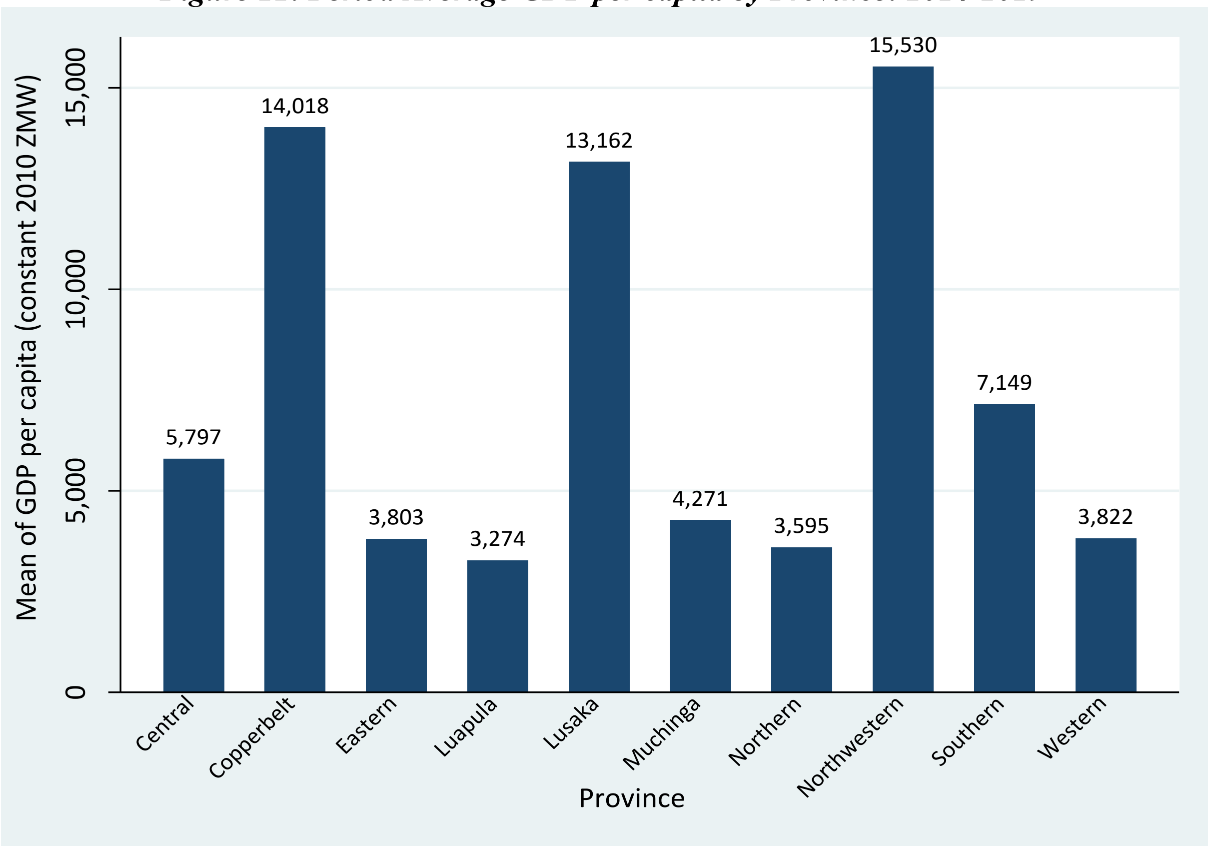


Figure 10: Trends in Provincial GDP per capita: 2014-2019



ZMW = Zambian Kwacha

Figure 11: Period Average GDP per capita by Province: 2014-2019



ZMW = Zambian Kwacha

3.3.2 Single regression analysis

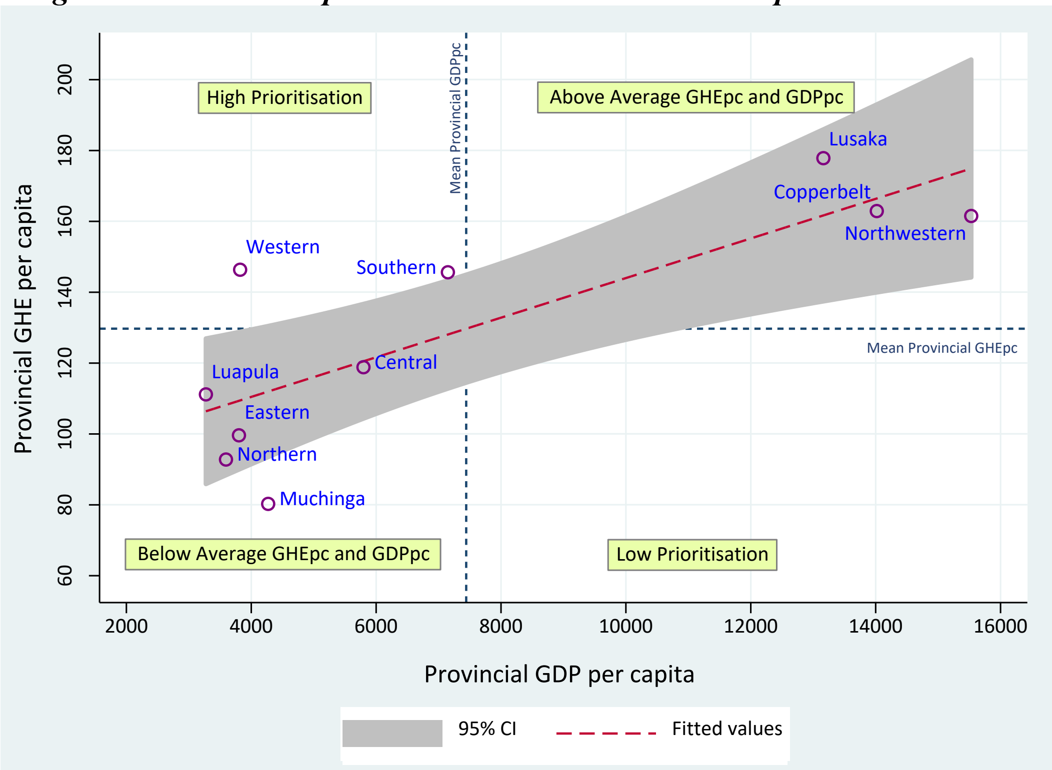
A scatter plot (with a linear regression line and a 95% confidence interval) was used to conduct a first order analysis of the relationship between provincial government health expenditure per capita (GHEpc) and provincial GDP per capita (GDPpc) (Figure 12). The averages of the provincial GHEpc and the provincial GDPpc over the period 2014-2019 were used. The data points represent the 10 provinces of Zambia, and the graph is divided into quadrants based on the national mean values of GDPpc and GHEpc at provincial level. This categorisation is aimed at placing the provinces into different levels of prioritization of health expenditure.

In general, the results show a positive relationship between provincial GHEpc and GDPpc, indicating that wealthier provinces tend to spend more on health in Zambia. This finding corroborates Wagner's law which suggests that there is a long-run propensity for government expenditure to grow as national income grows (Wagner, 1892). However, further analysis shows that only three provinces (Lusaka, Copperbelt, Northwestern) fall in the top right quadrant (above average GHEpc and GDPpc) meaning that they are relatively wealthier and prioritize health expenditure as predicted by the regression line. On the other hand, two provinces (Western and Southern) fall into the top left quadrant (high prioritisation). These provinces have below-average GDP per capita but above-average GHE per capita. This implies that even though these provinces have lower income, they prioritize health spending more than expected. Lastly, five provinces (Luapula, Central, Eastern, Northern, Muchinga) fall in the bottom left quadrant (below average GHEpc and GDPpc) meaning that they are relatively poorer and spend less on health per capita as predicted by the regression line. It is also worth noting that within the bottom left quadrant, Luapula province is more efficient than the other provinces while Muchinga is the least efficient.

Notwithstanding the results, the scatter plot is unable to sufficiently show the direction of the relationship between provincial GHEpc and GDPpc. Secondly, widening of the confidence interval at higher GDPpc values and dispersion of some of the data points from the trend line implies that there is some variability. Thirdly, Western, Southern, and Muchinga provinces are outliers, which suggests that other than GDPpc, there are factors influencing health spending at provincial level. To fully evaluate all the factors influencing government health expenditures at provincial level, a panel regression analysis was conducted, and the results are presented in sub-section 3.3.3. Meanwhile, a single regression analysis of provincial GHEpc verses GDPpc shows that there was a positive relationship between the two variables in only five provinces

(Copperbelt, Lusaka, Northwestern, Southern, and Western) (Table 10). In three of the provinces (Eastern, Muchinga, and Northern), a negative relationship was observed. Furthermore, the results in Luapula province are statistically insignificant.

Figure 12: Relationship Between Government Health Expenditure and GDP



GHEpc=Government Health Expenditure per capita, GDPpc=Gross Domestic Product per capita, GHE=Government Health Expenditure, GDP=Gross Domestic Product

Table 10: Provincial Government Health Expenditure vs Provincial GDP

Province	Coefficient	SE	t	P>|t|	[95% conf. interval]	
Copperbelt	0.3596*	0.1501	2.4000	0.0200	0.0580	0.6612
Eastern	-0.2006*	0.0922	-2.1800	0.0340	-0.3859	-0.0153
Luapula	-0.0948	0.1096	-0.8600	0.3920	-0.3151	0.1255
Lusaka	0.4482**	0.1424	3.1500	0.0030	0.1620	0.7344
Muchinga	-0.4052***	0.0808	-5.0100	0.0000	-0.5676	-0.2428
Northern	-0.2711**	0.0983	-2.7600	0.0080	-0.4687	-0.0735
Northwestern	0.3613*	0.1613	2.2400	0.0300	0.0372	0.6854
Southern	0.2113**	0.0736	2.8700	0.0060	0.0634	0.3592
Western	0.1865*	0.0916	2.0400	0.0470	0.0024	0.3707
Constant	5.2375***	1.3304	3.9400	0.0000	2.5639	7.9110

* p<.05; ** p<.01; *** p<.001

3.3.3 Panel regression analysis

As indicated in the methods section, robustness checks were done before running the panel regression analysis. The tests indicated that the fixed-effects model was ideal, there was no cross-sectional dependence, and that there was groupwise heteroskedasticity (see Appendix 5). To control for heteroskedasticity, the fixed-effects model was run in "robust" model in Stata. The random-effects (in robust mode) and PCSE regression models were also used. Summary of the results from the panel regression analysis are presented in Table 11. The results show that there is a positive relationship between per capita government health expenditure (dependant variable) and provincial GDP per capita, and number of health facilities per 10,000 population, number of TB notifications per 10,000 people. On the other hand, there is a positive relationship between per capita government health expenditure and urbanisation (share of the provincial population in urban residence).

Table 11: Summary of Results from the Panel Regression Analysis

Variable	**Fixed**	**Random**	**PCSE**
Provincial GDP per capita	-0.212891	**0.1897717****	**0.1897717****
Population density (No. of people per sq. km)	-1.392115	0.0334069	0.0334069
Population under 15	0.4780845	0.1332447	0.1332447
Population over 65	-0.6216952	-0.0047868	-0.0047868
No. of health facilities per 10,000 population	**0.1894528***	**0.2749919*****	**0.2749919*****
No. of skilled health providers per 10,000 population	0.0157914	0.0718916	0.0718916
Outpatient and inpatient attendances per 10,000 population	-0.2436247	-0.1413952	-0.1413952
TB notifications per 10,000 people	-0.0087474	**0.3309908*****	**0.3309908*****
Urbanisation (share of the population in urban residence)	1.040617	**-0.0884632*****	**-0.0884632****
Constant	8.608073	2.976455	2.976455
N	40	40	40
R-squared	0.5580220		0.8805368
Adjusted R-squared	0.4254286		

PCSE=correlated panels corrected standard errors * p<.05; ** p<.01; *** p<.001

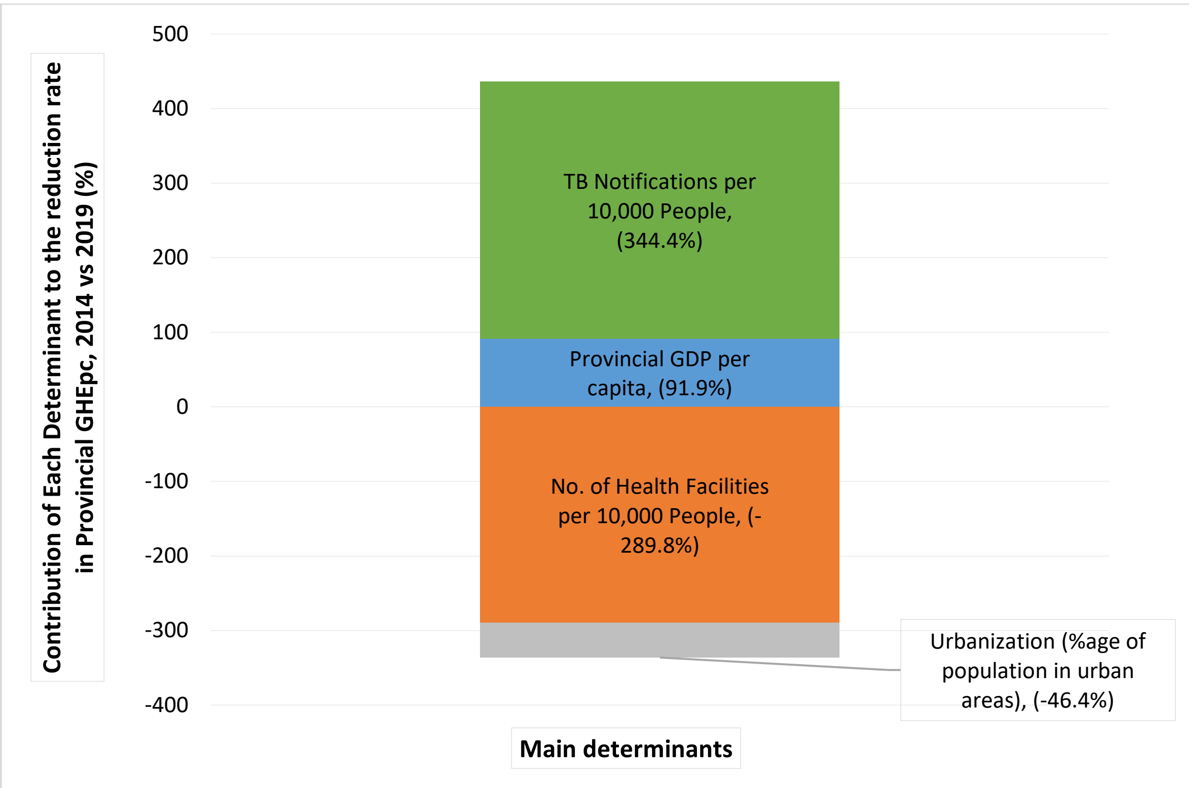
3.3.4 Decomposition analysis

As observed in Table 11 above, provincial per capita government health expenditure is positively associated with changes in the provincial GDP per capita, number of health facilities per 10,000 population, and number of TB notifications per 10,000 people; and negatively associated with the level of urbanisation. Using the Das Gupta decomposition method (Gupta, 1991; Zhai et al. 2017), these four variables were further analysed aimed at quantifying the changes attributable to each variable by province. The results show a large decrease in the provincial per capita government health expenditure between 2014 and 2019 (Table 12). The main drivers of the reduction across the provinces were the number of TB notifications per 10,000 population (which contributed 344.4% of the overall decrease) and provincial GDP per capita (which contributed 91.9% of the overall decrease) (Table 12 and Figure 13). On the other hand, across the provinces, the number of health facilities per 10,000 population offset 289.8% of the overall reduction in provincial per capita government health expenditure. This suggests that regions with more health facilities per 10,000 population have higher government health expenditure. Similarly, the level of urbanisation across the province had a mitigating effect on the overall reduction in provincial per capita government health expenditure as it counteracted 46.4% of the total decrease (Table 12 and Figure 13).

Table 12: Decomposition of the Main Determinants of Provincial GHEpc, 2014 vs 2019

Component	Absolute Difference	Proportion (%)
Provincial GDP per capita	-7,217,789	91.86
No. of Health Facilities per 10,000 People	22,774,530	-289.84
TB Notifications per 10,000 People	-2,705,964	344.37
Urbanization (share of the population in urban residence)	3,645,292	-46.39
Overall	**-7,857,614**	**100.00**

Figure 13: Decomposition of the Main Determinants of Provincial GHEpc, 2014 vs 2019



The decomposition analysis was also done by province to get a detailed view of the contributions of the four variables by province. The results are presented in Table 13 and Figures 14 and 15. The results show that across the provinces, the number of TB notifications per 10,000 population was the main driver of the reduction in provincial per capita government health expenditure in Lusaka province (184.3%), Copperbelt province (71.2%), Northwestern province (27.1%), Central province (23.6%), and Southern province (23.5%) (Figure 15a). Secondly, GDP per capita was the main driver of the reduction in provincial per capita government health expenditure in Copperbelt province (152.8%) but it had a mitigating effect on the overall reduction in provincial per capita government health expenditure in Northwestern province (-48.6%) and Lusaka province (-13.8%) (Figure 15b).

Meanwhile, the number of health facilities per 10,000 population mitigated the overall reduction in provincial per capita government health expenditure in Copperbelt province (-213.5%) and Lusaka province (-207.5%); but contributed to the reduction in provincial per capita government health expenditure in Northwestern province (101.9%) and Western province (13.1%) (Figure 15c). Lastly, the level of urbanisation had a mitigating effect in all the provinces except for Western province (1.4%) and Central (0.0) (Figure 15d). In particular, urbanisation mitigated 30.5% of the reduction in provincial per capita government health expenditure in Northwestern province, followed by Copperbelt, Lusaka, Southern, and Muchinga provinces by 7.4%, 2.8%, 2.5%, and 2.3%, respectively (Figure 15d).

Table 13: Decomposition of the Main Determinants by Province - 2014 vs 2019

Province	Component	Absolute Difference	Proportion (%)
Central	Provincial GDP per capita	91,009	-1.16
	No. of Health Facilities per 10,000 People	-409,468	5.21
	TB Notifications per 10,000 People	-1,850,861	23.56
	Urbanization (share of the population in urban residence)	0.0000	-0.00
Copperbelt	Provincial GDP per capita	-12,007,690	152.82
	No. of Health Facilities per 10,000 People	16,774,034	-213.47
	TB Notifications per 10,000 People	-5,591,244	71.16
	Urbanization (share of the population in urban residence)	583,956	-7.43
Eastern	Provincial GDP per capita	-26,096	0.33
	No. of Health Facilities per 10,000 People	28,956	-0.37
	TB Notifications per 10,000 People	-315,806	4.02
	Urbanization (share of the population in urban residence)	23,435	-0.30
Luapula	Provincial GDP per capita	204,259	-2.60
	No. of Health Facilities per 10,000 People	-426,018	5.42
	TB Notifications per 10,000 People	-229,539	2.92
	Urbanization (share of the population in urban residence)	138,637	-1.76
Lusaka	Provincial GDP per capita	1,086,509	-13.83
	No. of Health Facilities per 10,000 People	16,306,828	-207.53
	TB Notifications per 10,000 People	-14,483,304	184.32
	Urbanization (share of the population in urban residence)	221,150	-2.81
Muchinga	Provincial GDP per capita	-154,976	1.97
	No. of Health Facilities per 10,000 People	-442,214	5.63
	TB Notifications per 10,000 People	-181,406	2.31
	Urbanization (share of the population in urban residence)	179,136	-2.28
Northern	Provincial GDP per capita	-23,312	0.30
	No. of Health Facilities per 10,000 People	-86,471	1.10
	TB Notifications per 10,000 People	407,384	-5.18
	Urbanization (share of the population in urban residence)	19,845	-0.25
Northwestern	Provincial GDP per capita	3,817,566	-48.58
	No. of Health Facilities per 10,000 People	-8,007,869	101.91
	TB Notifications per 10,000 People	-2,126,376	27.06
	Urbanization (share of the population in urban residence)	2,396,264	-30.50
Southern	Provincial GDP per capita	-165,218	2.10
	No. of Health Facilities per 10,000 People	67,855	-0.86
	TB Notifications per 10,000 People	-1,848,542	23.53
	Urbanization (share of the population in urban residence)	195,715	-2.49
Western	Provincial GDP per capita	-39,839	0.51
	No. of Health Facilities per 10,000 People	-1,031,102	13.12
	TB Notifications per 10,000 People	-839,952	10.69
	Urbanization (share of the population in urban residence)	-112,847	1.44
Total		**-7,857,614**	**100.00**

Figure 14: Overall Contributions of Main Determinants to the Reduction Rate in Provincial GHEpc by Province, 2014 vs 2019

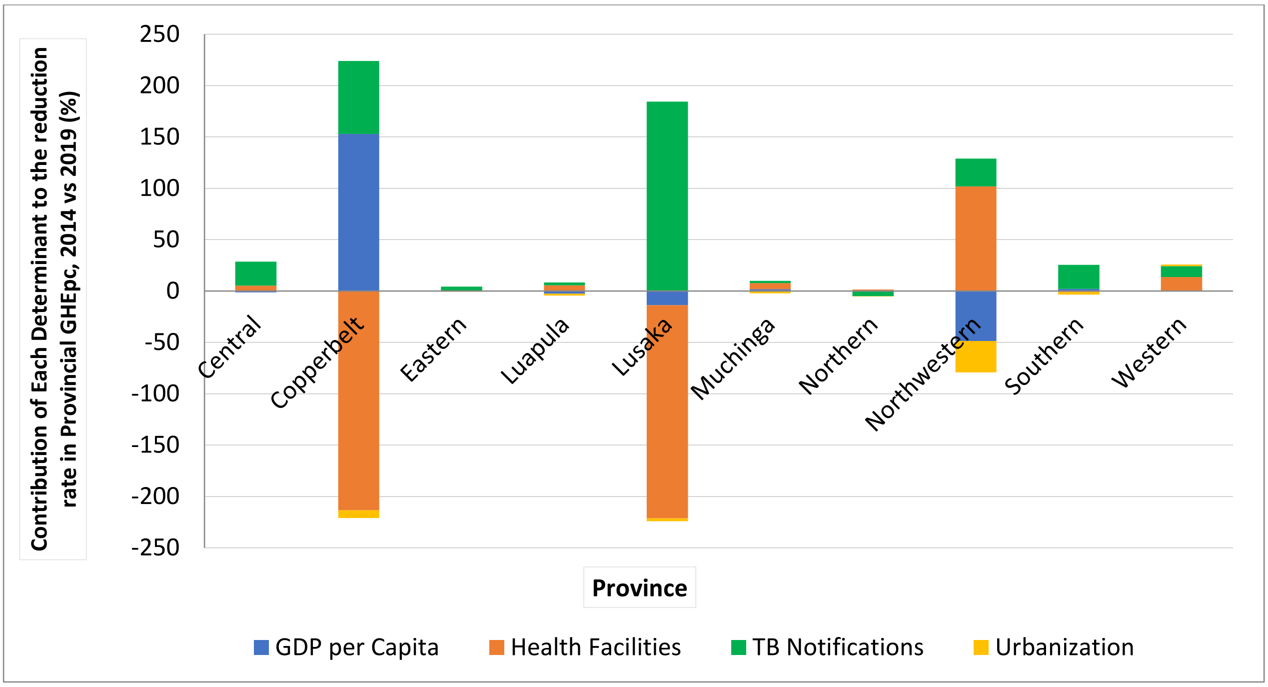
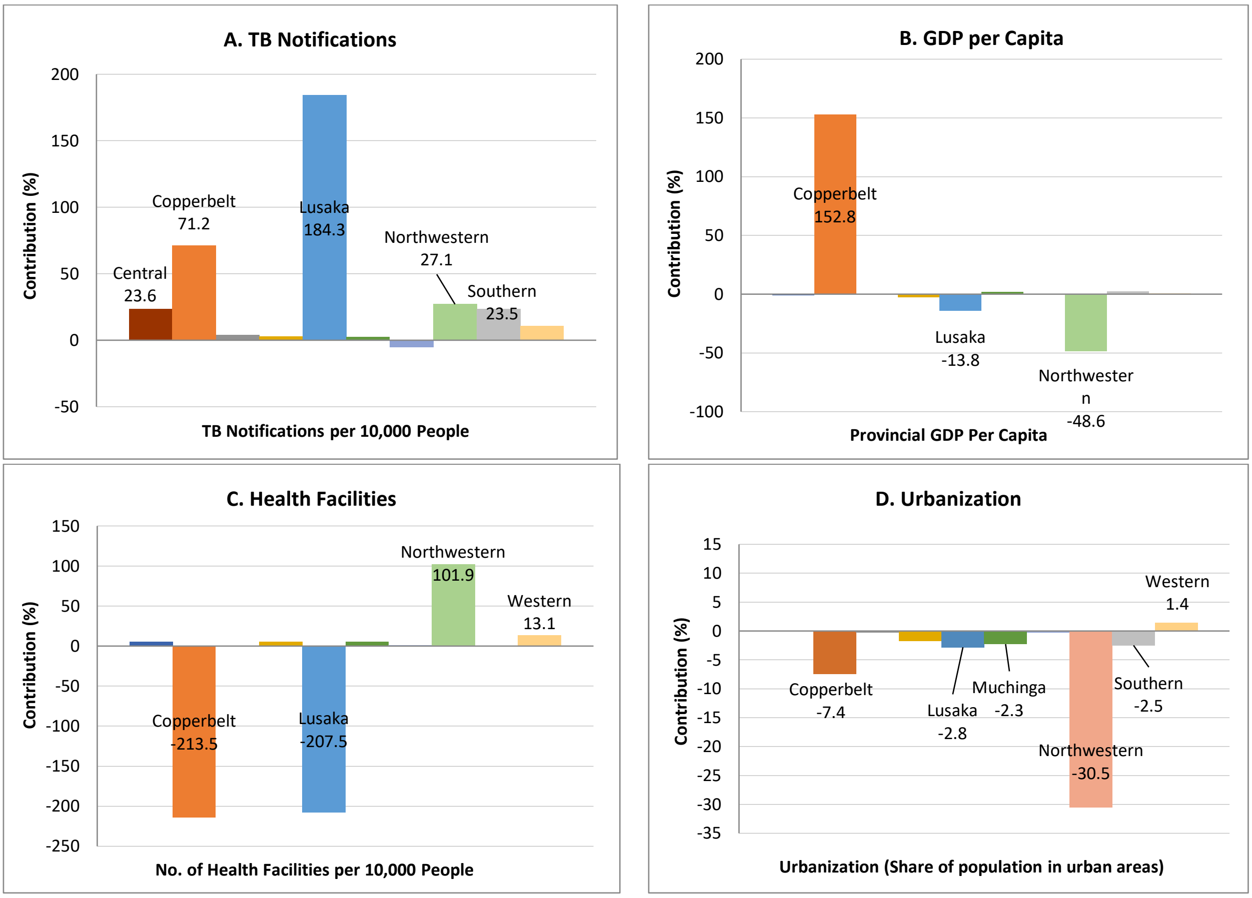


Figure 15: Contribution of Each Determinant to the Reduction Rate in Provincial GHEpc by Province, 2014 vs 2019

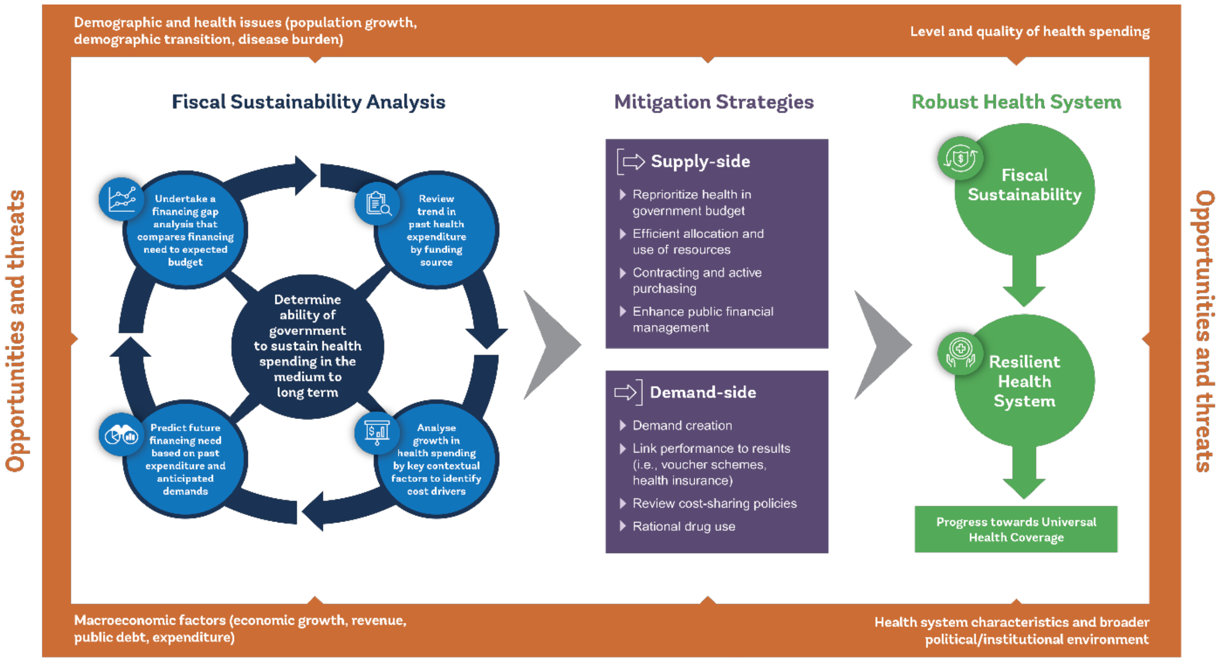


3.4. Analytical framework for fiscal sustainability of a health system

Figure 16 presents a framework for analysing fiscal sustainability of health systems in LLMICs that was adapted through the study. The framework is presented in three parts, namely: (i) fiscal sustainability analysis, (ii) mitigation strategies, and (iii) robust health system. The fiscal sustainability analysis (column 1) is the diagnosis part where national governments can determine if their health system is sustainable in the medium to long term. This can be done in four steps: (a) reviewing trends in past health expenditures by funding sources, (b) analysing growth in health expenditures by economic, demographic, health, and other key factors to identify the main cost drivers, (c) predicting future health financing needs based on past expenditures and anticipated demands, and (d) undertaking a health financing gap analysis. In the second column, mitigation strategies can be undertaken to address or lessen the health financing gap. This can be achieved through supply- and demand-strategies. Some of the supply-side strategies include reprioritisation of health in the national budget, efficient allocation and use of available resources, contracting and active purchasing, and enhancing public financial management. The demand-side interventions could include: demand creation, linking performance to results (voucher schemes, health insurance, etc), cost-sharing schemes, and rational drug use.

It is anticipated that the mitigation strategies would make the health system fiscally sustainable and resilient; and lead to the attainment of UHC (column 3). However, implementation of health programs and interventions, and mitigation strategies are constantly exposed to opportunities and threats. These are highlighted is the outer orange section of the framework. The opportunities and threats include: macroeconomic factors (economic growth, revenue, public debt, national expenditure); demographic and health issues (population growth, demographic transition, disease burden); level and quality of health spending; health system characteristics; and political/institutional issues. This means that for a health system to be fiscally sustainable, opportunities need to be seized while the threats need to be addressed repeatedly. This means that having a fiscally sustainable health system is a continuous process of checks and balances.

Figure 16: Analytical Framework for Fiscal Sustainability of a Health System



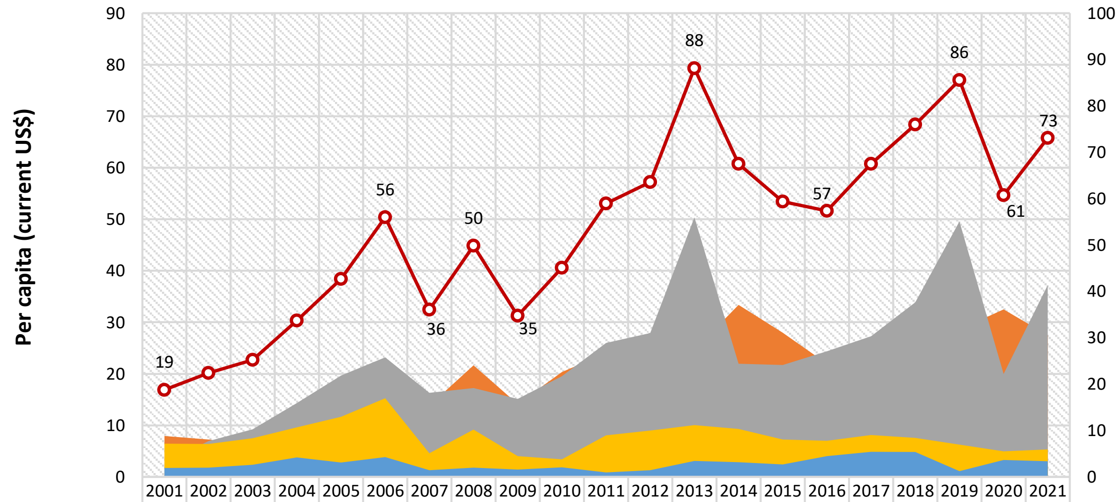
3.5. Fiscal sustainability analysis of the health system in Zambia

The analytical framework for fiscal sustainability of a health system (Figure 16) that was devised through the study was applied in Zambia. All the four steps under the diagnostic part of the framework (first column) were followed. The aim of the first part of the framework is to determine the ability of the government to sustain health spending in the medium to long-term. This includes an analysis of spending patterns, sufficiency/adequacy of funding, and efficiency/effectiveness. The results are presented below.

3.5.1 Review trends in past health spending by financing sources

Step one in the diagnostic part of the analytical framework involves a review of the trends in past health spending by financing sources. The results show a fluctuating but increasing trend in total health spending (in nominal terms) from US$19 per capita in 2001 to US$73 per capita in 2021 (Figure 17). On average, external (donor) financiers at US$23.1 per capita contributed the largest share (43%) of the total current health expenditure in Zambia each year over the period 2001-2021. This was followed by the Zambian government who contributed US$20.1 per capita per year (38% of the total current health expenditure); and households and employers who contributed US$7.7 per capita (14%) and US$2.6 (5%) of the total current health expenditure during the period 2001-2021, respectively. In absolute terms (current US$), external health expenditure increased nearly 14 times between 2001 and 2021, whereas government health expenditure quadrupled during the same period (Figure 17).

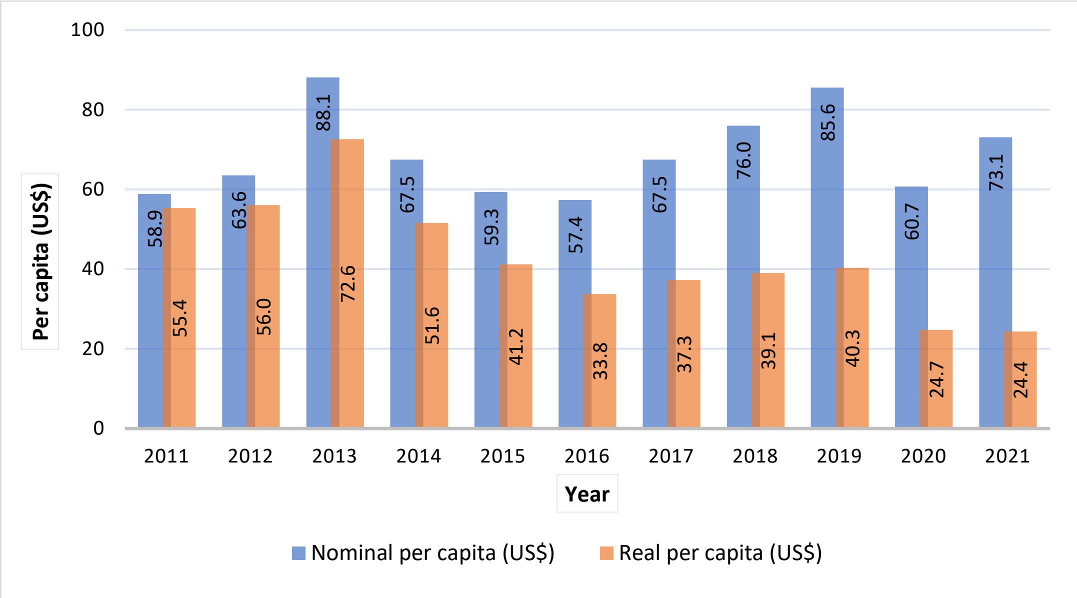
Figure 17: Trends in per capita Health Spending in Zambia, 2001–2021



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Government	7.9	7.3	6.2	6.0	8.5	13.7	13.8	21.6	14.1	20.3	24.0	25.4	24.6	33.4	28.0	22.0	27.2	29.7	28.6	32.5	27.5
External	2.7	7.0	9.3	14.3	19.7	23.2	16.3	17.3	15.1	19.5	26.0	27.9	50.4	22.0	21.7	24.4	27.3	33.9	49.6	20	37.2
Households	6.4	6.4	7.5	9.6	11.7	15.3	4.6	9.2	4.0	3.4	8.1	9.0	10.1	9.3	7.3	7.0	8.1	7.6	6.2	4.9	5.4
Employers	1.7	1.8	2.3	3.8	2.8	3.8	1.3	1.8	1.4	1.8	0.8	1.3	3.1	2.8	2.4	4.0	4.9	4.8	1.1	3.3	3.0
Total CHEpc	18.8	22.4	25.3	33.7	42.7	56.0	36.0	49.8	34.7	45.1	58.9	63.6	88.1	67.5	59.3	57.4	67.5	76.0	85.6	60.7	73.1

To gauge the actual value of total health spending in Zambia over the past decade (2011-2021), the nominal amounts were converted to real figures aimed at addressing inflation-induced growth. To do this, the consumer price index (2010=100) was used. The consumer price index uses Laspeyre's formula to incorporate changes in the cost of acquiring a basket of goods and services over time. The results show a significant decline in total per capita health spending in Zambia between 2011 and 2021. For instance, while the real value was 94% of the nominal value in 2011, the real value was only 33.4% of the nominal value in 2021 (Figure 18). This suggests that over the years, the level of funding in Zambia has been declining and is insufficient if compared to the benchmark of US$86 per capita (Mcintyre et al. 2017).

Figure 18: Adequacy of Past Financing – Nominal vs Real Spending



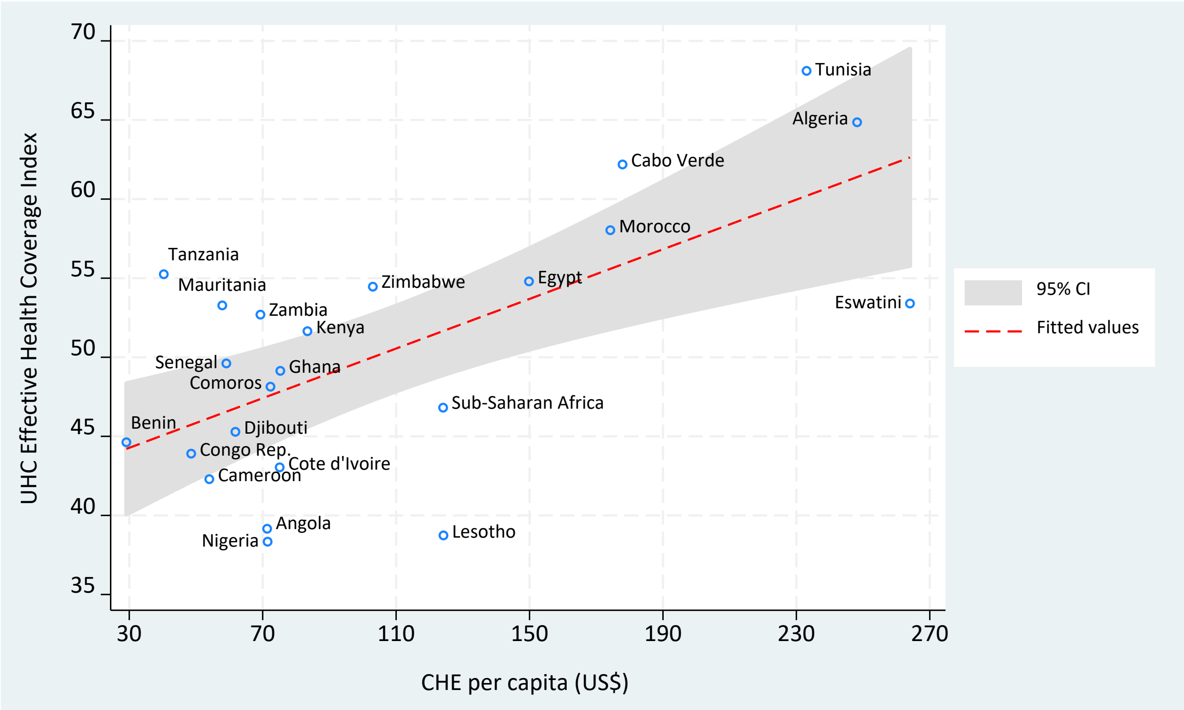
In addition to looking at the adequacy of funding, it is also important to look at efficiency of overall health spending. To do this, the benchmarking approach, as recommended by (Hafez, 2020), was used to evaluate if health spending in Zambia is efficient by comparing the UHC effective service coverage index[7] to the overall per capita current health spending. Considering that Zambia was a LMIC in 2019, comparisons were made to other LMICs in Africa in 2019. The results show that Zambia is more efficient than most of its peers (Nigeria, Angola, Cote d'Ivoire, Comoros, Ghana, Kenya, Lesotho, and Eswatini) at using available resources to produce health services (Figure 19). For example, with only US$69.3 per capita spending on health in 2019, Zambia had a UHC effective service coverage index score of 52.7. Meanwhile, Lesotho and Eswatini spent US$124.2 and US$264.1 per capita on health in 2019 but they scored 38.7 and 53.4 on the UHC effective service coverage index (Figure 19). Zambia's score on the UHC effective service coverage index is even better than the average score for sub-Saharan Africa. However, Zambia was less efficient than Tanzania and Mauritania.

Most of the data points in Figure 19 fall inside the 95% confidence interval (grey shaded area on the graph). This means that for most of the countries, their UHC effective service coverage index scores fall within the expected range given their CHE per capita. In other words, most of the data points are within the regression model's estimation of the relationship between the two

[7] The UHC service coverage index combines 16 tracer indicators of service coverage organized by four components of service coverage (reproductive, maternal, newborn and child health; infectious diseases; non-communicable diseases) into a single summary measure.

variables. The data points for Zambia lie outside the confidence interval which implies that, other than CHE per capita, there may be other factors influencing the UHC effective service coverage index score.

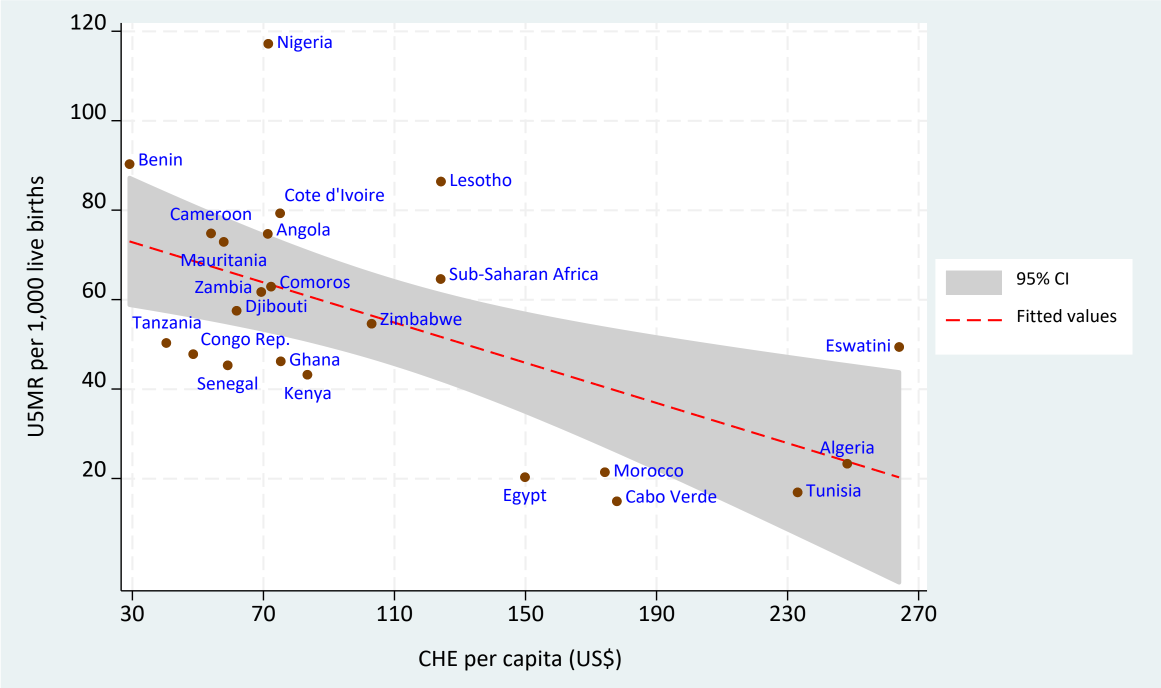
Figure 19: Benchmarking Efficiency in Spending - Zambia vs Peer Countries, 2019



UHC=Universal Health Coverage, CHE=Current Health Expenditure, CI=Confidence Interval

The benchmarking approach (Hafez, 2020) was also used to assess the effectiveness of overall health spending. Zambia was compared to other LMICs in Africa in 2019 given that Zambia was a LMIC in 2019. For the benchmarking on effectiveness, the objective was to gauge Zambia's ability to produce better health outcomes from the available resources. In this regard, one of the key health outcomes (under-5 mortality rate) was compared to the overall per capita current health spending. The results show that Zambia is more effective than Nigeria, Cote d'Ivoire, Angola, Comoros, and Lesotho at producing better child health outcomes (lower under-5 mortality rate). Zambia's is even effective than the average for sub-Saharan Africa. Furthermore, the data points for Zambia fall inside the 95% confidence interval (grey shaded area on the graph) which implies that the under-5 mortality rate is within the expected range given Zambia's CHE per capita. However, Zambia is less effective than Tanzania, Congo Republic, Senegal, Djibouti and Ghana (Figure 20).

Figure 20: Benchmarking Effectiveness in Spending - Zambia vs Peer Countries, 2019



U5MR=Under-5 Mortality Rate, CHE=Current Health Expenditure, CI=Confidence Interval

3.5.2 Analyse growth in health spending by key contextual factors

Step two in the diagnostic part of the analytical framework involves analysing growth in health spending by key contextual factors. These analyses were undertaken in the first objective of the study. This includes regression and decomposition analyses of the effect of income and non-income factors on changes in health spending at national and sub-national levels.

3.5.3 Future resources and financing need

Step three in the diagnostic part of the analytical framework entails predicting future health financing needs (based on the total cost of priority programmes) and mapping the availability resources in future from all the main sources of health financing. In addition to the historical spending, financing needs also include anticipated demands. These demands are from existing and expected increases in the disease burden, perennial and sporadic disease outbreaks (i.e. cholera), new health facilities, and the annual population growth rate. To estimate the total health financing need, information on the cost of providing priority programmes was used. This information was obtained from existing documents as explained in the methods section. For the expected funding to the health sector, the data was obtained from the medium-term expenditure framework at the Ministry of Finance and National Planning, results from a resource mapping survey that was undertaken by the Ministry of Health (Ministry of Health, 2023a), and national health account survey reports (Ministry of Health, 2018b; Ministry of Health, 2023b).

3.5.4 Financing gaps analysis and forecasting of the future health financing landscape

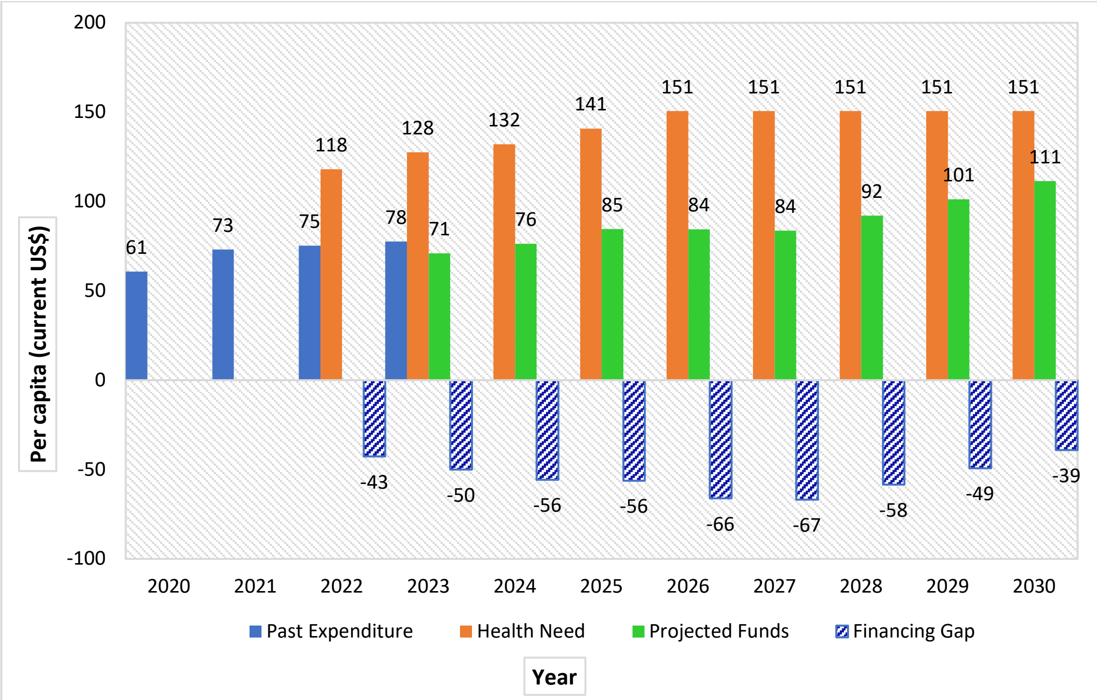
Step four in the diagnostic part of the analytical framework involves estimation of the total health financing gap or surplus by: (a) predicting the total expected health spending based on past trends and anticipated future challenges; (b) calculating the health financing need; and (c) subtracting the total expected health spending from the total health financing need to obtain the financing gap.

Descriptive health financing analysis

Using the numbers provided in Tables 3 and 4 (see the methods section), the total expected health funding and the total health financing need are projected to 2030. The numbers are expressed in per capita terms in order to maintain the value of the need vis-à-vis the population growth. For 2025-2026, the total expected health funds are assumed to be as predicted in the Zambia National Health Strategic Plan (2022-2026) (Table 4 in the methods section) and are expected to increase at an annual rate of 10% from 2027 to 2030. The total per capita health financing need is assumed to be US$141 in 2025, US$151 in 2026, and from 2027-2030 it is assumed to remain at the 2026 level (i.e. US$151 per capita). For the historical period (2022-2023), the projected funding, actual total health expenditure, and the total health financing need were extracted from the resource mapping, NHA data, and the Zambia National Health Strategic Plan (2022-2026), respectively. See Tables 3 and 4 in the methods section.

The results show that only US$75 per capita was spent on health in Zambia in 2022 even though US$118 per capita was required leading to a financing gap of US$43 per capita. In 2023, US$78 per capita was spent while US$128 per capita was required, leading to a financing gap of US$50. Over the period 2024-2030, the financing gap is projected to range from US$39 to US$67 per capita (Figure 21).

Figure 21: Financing Gap Analysis, 2022-2030



Predictive health financing analysis

Using the numbers in Tables 3 and 4, a predictive analysis was used to establish the: (a) total expected (pledged/committed) per capita funding on health, (b) total health financing need in per capita terms, and (c) total anticipated actual per capita spending on health over the period 2025 to 2030. All figures are expressed in per capita terms. As explained in the methods section, for the total anticipated actual per capita spending on health, an ARIMA 1,0,1 model was used to mirror past expenditures (1995-2021) and to predict what will be spent between 2022 and 2030. For the total expected health funding, estimates from the 2023-2027 resource mapping survey (Ministry of Health, 2023a) were used. From 2028 to 2030, an overall growth of 10% in the total expected health funds was assumed. For the total health financing need, estimates from the National Health Strategic Plan: 2022-2026 (Ministry of Health, 2022) were used. For the period 2027 to 2030, the 2026 per capita amount of US$151 was held constant.

The results (Figures 22 and 23), shows variances between the total per capita health financing need, total expected per capita health funding, and the total anticipated actual per capita spending on health. Firstly, there will be a total health financing gap (total health financing need vs total expected health funds) between 2025 and 2030 ranging from US$56 to US$67 per capita. Secondly, while the total expected health funds are expected to increase over the period 2025 to 2030, the actual amount that will be spent on health will be far less due to poor budget performance and unmet pledges and commitments. Therefore, there will be a commitment gap (total expected health funds vs actual total health expenditure) that will increase from US$20 per capita in 2025 to US$34 per capita in 2030. Ultimately, the effective health financing gap (total health financing need vs actual total health expenditure) will be high, rising from US$77 per capita in 2025 to US$92 per capita in 2030 (Figures 22 and 23). The results also show that Zambia's total health financing need of US$151 per capita is far above the recommended US$86 per capita for LLMICs (Mcintyre et al. 2017) (Figure 22). But even if the US$86 benchmark is used to represent Zambia's total health financing need, there will be a commitment gap which will in turn increase the effective health financing gap.

Figure 22: Predictive Analysis, 2025-2030

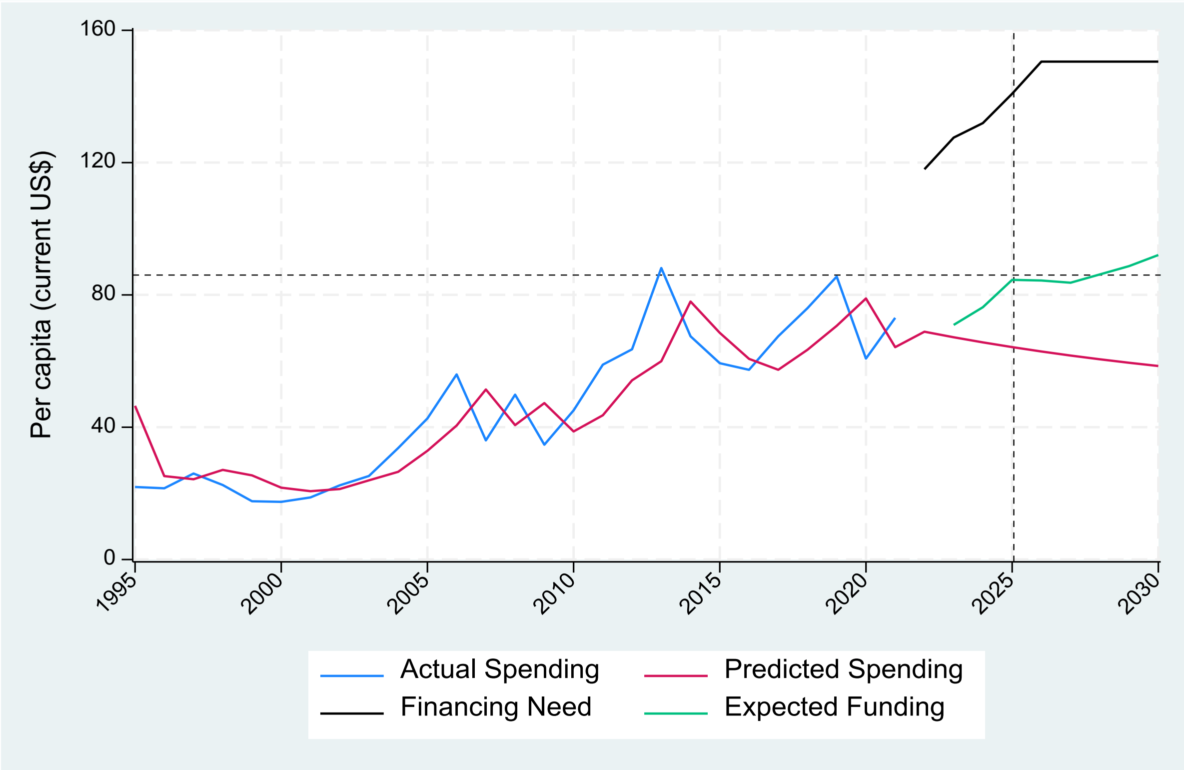
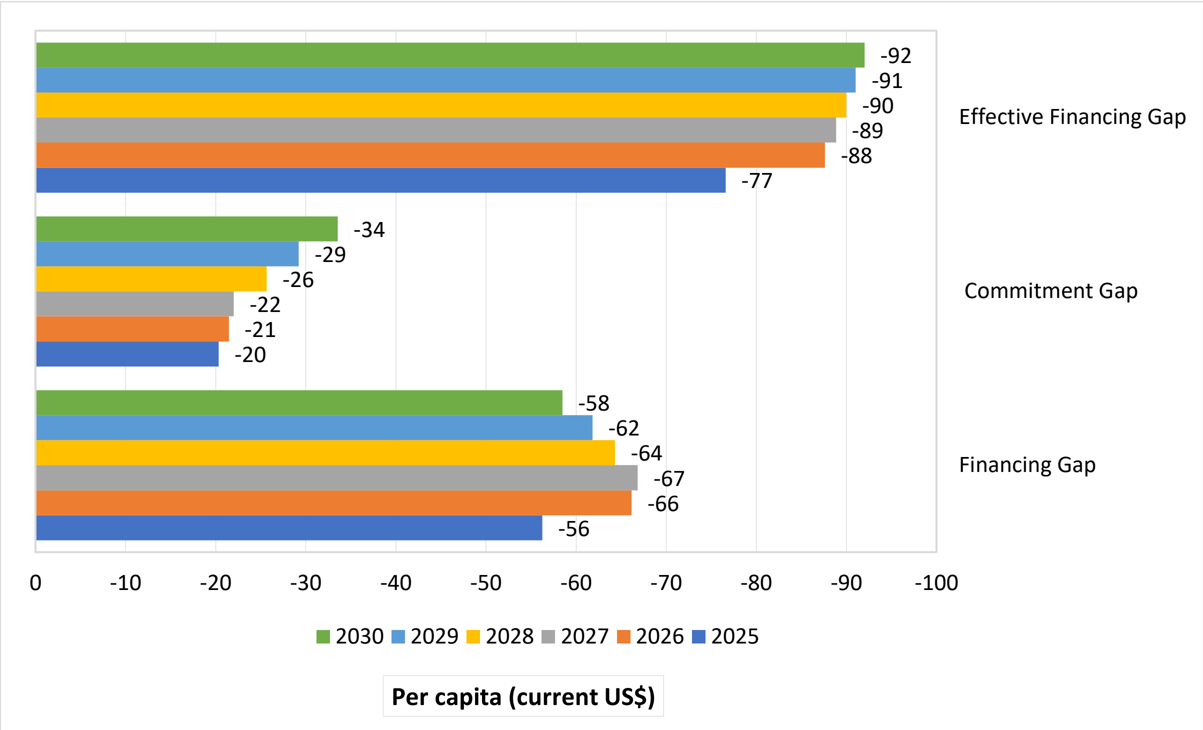


Figure 23: Effective Financing Gap Analysis, 2025-2030



4. DISCUSSION

In this chapter, the results from the study are interpreted and discussed. This is centred on the two objectives of the study, namely: (i) To assess the main drivers of the growth in total and public expenditure on health, and (ii) To assess fiscal sustainability of the health system in Zambia. The discussion is aligned to the five tasks under the two research objectives (see Table 1). These are: (a) Decomposition of public expenditure on health by macro-fiscal factors and funding sources, (b) Decomposition of total health expenditure by key demographic and health factors, (c) Evaluation of the main determinants of government health expenditure at sub-national (provincial) level and decomposition of the main determinants, (d) Adaptation of an analytical framework for fiscal sustainability analysis of health systems in LLMICs, and (e) Undertaking a fiscal sustainability analysis of the health system in Zambia. The chapter is arranged in the following order. Firstly, a summary and interpretation of key findings is provided followed by a detailed discussion of the key findings. Thereafter, the contribution of the study to the literature, policy implications, methodological considerations, and overall conclusion and policy recommendations are provided. Lastly, areas for future research are highlighted.

4.1. Summary and interpretation of key findings

The first objective of the study was to assess the main drivers of the growth in total and public expenditure on health. This was achieved in three parts, namely: analysing the role of macro-fiscal factors and funding sources in the growth of total and public expenditure on health; conducting a national level decomposition of total health expenditure by key demographic and health factors; and undertaking a sub-national level analysis to identify the main determinants of government health expenditures at provincial level and decomposing the main determinants. This is the first study in Africa to use decomposition analysis to investigate the determinants of health spending at national and sub-national levels in a single country. The studies that have used decomposition methods have focused on catastrophic health spending. Two studies (Tandon et al. 2018; Micah et al. 2019) have used decomposition methods to assess total health spending but these studies were cross-country comparisons. Country-specific contexts are vital when assessing the health financing landscape in a country. Furthermore, as recommended by some scholars (Berndt et al. 2000; Dunn et al. 2018), a decomposition of health expenditures by disease prevalence and cost of health service provision was also undertaken.

The second objective of the study was to undertake a fiscal sustainability of the health system in Zambia. The starting point was to "adapt" or modify an analytical framework for fiscal sustainability to for LLMICs. This framework was then used to conduct a fiscal sustainability analysis of the health system in Zambia. Other than South Africa, there has been no comprehensive study on fiscal sustainability analysis of health systems in Africa. Most of the studies have explored potential areas for increasing fiscal space for health and not fiscal sustainability analysis of the health system. Lack of studies on fiscal sustainability analysis of the health system can be attributed to: (i) inadequate understanding of the subject matter, and (ii) lack of an appropriate analytical framework. This study has addressed this methodological gap by adapting an analytical framework for fiscal sustainability of health systems in LLMICs and applying the framework in Zambia.

The main findings from the study are:

4.1.1 Decomposition of public expenditure on health by macro-fiscal factors and funding sources

- Between 1995 and 2018, and total health spending was responsive to the growth in the GDP per capita whereby a one percent increase in GDP growth was associated with a 2.1% increase in total health spending. However, external (donor) expenditure was the most responsive with an income elasticity of health spending of 5.8% while the responsiveness of government and households' expenditures were 1.1% and 0.8%, respectively.
- Income elasticity of spending on health by households was inelastic over the period 1995-2018. This shows the high importance of health to households in Zambia.
- Domestic government health expenditure as a share of the total government expenditure declined over the period 1995-2018. This means that there was de-prioritization of government spending on health.
- The main drivers of the increase in per capita public spending on health that was observed between 2000 and 2018 was on-budget external (donor) funding.

4.1.2 *Decomposition of total health expenditure by key demographic and health factors*

- There was a reduction in the prevalence rates and expenditure per prevalent case between 2013 and 2018.
- There was a substantial decline in the absolute amount of spending on almost all the nine level two IHME GBD diseases and conditions between 2013 and 2018. This means that fiscal space for health has been dwindling.
- Expenditure per prevalent case accounted for 101.7% of the reduction in total health expenditures between 2013 and 2018. This was followed by the disease prevalence rates which accounted for 6.95% of the reduction in total health expenditures between 2013 and 2018.
- Population growth and shifts in the age structure mitigated the decline in the total health expenditures by 4.3% each.
- Expenditure per prevalent case and prevalence rates affected reductions in spending on HIV/AIDS and sexually transmitted infections the most (58.4%), followed by non-communicable diseases (25.9%), and then malaria and neglected tropical diseases (15.8%).
- The 15-49 age group accounted for 90.4% of the reduction in the expenditure per prevalent case followed by the 5-14 age group which accounted for 7.5% of the reduction.

4.1.3 *Assess the main determinants of government health expenditure at provincial level*

- There is a relationship between GDP per capita and per capita government health expenditure. However, detailed analysis of this relationship by province shows that the effect can be positive or negative. The negative relationship was observed in three rural provinces (Eastern, Muchinga, and Northern).
- In all the 10 provinces in Zambia, per capita government health expenditure declined consistently over the period 2014 and 2019.
- The budget performance across the 10 provinces was suboptimal, as the actual government per capita health expenditures were consistently lower than the government per capita health budgets.
- Three non-income factors influence provincial per capita government health expenditure, namely: the number of health facilities and TB notifications per 10,000

people (both positively associated) and the degree of urbanization (negatively associated).

- The reduction in provincial per capita government health expenditure was primarily driven by the number of TB notifications, followed by provincial GDP per capita. For the TB notifications, the effect was highest in Lusaka, Copperbelt, Northwestern, Central, and Southern, respectively. For GDP per capita, the effect was highest in Copperbelt, but it had a mitigating effect in Northwestern and Lusaka.
- The number of health facilities in a province mitigated the overall reduction in provincial per capita government health expenditure especially in Copperbelt and Lusaka province but contributed to the reduction in Northwestern and Western. On the other hand, the level of urbanization mitigated the overall reduction in provincial per capita government health expenditure in all the provinces except for Western and Central.

4.1.4 Adapt an analytical framework for fiscal sustainability analysis of health systems in LLMICs

- An analytical framework for fiscal sustainability of health systems in LLMICs was adapted. This framework comprehensively synthesizes all the elements and processes required to conceptualize and examine financial sustainability of health systems in LLMICs.
- The framework puts diagnosis of income and non-income determinants of health expenditures at the core of the evaluation and doesn't treat fiscal space for health expansion as financial sustainability.
- The framework also considers fiscal sustainability analysis as a dynamic rather than a static process. In this regard, the premise is that there is need for continuous monitoring, evaluation, and adaptation to have a fiscally sustainable health system.

4.1.5 Conduct a fiscal sustainability analysis of the health system in Zambia

- In absolute (current US$) per capita terms, external health expenditure grew by almost 14 times between 2001 and 2021 while government health expenditure quadrupled during the same period. This means that external funding is a major and very important source of health financing in Zambia. This raises questions on national ownership, resource allocation capability, and financial sustainability of the health system.

- There has a declining trend in real total health spending (constant 2010 US$) in Zambia between 2001 and 2021. In real terms, total health spending was 94% of the nominal value in 2011, dropping to 33.4% in 2021. This raises questions on the adequacy/sufficiency of the overall funding for health in Zambia.
- Between 2025 and 2030, a health financing gap ranging from US$56 to US$67 per capita has been predicted.
- Actual spending on health between 2025 and 2030 is also predicted to be less than the expected funds, and this will create a commitment gap. The commitment gap is projected to increase from US$20 to US$34 per capita between 2025 and 2030. This will create an 'effective' health financing gap that will rise from US$77 to US$92 per capita between 2025 and 2030.
- Given its level of spending on health, Zambia is more efficient than most of its peer countries at providing health services and more effective than most of its peers at producing better child health outcomes (under-5 mortality rate). However, Zambia has to improve because some other peer countries are more efficient and effective.
- Interpreting all the results together suggests that the Zambia health system is financially unsustainable.

4.2. Discussion of key findings

4.2.1 Decomposition of public expenditure on health by macro-fiscal factors and funding sources

The results show a significant increase in real GDP per capita in Zambia between 1995 and 2018. Furthermore, health spending was found to be responsive to the growth in the GDP per capita whereby a one percent increase in GDP growth was associated with a 2.1% increase in total health spending. Across the three main sources of health financing in Zambia, external (donor) expenditure was found to be the most responsive with income elasticity of spending of 5.8% followed by government and households' expenditures which had magnitudes of income elasticity of spending of 1.1% and 0.8%, respectively. The finding on the income elasticity of public spending on health is consistent with findings from other studies (Tandon et al. 2018; Barroy et al. 2017) which have concluded that the magnitude of change in public spending on health was more than the increase in national income (GDP growth). The low magnitude of change in the income elasticity of government spending on health in Zambia can also be determined by looking at the domestic government health expenditure as a share of the total government expenditure over the period 1995-2018. The results showed a fluctuating trend, and ultimately, a decline. This means that there was de-prioritization of government spending on health over the period 1995-2018. For the households, the magnitude of change in spending on health was less than one. This means that households consider health care to be a necessity in Zambia.

Findings from the trend analysis are corroborated by the results from the decomposition analysis. Decomposition of the macro-fiscal factors in Zambia between 2000 and 2018 reveals an increase in economic growth (GDP). Increased economic growth led to an increase in total government spending but this did not lead to increased domestic government spending on health. Instead, domestic government spending on health decreased, indicating a de-prioritisation of the health sector by the Zambian government. Furthermore, an analysis of the growth in per capita public spending on health by financing sources shows that most resources came from on-budget external (donor) funding. These results contrast with a study by Tandon and others (2018) which found that growth in per capita public spending on health in LMICs was primarily driven by economic growth (67%), with the main driver of growth being domestic government revenues (73%). Similarly, in SSA, the main driver of the growth in per capita public spending for health was economic growth (46%) and by financing sources it was domestic government revenues (56%) (Tandon et al. 2018).

In conclusion, results from this component of the study reveal the following: (i) the main sources for health spending over the period under review was from donors, (ii) there is low prioritisation of health by the Zambian government, and (iii) income elasticity of spending on health by households was inelastic which demonstrates the high importance of health to households in Zambia. For sustainability of health programs, it is extremely important for increased government spending on health from domestic sources (Lu et al. 2010). Therefore, relying on domestic government health spending can enhance the sustainability and resilience of health systems. Consequently, it is imperative for the Zambian government to prioritise funding for the health sector because enhancing domestic government spending on health is a vital step towards achieving fiscal sustainability.

4.2.2 *Decomposition of total health expenditure by key demographic factors – national level analysis*

Results from the decomposition analysis shows that expenditure per prevalent case followed by prevalence rates were the main factors that were associated with the reduction in total health expenditures in Zambia between 2013 and 2018. This could be due to the decline in the prevalence rates and expenditure per prevalent case over the same period that was also observed in the study. The results from the study are similar to findings by Zhai and others (2017) who observed that expenditure per prevalent case was the main determinant of total health expenditure in China. However, the study by Zhai and others (2017) identified expenditure per prevalent case as the main driver of the growth in total health expenditure in China, but my study showed that expenditure per prevalent case was associated with a reduction in total health expenditures in Zambia. Among the key reasons why expenditure per prevalent case is reducing total health expenditures in Zambia could be due to the ongoing switch from costly originator (patented) brand medicines to lowest-priced generic equivalents as recommended by Cameron and others (2009 and 2012), declining value of the Zambian Kwacha against the major foreign currencies (World Bank, 2017a), and reduced government funding for health and low execution of the government health budget due to rising debt obligations (World Bank, 2018). Similar to the study by Zhai and others (2017) on China, my study shows that population growth and age structure are associated with an increase in total health expenditure in Zambia.

Further analysis by diseases shows that expenditure per prevalent case and prevalence rates affected reductions in spending on HIV/AIDS and sexually transmitted infections the most, followed by non-communicable diseases, and then malaria and neglected tropical diseases. Additionally, the 15-49 age group accounted for most of the reductions in spending on HIV/AIDS and sexually transmitted infections, non-communicable diseases, and malaria and neglected tropical diseases. The high reduction in expenditure per prevalent case for HIV/AIDS and sexually transmitted infections is due to the reducing overall HIV prevalence among women and men aged 15–49 years between 2001/2 and 2013/14 (Nakazwe et al. 2019); decline in the HIV incidence among persons aged 15-59 years between 2016 and 2021 (Mulenga et al. 2024); and changes in the treatment regimens and reduced costs of antiretroviral drugs. For the latter, the prices of antiretroviral medicines have reduced from about US$1200 per person per year in LLMICs in 2003 to under US$100 per person per year in 2018 in SSA for most of the fixed-dose combinations of antiretroviral medicines (UNAIDS, 2021). To further reduce the expenditure per prevalent case for HIV/AIDS and sexually transmitted infections, non-communicable diseases, and malaria and neglected tropical diseases, the Zambian government needs to undertake health promotion campaigns, and introduce more cost-effective prevention and treatment regimens. For malaria, a vaccine (RTS, S/AS01) was approved for use by the World Health Organisation in 2021.

Overall, the results from the study show a substantial decline in the absolute amount of spending on almost all the nine level two GBD diseases and conditions between 2013 and 2018. This means that fiscal space for health has been dwindling even though by virtual of the increasing population, spending on health ought to be increasing. It could be argued that the rising population is not a key factor, given the declining prevalence rates, but Zambia has not yet attained the demographic dividend. With a median age of 17, an annual population growth rate of 3.4%, and a national population density of 26.1 people per square kilometre (Zambia Statistics Agency, 2022); the population is expected to increase significantly because of the large number of people in reproductive age. This is likely to outstrip the already limited health budget and increase the disease burden. Therefore, for Zambia to attain the demographic dividend, additional investment in human capital is required. Sadly, according to the results from the predictive analysis (see section 4.2.5 below), future health spending is projected to decline progressively over the period 2025-2030. This suggests a continuous reduction in health expenditure in Zambia in the next five years.

The reduction in the expenditure per prevalent case for all the diseases and conditions implies that cost containment strategies are being implemented. However, reduction in costs doesn't necessarily mean that there is improved efficiency or financial sustainability. Financial sustainability needs to be associated with health need. Reduced spending on health can also be attributed to reduced financing by the Zambian government and development partners and not necessarily that there is a deliberate policy to contain costs in the health sector. Additionally, the declining overall spending on health and expenditure per prevalent case can also be attributed to forgone health care. This is because reduced government spending on health can lead to a decrease in the public provision of health services, thereby compelling households to seek services and medicines from private health facilities and drug stores. However, poor households may not have the resources to pay for medical care from private health facilities and end up forgoing medical treatment. This could be the reason for the declining overall spending on health and expenditure per prevalent case in Zambia between 2013 and 2018. A study by Kabembo (2024) identified financial challenges as one of the reasons for forgone health care among youths with substance use disorders in Zambia.

4.2.3 Main determinants of government health expenditure at provincial level

Results from the single and panel regression analyses show that there is a relationship between GDP per capita and per capita government health expenditure. These results are consistent with Wagner's law of increasing state activity (Wagner, 1892) and several studies that have been conducted in Africa such as Gbesemete and Gerdtham, (1992), Tandon and others (2018), and Baltagi and others (2017). However, detailed analysis of this relationship at provincial level shows that the effect can be positive or negative depending on the province. The positive relationship was observed in all the provinces except for Eastern, Muchinga, and Northern where there was a negative relationship. In Northwestern province, where there has been a lot of mining activities over the past 10 years, the average GDP per capita over the period 2014-2019 was the highest, surpassing even that of Copperbelt and Lusaka provinces.

In all the 10 provinces, the results show that per capita government health expenditure was constantly declining over the period 2014 and 2019. The declining per capita government health expenditure could be attributed to macro-fiscal challenges that Zambia was experiencing during the period 2014-2019 (International Monetary Fund, 2023b; World Bank, 2022), and an increasing population. The macro-fiscal challenges also explain the low budget performance (budget execution) that was observed in this study. This implies that having a larger government health budget (even if not fully disbursed) could increase government expenditure on health. The low budget performance suggests low prioritisation of health by the Zambian government. This is likely to affect Zambia's goal of achieving UHC and the health-related SDGs.

Results from the panel regression analysis show that both income and non-income factors influenced changes in the per capita government health expenditure at provincial level in Zambia over the period 2014-2019. The main factors were: provincial GDP per capita, number of TB notifications per 10,000 people, number of health facilities per 10,000 people, and the degree of urbanization. Decomposition of these four factors revealed a large reduction in the provincial per capita government health expenditure between 2014 and 2019. The reduction was primarily driven by decreased expenditure on TB, especially in Lusaka, Copperbelt, Northwestern, Central, and Southern. The underlying factor was a decline in the number of TB notifications in the five provinces. Thus, even though the number of TB notifications shows that Zambia is still a high TB burden country (Lungu et al. 2022; Kapata et al. 2016), there has been a signficant reduction in the number of TB notifications from 42,716 in 2014 to 36,866 in 2019 (Lungu et al. 2022).

The association between per capita government health expenditure and prevalence of TB is logical given the longevity of TB and costs associated with its treatment. As observed by Ghazy and others (2022) in LLMICs, patients with TB can incur expenses equivalent to 50% of their annual income. In Zambia where the costs for TB prevention and treatment are largely incurred by the Zambian government, prolonged treatment of TB patients can lead to high government health expenditure. Thus, the reduction in expenditure on TB implies that the Zambian government has been implementing cost containment interventions. For example, in 2018, Zambia scaled-up the use of shorter TB treatment regimens for RR-/MDR-TB patients which led to a reduction in the duration of TB treatment from 24 to 9-12 months (Challenge TB, 2020). Evidence from the TB-PRACTECAL trial countries (India, Georgia, Philippines, and South Africa) show that the use of short treatment regimens for RR-/MDR-TB such as BPaL can improve health outcomes and save US$112-US$1,173 per person (Sweeney et al. 2022). If BPaLM/BPaL regimens are used, the potential savings are estimated at 75% ($4,000-$6,000 savings per patient) compared to using longer treatment regimens (Gupta et al. 2022).

Notwithstanding the above, the reduction in TB spending during the period under review could have been due to reduced financing by the Zambian government and development partners, and not necessarily that there was a deliberate strategy to contain TB programme costs. Financial sustainability should be aligned to a purposeful cost-containment policy in the health sector. Furthermore, cost-containment strategies do not necessarily lead to improved efficiency and/or financial sustainability. To achieve the intended health outcomes, the costs of programme implementation should be linked to the health needs. Considering that uptake of TB preventive therapy among people living with HIV is hampered by inadequate tuberculosis screening (Melgar et al. 2021), overcoming this and other barriers to access can help to reduce TB infections and this could help to reduce government spending on TB.

After TB notifications, provincial GDP per capita was the second largest contributor to the reduction in the provincial per capita government health expenditure during the period under review. The reduction was highest in Copperbelt while in Northwestern and Lusaka there was a mitigating effect. This trend can be attributed to the declining mining and economic activities in the Copperbelt region during the period under review. Conversely, Northwestern province experienced increased mining activities, while Lusaka saw a rise in foreign direct investments and trade.

Meanwhile, the number of health facilities per 10,000 people contributed to the reduction in provincial per capita government health expenditure in Northwestern and Western but mitigated the reduction in Copperbelt and Lusaka. This suggests that regions with more health facilities per 10,000 population have higher government health expenditure. Considering that the allocation of resources in the health sector in Zambia depends on the number and size of the health facilities in each province, it is logical that there is a positive relationship. Further, since health facilities are production entities, inputs to service provision (human resources, medicines, vaccines, and equipment) are linked to the number health facilities in a province. While the government built several hospitals and health centres in most of the provinces in rural areas during the period under review, the number of health facilities per 10,000 people reduced in some of the provinces due to a growth in population. Thus, while Northwestern province already has a high number of first- and secondary-level health facilities, the new health facilities did not increase the number of health facilities per 10,000 people—and ultimately, the reduced number of health facilities per 10,000 people contributed to the reduction in per capita government health expenditure in the province.

Lastly, the provincial level analysis shows that the level of urbanization mitigated the overall reduction in provincial per capita government health expenditure in all the provinces except for Western and Central (predominantly rural provinces). This could be due to the concentration of health care infrastructure and services in urban areas. Urban areas often have better access to health care facilities, resources, and services, which can offset reductions in expenditure by improving cost-efficiency and health care delivery. In Zambia a study by Schutte and others (2015) supports this by showing that the average unit costs per immunised child in Zambia were higher in health facilities in rural than urban areas due to higher travel-related allowances and costs, low utilisation levels, and small size of facilities in rural areas. Given that immunization costs in Zambia are incurred by the government, this illustrates the difficulties in achieving cost-efficiency and scalability in rural areas. Another study that was conducted by Achoki and others (2017) concluded that districts in Zambia with higher urbanization and a greater proportion of educated women demonstrated greater technical efficiency in utilizing resources for child survival. In China, a study by Shao and others (2022) showed that urbanization in the eastern and central regions of China only increases health care expenditure if population aging is incorporated in the analysis.

4.2.4 Analytical framework for fiscal sustainability of health systems

Through the study, an analytical framework for fiscal sustainability of health systems was adapted. This framework is comprehensive in that it synthesizes all the elements and processes required to examine financial sustainability of health systems in LLMICs, especially those in Africa. The importance of the framework is that it provides a systematic way of conceptualizing as well as analysing fiscal sustainability of health systems in LLMICs. For instance, the framework puts diagnosis of income and non-income determinants of health expenditures at the core of the evaluation rather than treating fiscal space for health expansion (Barroy et al. 2016; Tandon and Cashin, 2010) as financial sustainability. It also aligns financing needs with the financial resources available to deliver health services. The framework uses the definition of fiscal sustainability by Rebba (2014) and existing theories on the determinants of health expenditure as provided in the literature. It differs from the conceptual framework by Scheirer and Dearing (2011) and Birch and others (2014) because it considers fiscal sustainability as both an endogenous and exogeneous concept, but more importantly as an outcome of interest.

The framework also considers fiscal sustainability analysis as a dynamic rather than a static process. In this regard, the premise is that there is need for continuous monitoring, evaluation, and adaptation to have a fiscally sustainable health system. Henceforth, governments in LLMICs should be ready to seize opportunities, and avert and/or mitigate threats to financial sustainability in the health system. For example, to contain medical expenses under the public health insurance program in Japan, a single payment system is used while the fee schedule is revised every two years by the Ministry of Health, Labour and Welfare of Japan (HGPI, n.d.; Maeda et al. 2014). Similar to Japan, LLMICs in Africa should consistently monitor, adapt, and innovate to maintain a fiscally sustainable health system. This is critical because availability of public spending on health in the required amounts is often unpredictable in Africa. This means that periods of hardship (poor economic growth, economic mismanagement, debt and deficits), disease and pandemic outbreaks, drought/famine, armed conflicts, and other internal/external factors need to be anticipated and planned for. In this regard, strategies to protect or ring-fence funding for health and other human development programs during periods of hardships need to be developed and implemented in advance. On the other hand, there could be opportunities for increased health spending when there is a fiscal surplus. Thus, as is the case in Chile, economic and social stabilization funds could be established to mitigate fiscal deficits and to amortize public debt (Chile Ministry of Finance, 2020). The other example is Germany where an economic stabilisation fund was established in 2020 to address the economic and social impacts of the COVID-19 pandemic (Federal Republic of Germany, 2020).

Though economic growth can bring opportunities for increased funding for health, it can also lead to reduced external funding to health. Considering that external funding constitutes a large part of the overall funding to the health sectors in most of the LLMICs, reduced external funding can lead to reduced provision of priority health services such as childhood immunization, HIV/AIDS, TB, etc. For instance, with real GDP averaging 8.7% per annum over the period 2006-2011, Zambia attained lower middle-income status in 2011 (Ministry of Finance and National Planning, 2022). However, graduation to lower-middle income status led to an increase in Zambia's co-financing obligations to Gavi (the vaccine alliance) for routine childhood vaccines (Griffiths et al. 2016). Consequently, Zambia was moved from the poorest to the intermediate co-financing country group, which led to a 15% annual increase in the amount per vaccine dose. By 2016, Zambia was placed in the accelerated transition group and was expected to fully finance all vaccines in 2022 and this placed doubt on the long-term affordability and sustainability of the national immunization program (Griffiths et al. 2016).

A study by Neel and others (2024) on the sustainability of HIV programmes in countries in Southern and Eastern Africa also suggests that external funding for HIV programmes should be contextualised to achieve long-term sustainability. This is because external funding for HIV programmes has weakened prospects for increased fiscal space, integration of HIV services into the broader health systems, technical capacity, and national ownership (Neel et al. 2024). These two studies underscore the need for governments in LLMICs to be vigilant and fill the health financing gaps left by external development partners. In this regard, raising additional funds through domestic resource mobilisation strategies is critically important as this can enable governments to fill the health financing gaps and meet the required health needs.

4.2.5 Fiscal sustainability of the health system in Zambia

In summary, results from the review of the health financing landscape in Zambia—both historically and futuristically—suggests that the Zambia health system is financially unsustainable. Firstly, the results show that the total per capita spending in Zambia has been inadequate to meet the financing need. While Zambia has costed the priority programmes at about US$151 per capita per annum, only US$53.4 per capita per annum, was spent on average over the period 2001-2021. Further, only US$73.1 per capita was spent in 2021 when the last national health accounts survey was conducted. While Zambia's financing need of US$151 per capita per annum seems high, the high cost of service provision in Zambia (Hjortsberg and Mwikisa, 2002) justifies this amount. In any case, for a country like Zambia which is sparsely populated (Central Statistical Office, 2012), health service provision is expensive. This means that the US$86 per capita spending as prescribed by (Mcintyre et al. 2017) is a ballpark figure that may not be suitable for all the LLMICs. As a matter of fact, some scholars have suggested that there are no magic numbers on health spending and that there is scope to improve health outcomes at any given level of spending (Jowett et al. 2016). Therefore, improved efficiency in spending is vital for Zambia to achieve UHC.

In real terms, the total per capita spending on health in 2021 was only 33.4% of the nominal value. In other words, only US$24.4 per capita was actually spent in 2021. This underscores the need for the government to stabilise the exchange rate for the US dollar to the Zambian Kwacha. As observed by Chansa and others (2018), variations in the exchange rates can lead to reduced financial stability, funding gaps, and poor health service delivery. This is because most of the inputs for health service delivery such as medicines, vaccines, and medical supplies are procured outside the country. These are paid for in foreign currencies (especially in US$) meaning that there is usually an exchange rate loss when converting from the Zambian Kwacha to foreign currencies.

Going forward, the study predicts a health financing gap ranging from US$56 to US$67 per capita over the period 2025-2030. Additionally, between 2025 and 2030, a commitment gap ranging from US$20 to US$34 per capita has been predicted because the actual spending on health is likely to be less than the expected (pledged/committed) funding for health. The commitment gap will create an 'effective' health financing gap ranging from US$77 to US$92 per capita between 2025 and 2030. I define the 'effective' health financing gap as the difference between the actual expenditure on health and the health financing need. There are several reasons why there will be a commitment gap. Firstly, as presented in the results section, about 29% of the expected health funds will come from external sources (development partners) and 63% from the Zambian government. However, government budget performance is poor (as shown in my study) and as revealed by the World Bank (2018) which reported poor government budget execution at almost all the levels of the health system between 2006 and 2016, especially for medicines and medical supplies. In addition, the expected funds from external development partners are also highly unpredictable.

Furthermore, Zambia is currently in a debt crisis and this has led to a reduction in the overall fiscal space for the government. By the end of 2021, the government gross debt as a share of the GDP was estimated at 110.8% of the GDP (International Monetary Fund, 2023b). In addition, agricultural, water, energy, and industrial production are expected to go down substantially in the short to medium term due to a major drought during the 2023/2024 rainy season. The President of Zambia declared the drought as a national disaster and emergency on 29th February 2024 (Government of Zambia, 2024). Therefore, the amount of revenue that the Zambia Revenue Authority is likely to mobilise between 2024 and 2030 is most likely going to be very low. As a result, government spending on health between 2025 and 2030 will probably be lower than the expected funding, and far much lower than the health financing need. These findings are corroborated by Kurowski and others (2024) who predict that most countries worldwide are expected to have low government health expenditure per capita between 2025 and 2029, especially LLMICs with contracting or stagnating overall government spending.

The results show that external funding is an important component of the national health budget in Zambia. This raises questions on national ownership, resource allocation capability, and financial sustainability of the health system. As observed by Huffstetler and others (2022), high dependency on donor funding can make a health system financially unsustainable and cause disruptions in health service delivery when the donors discontinue their funding. With regards to future pledges and commitments from external development partners for the period 2025-2030, it is likely that donor funding will reduce due to donor fatigue (Grépin, 2012; Moszynski, 2010) and the armed conflicts in Russia-Ukraine and Israel-Gaza. It has already been reported that donor funding for public health emergencies and child health interventions in West and Central Africa have reduced by almost 50% due to the Russia-Ukraine and Israel-Gaza conflicts (TRT Afrika, 2023). In any case, donor funding in Zambia is already high and may not grow beyond the current level. This means that between 2025 and 2030, the main source of funding to the health sector in Zambia will be from the government. But as pointed out earlier, there are a lot of uncertainties with government funding to health in the short to medium term.

On efficiency of health spending, the study observed that Zambia is more efficient than most of its peer countries at providing health services. Similarly, Zambia is more effective than most of its peers at producing better child health outcomes (under-5 mortality rate). However, there is room for improvement in Zambia because some other peer countries are more efficient and effective. Furthermore, a study examining the technical and scale efficiency in delivering child health services in Zambia identified significant inefficiencies in resource utilization for child survival and urged decision-makers to find more efficient methods of service delivery to achieve UHC (Achoki et al. 2017). Jowett and others (2016) also observe that there is scope to increase efficiency and effectiveness of public spending on health in developing countries; and to understand the factors associated with high performance in countries that spend very low on health.

Notwithstanding the results from the benchmarking analysis, it is worthwhile to point out that the benchmarking approach has some flaws. While benchmarking is ideal for cross-country comparisons, it doesn't take into consideration differences in the cost-of-service provision between the countries. Furthermore, the benchmarking approach is also not suitable for in-country analysis. As shown in earlier sections, granular analysis of spending at sub-national level is critically important. Other efficiency and equity optimization tools such as the Health Interventions Prioritization tool (HIPtool) and the Equitable Impact Sensitive Tool (EQUIST) can be used for more detailed and contextualised analyses. The HIPtool is an allocative efficiency tool which can optimize available funding across priority health interventions to achieve desired health impact (Fraser-Hurt et al. 2021). The EQUIST is helpful in developing equitable strategies to improve health and nutrition for the most vulnerable children and women (Uneke et al. 2018). Further, some scholars have also called for improvements in public financial management to achieve desired health outcomes (Cashin et al. 2017). Other alternative approaches to efficiency analysis such as the stochastic frontier analysis or the data envelopment analysis can also be used for the analysis.

4.3. Contribution of the current study to the literature

4.3.1 First study in Africa to use decomposition analysis to investigate the determinants of health spending at national and sub-national levels in a single country

This study has contributed to the literature on the determinants of health expenditures by applying the Das Gupta decomposition method (Gupta, 1991; 1994) to assess the effect of macro-fiscal factors and financing sources on growth in public spending on health. Some scholars (de Meijer et al. 2013) have recommended the use of decomposition methods when analysing the growth in health expenditures because they are able to quantify the magnitude of the change in the determinants of health care expenditures, and whether the change across the distribution is constant (or not). Other studies that have applied decomposition methods in Africa have looked at equity in health financing (Edoka et al. 2017; Mulaga et al. 2022; Setshegetso, 2020) while others studies (Tandon et al. 2018; Micah et al. 2019) have used decomposition methods to assess total health spending cross several countries. Secondly, Bhat and Jain (2004) have called for analysis of the determinants of health care expenditures at sub-national level to get more insights on the relationship between health care expenditures and their determinants. The study is the first study in Africa to analyse the main determinant of government expenditure on health at sub-national level and to decompose the main determinants.

4.3.2 First study in Africa to analyse the main drivers of total expenditure on health by diseases and population age structure

Some scholars (Berndt et al. 2000; Dunn et al. 2018) have recommended for the decomposition of health expenditures by disease prevalence, cost of health service provision, and other similar inputs. This is the first study in Africa to fill this knowledge gap.

4.3.3 First study to devise an analytical framework for fiscal sustainability analysis of health systems in LLMICs

This is the first study that has come up with a framework for conceptualising and analysing fiscal sustainability analysis of health systems in LLMICs. Most of the studies have looked at the availability of fiscal space for health and earmarking the funds generated to the health sector (Okwero et al. 2010; Tandon and Cashin, 2010; Barroy et al. 2016). However, increasing fiscal space for health is not equivalent to fiscal sustainability even though it is part of fiscal sustainability. By devising an analytical framework for fiscal sustainability analysis of health systems in LLMICs, this study provides clarity on the understanding of fiscal sustainability analysis and an analytical framework that can be used for the analysis. To provide guidance for researchers and policymakers on the application of the framework, this study implemented it in Zambia.

4.4. Policy implications

4.4.1 Monitoring changes in total and public expenditures on health is critical to achieving fiscal sustainability and desired health outcomes

Given the limited resources available in most LLMICs, it is essential for policy makers and implementers to continuously monitor the allocation and use of the available resources. This study observes that there was de-prioritisation of health spending by the Zambian government, and this poses a huge risk to the attainment of UHC and the health-related SDGs. As observed by Lu and others (2010), spending by governments on health from domestic sources indicates their commitment to the health of their citizens. Therefore, for the sustainability of health programs in Zambia, it is critically important for the government to provide sufficient funding to the health sector. While it is understandable that the Zambia Revenue Authority could mobilise below target revenues in some years, funding to the health sector needs to be ring-fenced/protected during difficult periods. If this is not done, the health financing burden is bound to be pushed to households, and this can lead to catastrophic health spending or forgone health care by poor and vulnerable households. Changes in the income status of a country (i.e. from LIC to LLMIC), can also lead to reduced external funding to health. This accentuates the need for continuous monitoring of health expenditures and consistent government funding for health.

4.4.2 Monitoring the prevalence of disease by age groups can help to control health expenditures

The study shows that expenditure per prevalent case and prevalence rates were the main factors that were associated with changes in total health expenditures in Zambia between 2013 and 2018. The 15-49 age group accounted for most of the changes in spending, particularly for spending on HIV/AIDS and sexually transmitted infections, non-communicable diseases, and malaria and neglected tropical diseases. At provincial level, the number of TB notifications per 10,000 population was positively related to provincial per capita government health expenditure. This points to two important considerations. Firstly, health policy should be targeted at health promotion and treatment for the most affected and vulnerable groups. Secondly, the national treatment regimens for HIV/AIDS and sexually transmitted infections, non-communicable diseases, malaria and neglected tropical diseases, and TB should be highly cost-effective. Thirdly, vulnerable groups should be deliberately included in the disease prevention and control programs. This is because focusing on diseased individuals can help to limit spread of a disease and increase quality of life (Van Seventer and Hochberg, 2017).

4.4.3 Sub-national analyses are key to identifying determinants of health expenditure

Considering that the bulk of health services are provided at the lower levels of a health system, it is essential for studies on health financing to inform policy and planning at sub-national level. In this regard, this study examined the main determinants of health expenditure across the 10 provinces of Zambia. A decomposition analysis of the main determinants was later conducted. The analysis revealed that provincial GDP per capita, the number of health facilities per 10,000 population, the number of TB notifications per 10,000 people, and the level of urbanization each had distinct impacts on changes in provincial government health expenditure. These differences underscore the need for a more granular understanding of the main determinants of health spending across regions within a country. Bhat and Jain (2004) have stressed the need for sub-national analysis on health spending. Chatterjee and Smith (2021) analysed the equity and effectiveness of public spending on health in Odisha, India and observed a weak link between district spending and district need. In their conclusion, they called for a needs-based approach to public resource allocation. Likewise, the results from the provincial decomposition analysis from my study have highlighted regional variations and their impacts on overall changes, which makes it easier for Zambian policymakers to design targeted interventions.

4.4.4 Fiscal sustainability of a health system is a dynamic process

The study has highlighted the need for deliberate policies and strategies to continually monitor the balance between expenditure, cost, and available resources. This is because fiscal sustainability of a health system is an evolving process which requires strategic foresight and continuous adjustments to match the limited funds to the health care needs of the population without compromising on quality. The study concludes that the health system in Zambia is financially unsustainable and identifies some areas that require immediate intervention by the Zambian government. Among others, this includes improved government funding to health, improved budget performance, and improved efficiency in resource use.

Secondly, even though population growth was not identified as a major determinant of health spending in Zambia, there is need to re-examine the situation in future because Zambia is still in pre-demographic dividend status. This means that the population is expected to increase significantly because of the large number of young people in reproductive age. This is likely to increase the disease burden and place more demands on the limited public health services. This could affect the financial sustainability of the health system. The other issue is the declining expenditure on health. It is possible that some priority areas are not being adequately funded, and as a result, the potential effect was not observed.

4.5. Methodological consideration

4.5.1 Research objective one

Existing demand- and supply-side theories on the determinants of health expenditures were taken into consideration to satisfy the first objective of the study. The choice of independent variables was key in the analytical approach. Drawing from the literature and contextual factors relevant to Zambia and other LLMICs in Africa, the analysis included variables such as the degree of urbanisation, the number of health facilities per 10,000 population, and the number of skilled health providers per 10,000 population. The key consideration was for the study to enhance the understanding of the relationships between health expenditure and its determinants; and quantification of the changes in health expenditures by key factors by using decomposition analyses at both national and sub-national levels.

4.5.2 Research objective two

The study hypothesized that the ability of LLMICs in Africa to maintain financially sustainable health systems will be difficult without a systematic framework for assessing threats (and opportunities) in health spending. This study filled this methodological gap by adapting an analytical framework for fiscal sustainability of health systems in LLMICs. The framework differs from the conceptual framework by Scheirer and Dearing (2011) and Birch and others (2014) because it considers fiscal sustainability as both an endogenous and exogeneous concept, and as an outcome of interest. The framework that has been adapted through this study synthesizes all the elements and processes required to examine fiscal sustainability of health systems in LLMICs, especially those in Africa. The framework incorporates diagnostic and remedial measures; and treats fiscal sustainability of a health system as a dynamic process.

4.6. Conclusions and policy recommendations

4.6.1 Overall conclusion

The first objective of the study was to assess the main drivers of the growth in total and public expenditure on health. The study shows that total health spending was responsive to the growth in the GDP per capita and that the main drivers of the increase in per capita public spending on health was on-budget external funding to the health sector. There was a decline in domestic government spending on health which means that there was de-prioritization of health by the Zambian government. Income elasticity of households spending on health was inelastic, which signifies the importance of health to households in Zambia. Additionally, there was a significant decrease in total health spending between 2013 and 2018, primarily driven by reduced expenditure per prevalent case. The most notable reduction in spending occurred in the areas of HIV/AIDS and sexually transmitted infections, followed by non-communicable diseases, and subsequently malaria and neglected tropical diseases. This pattern was particularly evident among the 15-49 age group.

Results from the sub-national (provincial) analysis covering the period 2014-2019 showed that budget performance was suboptimal, while the relationship between provincial government health expenditure and provincial GDP was positive in five provinces and negative in three rural provinces. The provincial per capita government health expenditures declined consistently during the period under review with wide variations in the level of spending across the provinces. And though provincial per capita health government expenditures were positively related to the number of health facilities per 10,000 population and the number of TB notifications per 10,000 people; it was negatively related to urbanisation (share of the population in urban residence). Decomposition of the four main determinants showed that the primary driver of the reduction in provincial per capita government health spending was the number of TB notifications per 10,000 people, especially in Lusaka, Copperbelt, Northwestern, Central, and Southern. This was followed by provincial GDP per capita which had the largest contribution to the reduction in Copperbelt while in Northwestern and Lusaka there was a mitigating effect. The number of health facilities per 10,000 people contributed significantly to the reduction in Northwestern and Western but mitigated the reduction in Copperbelt and Lusaka. Lastly, the level of urbanization mitigated the overall reduction in all the provinces except for Western and Central.

The second objective of the study sought to undertake a fiscal sustainability of the health system in Zambia. To meeting this objective, an analytical framework for fiscal sustainability analysis was adapted. This framework was then used to conduct a fiscal sustainability analysis of the health system in Zambia. The results show a total health financing gap ranging from US$56 to US$67 per capita over the period 2025-2030, and a total 'effective' health financing gap ranging from US$77 to US$92 per capita over the same period. These shortfalls can be attributed to projected reductions in per capita spending on health by the government and external sources over the period 2025-2030. Therefore, the study concludes that Zambia's health system is financially unsustainable.

4.6.2 Policy recommendations

The declining fiscal space for health in Zambia poses a significant risk to the country's ambitions to achieve UHC and attain the health-related SDGs. Therefore, for the sustainability of health programs in Zambia, it is critically important for the government to provide sufficient funding to the health sector. This can be achieved through additional funding and/or by enhancing efficiency in resource allocation and use. Regular monitoring of changes in total and public expenditures on health is also highly recommended.

The study observed that expenditure per prevalent case was the main determinant of changes in total health expenditures in Zambia between 2013 and 2018. Furthermore, spending on HIV/AIDS and sexually transmitted infections, non-communicable diseases, and malaria and neglected tropical diseases drove most of the changes, especially among the 15-49 age group. At provincial level, the number of TB notifications per 10,000 population was positively related to provincial per capita government health expenditure. To reduce spending on diseases, the government needs to focus health promotion activities on the most affected and vulnerable groups, and implement highly cost-effective disease treatment regimens. These strategies can help reduce prevalence rates and expenditures per prevalent case.

Across the provinces, the study revealed poor budget performance, a consistent decline in per capita government health expenditures, and wide variations in spending. Additionally, the number of health facilities and prevalence of TB in a province were key determinants of government health spending at provincial level. To address this, the Zambian government needs to: (i) develop and implement a needs-based formula for allocating financial resources equitably across the 10 provinces. The formula must incorporate parameters on the number of health facilities in a province and disease burden (ideally the prevalence of TB and HIV), and (ii) increase predictability of funding by ensuring that all the budgeted funds are released in full and on time.

Lastly, considering that fiscal sustainability of a health system is a dynamic process, the study recommends continuous monitoring and adaptation aimed at matching the available funds to the health care needs of the population without compromising on quality. A dedicated unit within the Directorate of Health Policy and Planning needs to be established and charged with the responsibility of undertaking fiscal sustainability analysis of the health system annually.

4.6.3 Recommendation for future research

The study recommends for further analysis of the determinants of health spending at district level. Although part of the study was undertaken at the provincial level, more detailed information could be obtained by conducting studies at the district level. Furthermore, considering that Zambia established a National Social Health Insurance Scheme in 2018, and that the number of specialised hospitals has been increasing; future studies could also assess: (i) the medium- to long-term financial sustainability of the National Social Health Insurance Scheme, and (ii) the effect of the growing number of specialised hospitals in Zambia on government health spending. Lastly, my study looked at the quantity and not the quality (effectiveness) of health spending. Future studies could incorporate parameters on the effectiveness of health spending.

5. SUMMARY

5.1. Introduction and rationale

Over the past three decades, several countries worldwide have experienced a rapid and unsustainable increase in total health expenditures. In contrast, health financing in Africa has been diminishing due to reduced domestic revenue mobilisation, high public debt, and declining external financing. Persistent infectious disease outbreaks and natural disasters have also overwhelmed the already weak health systems in Africa. Increasing health care needs coupled with decreasing spending on health make it difficult to provide quality health care in low- and lower middle-income countries (LLMICs) in Africa. Despite the growing challenge of fiscal sustainability of health systems in LLMICs in Africa, there is no comprehensive study on the subject-matter. Motivated by knowledge and methodological gaps in the existing literature, this study assessed the main drivers of changes in total and public expenditure on health in Zambia by looking at macro-fiscal factors, funding sources, demographic, health, institutional, and social factors at national and sub-national levels. The study has addressed the following research question: To what extent is the Zambian health system financially sustainable?

5.2. Materials and methods

Given that Zambia's macro-fiscal, demographic, epidemiological, and health system profile are comparable to those in other LLMICs in Africa, the study was conducted in Zambia. To meet the first objective of the study, panel regression analysis and the Das Gupta decomposition method were used to assess the main determinants of total and public expenditures on health in Zambia at national level; and government health spending at sub-national level. Decomposition analysis made it possible to disintegrate and quantify changes in health expenditures by key factors. For the second objective of the study, an extensive literature review was undertaken to conceptualise and adapt an analytical framework for fiscal sustainability of health systems in LLMICs. To achieve this, reference was made to existing supply- and demand-side theories on the determinants of health expenditures; the general body of work on fiscal policy sustainability; and health-sector specific studies on fiscal sustainability and health system resilience. Thereafter, a predictive analysis of future financing needs and fiscal space for health was undertaken to gauge if the health system in Zambia was financially sustainable.

5.3. Results

The results show a substantial reduction in funding to the health sector in Zambia over the period 2013-2019, particularly for government domestic spending on health. This suggests a de-prioritisation of health spending by the Zambian government. Furthermore, the results show that expenditure per prevalent case was the main cause of the reduction in total health expenditures in Zambia. There was decreased spending on HIV/AIDS and sexually transmitted infections, followed by non-communicable diseases, and malaria and neglected tropical diseases. The reductions were predominant in the 15-49 age group.

At the provincial level, there was low budget performance and a persistent decline in per capita government health expenditure. The main driver of the reduction in per capita government health spending was the number of TB notifications per 10,000 people, followed by GDP per capita. On the other hand, the number of health facilities per 10,000 people and the level of urbanization mitigated the overall reduction in per capita government health spending. However, each of these factors had distinct impacts on changes in the per capita government health expenditure across the provinces. The study predicts a total 'effective' health financing gap of US$77 to US$92 per capita over the period 2025-2030. This gap can be attributed to projected reductions in per capita spending on health by the government and external development partners.

5.4. Conclusions and recommendations

The study concludes that Zambia's health system is financially unsustainable, with government health financing deprioritized from 2013-2019, and a significant financing gap projected for 2025-2030. The main determinants of total health spending are HIV/AIDS and sexually transmitted infections in the 15-49 age group. At the provincial level, key factors influencing per capita government health spending are TB notifications, GDP per capita, the number of health facilities, and the level of urbanization. To sustain the functionality of the health system in Zambia, the study advocates for sufficient government health funding, increased predictability of funding, and improved efficiency in resource allocation and use. The study also calls for regular monitoring and matching of available funds with the health care needs of the population. Future research could assess the effectiveness of health spending, determinants of health spending at the district level, sustainability of system-level interventions (i.e. the National Health Insurance Scheme), and rising number of specialized hospitals.

5. ZUSAMMENFASSUNG

5.1 Einführung und Begründung

In den letzten drei Jahrzehnten haben mehrere Länder weltweit einen raschen und nicht tragbaren Anstieg der Gesamtausgaben für das Gesundheitswesen erlebt. Im Gegensatz dazu ist die Finanzierung des Gesundheitswesens in Afrika aufgrund der geringeren Mobilisierung inländischer Einnahmen, der hohen Staatsverschuldung und der rückläufigen externen Finanzierung rückläufig. Anhaltende Ausbrüche von Infektionskrankheiten und Naturkatastrophen haben auch die ohnehin schwachen Gesundheitssysteme in Afrika überfordert. Der steigende Bedarf an Gesundheitsversorgung in Verbindung mit sinkenden Gesundheitsausgaben erschwert die Bereitstellung einer qualitativ hochwertigen Gesundheitsversorgung in den afrikanischen Ländern mit niedrigem und niedrigem mittleren Einkommen (LLMIC). Trotz der zunehmenden Herausforderung der fiskalischen Nachhaltigkeit der Gesundheitssysteme in den LLMICs in Afrika gibt es keine umfassende Studie zu diesem Thema. Angeregt durch Wissens- und Methodiklücken in der vorhandenen Literatur wurden in dieser Studie die wichtigsten Triebkräfte für Veränderungen bei den Gesamtausgaben und den öffentlichen Ausgaben für Gesundheit in Sambia untersucht, indem makrofiskalische Faktoren, Finanzierungsquellen, demografische, gesundheitliche, institutionelle und soziale Faktoren auf nationaler und subnationaler Ebene betrachtet wurden. Die Studie befasste sich mit der folgenden Forschungsfrage: Inwieweit ist das sambische Gesundheitssystem finanziell nachhaltig?

5.2 Materialien und Methoden

Angesichts der Tatsache, dass Sambias makrofiskalisches, demografisches, epidemiologisches und Gesundheitssystemprofil mit dem anderer LLMICs in Afrika vergleichbar ist, wurde die Studie in Sambia durchgeführt. Um das erste Ziel der Studie zu erreichen, wurden eine Panel-Regressionsanalyse und die Das-Gupta-Zerlegungsmethode verwendet, um die Hauptdeterminanten der gesamten und öffentlichen Gesundheitsausgaben in Sambia auf nationaler Ebene sowie die staatlichen Gesundheitsausgaben auf subnationaler Ebene zu bewerten. Die Dekompositionsanalyse ermöglichte es, Veränderungen bei den Gesundheitsausgaben nach Schlüsselfaktoren aufzuschlüsseln und zu quantifizieren. Für das zweite Ziel der Studie wurde eine umfassende Literaturanalyse durchgeführt, um einen analytischen Rahmen für die fiskalische Nachhaltigkeit von Gesundheitssystemen in LLMICs zu konzipieren und anzupassen. Zu diesem Zweck wurde auf bestehende angebots- und nachfrageseitige Theorien zu den Determinanten der Gesundheitsausgaben, auf allgemeine Arbeiten zur fiskalpolitischen Nachhaltigkeit und auf gesundheitssektorspezifische Studien zur fiskalischen Nachhaltigkeit und Widerstandsfähigkeit der Gesundheitssysteme Bezug genommen. Anschließend wurde eine vorausschauende Analyse des künftigen Finanzierungsbedarfs und des fiskalischen Spielraums für das Gesundheitswesen vorgenommen, um festzustellen, ob das Gesundheitssystem in Sambia finanziell tragfähig ist.

5.3 Ergebnisse

Die Ergebnisse zeigen, dass die Mittel für den Gesundheitssektor in Sambia im Zeitraum 2013-2019 erheblich gekürzt werden, insbesondere die staatlichen Inlandsausgaben für das Gesundheitswesen. Dies deutet auf eine Depriorisierung der Gesundheitsausgaben durch die sambische Regierung hin. Außerdem zeigen die Ergebnisse, dass die Ausgaben pro Krankheitsfall die Hauptursache für den Rückgang der gesamten Gesundheitsausgaben in Sambia waren. Die Ausgaben für HIV/AIDS und sexuell übertragbare Infektionen gingen zurück, gefolgt von nicht übertragbaren Krankheiten, Malaria und vernachlässigten tropischen Krankheiten. Die Kürzungen betrafen vor allem die Altersgruppe der 15- bis 49-Jährigen.

Auf der Ebene der Provinzen waren die Haushaltsergebnisse niedrig und die staatlichen Gesundheitsausgaben pro Kopf gingen kontinuierlich zurück. Hauptursache für den Rückgang der staatlichen Pro-Kopf-Gesundheitsausgaben war die Zahl der Tuberkulose-Meldungen pro 10.000 Einwohner, gefolgt vom Pro-Kopf-BIP. Andererseits milderten die Anzahl der Gesundheitseinrichtungen pro 10.000 Einwohner und der Grad der Verstädterung den Gesamtrückgang der staatlichen Gesundheitsausgaben pro Kopf ab. Jeder dieser Faktoren hatte jedoch unterschiedliche Auswirkungen auf die Veränderungen der staatlichen Pro-Kopf-Gesundheitsausgaben in den einzelnen Provinzen. Die Studie prognostiziert für den Zeitraum 2025-2030 eine „effektive" Gesundheitsfinanzierungslücke von insgesamt 77 bis 92 US-Dollar pro Kopf der Bevölkerung. Diese Lücke ist auf die prognostizierten Kürzungen der Pro-Kopf-Ausgaben für Gesundheit durch die Regierung und externe Entwicklungspartner zurückzuführen.

5.4 Schlussfolgerungen und Empfehlungen

Die Studie kommt zu dem Schluss, dass Sambias Gesundheitssystem finanziell nicht tragfähig ist, da die staatliche Finanzierung des Gesundheitswesens von 2013 bis 2019 keine Priorität hat und für 2025 bis 2030 eine erhebliche Finanzierungslücke prognostiziert wird. Die wichtigsten Determinanten der gesamten Gesundheitsausgaben sind HIV/AIDS und sexuell übertragbare Infektionen in der Altersgruppe der 15- bis 49-Jährigen. Auf Provinzebene sind die wichtigsten Faktoren, die die staatlichen Pro-Kopf-Gesundheitsausgaben beeinflussen, Tuberkulose-Meldungen, das Pro-Kopf-BIP, die Anzahl der Gesundheitseinrichtungen und der Grad der Verstädterung. Um die Funktionsfähigkeit des Gesundheitssystems in Sambia aufrechtzuerhalten, plädiert die Studie für eine ausreichende staatliche Finanzierung des Gesundheitswesens, eine bessere Vorhersehbarkeit der Finanzierung und eine verbesserte Effizienz bei der Zuweisung und Nutzung der Ressourcen. Die Studie fordert außerdem eine regelmäßige Überwachung und Abstimmung der verfügbaren Mittel mit dem Gesundheitsbedarf der Bevölkerung. Künftige Forschungsarbeiten könnten die Wirksamkeit der Gesundheitsausgaben, die Determinanten der Gesundheitsausgaben auf Bezirksebene, die Nachhaltigkeit von Maßnahmen auf Systemebene (z. B. das Nationale Krankenversicherungssystem) und die steigende Zahl von Fachkrankenhäusern untersuchen.

6. BIBLIOGRAPHY

Abizadeh, S. and Gray, J. (1985). **Wagner's law: A pooled time-series, cross-section comparison**. National Tax Journal, *38,* 209-218.

Aboubacar, B. and Xu, D. (2017). **The impact of health expenditure on the economic growth in Sub-Saharan Africa**. Theoretical Economics Letters, *7*, 615-622.

Achoki, T., Hovels, A., Masiye, F., Lesego, A., Leufkens, H. and Kinfu, Y. (2017). **Technical and scale efficiency in the delivery of child health services in Zambia: results from data envelopment analysis**. BMJ open, *7*, e012321.

African Development Bank. (2022). **Zambia Country Diagnostic Note**. Abidjan: African Development Bank. URL: https://www.afdb.org/sites/default/files/documents/projects-and-operations/country_diagnostic_note_zambia_final.pdf [last accessed 15 July 2024].

Ahmed, T., Roberton, T., Vergeer, P., et al. (2022). **Healthcare utilization and maternal and child mortality during the COVID-19 pandemic in 18 low- and middle-income countries: An interrupted time-series analysis with mathematical modeling of administrative data**. PLoS Med, *19*, e1004070.

Albouy, V., Davezies, L. and Debrand, T. (2010). **Health expenditure models: A comparison using panel data**. Economic Modelling, *27*, 791-803.

Alcalde-Unzu, J., Ezcurra, R. and Pascual, P. (2009). **Cross-country disparities in health-care expenditure: a factor decomposition**. Health Economics, *18*, 479-485.

Angelis, A., Tordrup, D. and Kanavos, P. (2017). **Is the Funding of Public National Health Systems Sustainable over the Long Term? Evidence from Eight OECD Countries**. Global Policy, *8*, 7-22.

Angko, W. (2013). **The determinants of healthcare expenditure in Ghana**. Journal of Economics and Sustainable Development, *4*, 102-124.

Arksey, H. and O'malley, L. (2005). **Scoping studies: towards a methodological framework**. International journal of social research methodology, *8*, 19-32.

Arrow, K. J. (1963). **Uncertainty and the Welfare Economics of Medical Care**. The American Economic Review, *53*, 941-973.

Asamani, J. A., Kigozi, J., Sikapande, B., Christmals, C. D., Okoroafor, S. C., Ismaila, H., Ahmat, A., Nyoni, J., Nabyonga-Orem, J. and Mwinga, K. (2022). **Investing in the health workforce: fiscal space analysis of 20 countries in East and Southern Africa, 2021–2026**. BMJ Global Health, *7*, e008416.

Astolfi, R., Lorenzoni, L. and Oderkirk, J. (2012a). **A comparative analysis of health forecasting methods**. OECD Health Working Papers, No. *59*, doi: 10.1787/5k912j389bf0-en.

Astolfi, R., Lorenzoni, L. and Oderkirk, J. (2012b). **Informing policy makers about future health spending: a comparative analysis of forecasting methods in OECD countries**. Health Policy, *107*, 1-10.

Atella, V. and Kopinska, J. (2019). **New Technologies and Costs in Healthcare.** Oxford University Press, doi: 10.1093/acrefore/9780190625979.013.68.

Atim, C., Arthur, E., Achala, D. M. and Novignon, J. (2020). **An Assessment of Domestic Financing for Reproductive, Maternal, Neonatal and Child Health in Sub-Saharan Africa: Potential Gains and Fiscal Space**. Applied Health Economics and Health Policy, *18*, 789-799.

Bakare, A. a. and Olubokun, S. (2011). **Health care expenditure and economic growth in Nigeria: An empirical study**. Journal of emerging trends in economics and management sciences, *2*, 83-87.

Baltagi, B. H. (2021). **Econometric Analysis of Panel Data.** Switzerland: Springer.

Baltagi, B. H., Lagravinese, R., Moscone, F. and Tosetti, E. (2017). **Health care expenditure and income: A global perspective**. Health economics, *26*, 863-874.

Barroy, H., Sparkes, S. and Dale, E. (2016). **Assessing fiscal space for health expansion in low-and-middle income countries: a review of the evidence**. Geneva: World Health Organization.

Barroy, H., Vaughan, K., Tapsoba, Y., Dale, E. and Van de Maele, N. (2017). **Towards universal health coverage: thinking public: overview of trends in public expenditure on health (2000-2014)**. Geneva: World Health Organization.

Bates, L. J. and Santerre, R. E. (2013). **Does the U.S. health care sector suffer from Baumol's cost disease? Evidence from the 50 states**. J Health Econ, *32*, 386-91.

Baumol, W. J. (1967). **Macroeconomics of unbalanced growth: the anatomy of urban crisis**. The American economic review, *57*, 415-426.

Baumol, W. J. (1993). **Health care, education and the cost disease: A looming crisis for public choice**. Public Choice, *77*, 17-28.

Beard, J. R., Officer, A., de Carvalho, I. A., Sadana, R., Pot, A. M., Michel, J.-P., Lloyd-Sherlock, P., Epping-Jordan, J. E., Peeters, G. M. E. E., Mahanani, W. R., Thiyagarajan, J. A. and Chatterji, S. (2016). **The World report on ageing and health: a policy framework for healthy ageing**. The Lancet, *387*, 2145-2154.

Berndt, E. R., Cutler, D. M., Frank, R. G., Griliches, Z., Newhouse, J. P. and Triplett, J. E. (2000). **Medical care prices and output.** Handbook of health economics. Elsevier.

Bhat, R. and Jain, N. (2004). **Analysis of public expenditure on health using state level data.** URL: https://www.iima.ac.in/sites/default/files/rnpfiles/2004-06-08rbhat.pdf [last accessed 12 May 2017].

Birch, S., Murphy, G. T., Mackenzie, A. and Cumming, J. (2014). **In place of fear: aligning health care planning with system objective to achieve financial sustainability**. Journal of health services research & policy, *20*, 109-114.

Bird, R. M. (1971). **Wagner's Law of Expanding State Activity**. Public Finance, *26*, 1-26.

Blecher, M. S., Kollipara, A., Daven, J., Meyer-Rath, G., Chiu, C., Pillay, Y., Abdullah, F., Borowitz, M. and Tavanxi, N. (2016). **HIV and AIDS financing in South Africa: sustainability and fiscal space**. South African Health Review, *2016*, 203-219.

Blinder, A. S. (1973). **Wage discrimination: reduced form and structural estimates**. Journal of Human resources, 436-455.

Box, G. E. P. and Jenkins, G. M. (1970). **Time Series Analysis: Forecasting and Control.** San Francisco: Holden-Day.

Brault, M. A., Mwinga, K., Kipp, A. M., Kennedy, S. B., Maimbolwa, M., Moyo, P., Ngure, K., Haley, C. A. and Vermund, S. H. (2020). **Measuring child survival for the Millennium Development Goals in Africa: what have we learned and what more is needed to evaluate the Sustainable Development Goals?** Global Health Action, *13*, 1732668.

Burnside, C. (2005). **Theoretical Prerequisites for Fiscal Sustainability Analysis.** In: Burnside, C. (ed.) Fiscal Sustainability in Theory and Practice: A Handbook. Washington DC: World Bank.

Cameron, A., Ewen, M., Ross-Degnan, D., Ball, D. and Laing, R. (2009). **Medicine prices, availability, and affordability in 36 developing and middle-income countries: a secondary analysis.** The Lancet, *373*(9659), pp.240–249. doi:10.1016/S0140-6736(08)61762-6.

Cameron, A., Mantel-Teeuwisse, A.K., Leufkens, H.G.M. and Laing, R.O. (2012). **Switching from originator brand medicines to generic equivalents in selected developing countries: how much could be saved?** Value in Health, *15(5)*, pp.664–673. doi:10.1016/j.jval.2012.04.004.

Cashin, C., Bloom, D., Sparkes, S., Barroy, H., Kutzin, J. and O'Dougherty, S. (2017). **Aligning public financial management and health financing: sustaining progress toward universal health coverage.** Health Financing Working Paper No. *4*. URL: http://apps.who.int/iris/bitstream/10665/254680/1/9789241512039-eng.pdf [last accessed 15 December 2018].

CDC (Centers for Disease Control and Prevention). (2019). **2014-2016 Ebola Outbreak in West Africa**. URL: https://www.cdc.gov/vhf/ebola/history/2014-2016-outbreak/index.html [last accessed 6 August 2023].

Central Statistical Office. (2012). **Zambia 2010 Census of Population and Housing: National Analytical Report**. Lusaka: Central Statistics Office.

Central Statistical Office. (2016). **2015 Living Conditions Monitoring Survey Report**. Lusaka: Central Statistical Office.

Cetină, I., Orzan, G., Rădulescu, V. and Orzan, M. (2009). **Grounding the Marketing Strategy of the Organizations in the Field of Health Care**. Theoretical & Applied Economics, *3*, 71-78.

Challenge TB. (2020). **Rapid scale-up of new drugs and regimens for the treatment of drug-resistant TB in Zambia.** Lusaka, Challenge TB. URL: https://www.challengetb.org/publications/tools/briefs/Zambia_NDR_Technical_Brief.pdf [last accessed 2 June 2024].

Chansa, C., Chama-Chiliba, C. and Velenyi, E. (2015). **Health Financing Background Report for the Mid-Term Review of the National Health Strategic Plan 2011-2016**. Lusaka: Ministry of Health.

Chansa, C., Sundewall, J. and Östlund, N. (2018). **Effect of currency exchange rate fluctuations on Aid Effectiveness in the Health Sector in Zambia**. Health Policy and Planning, *33,* 811-820, doi: 10.1093/heapol/czy046.

Chatterjee, U. and Smith, O. (2021). **Going Granular: Equity of Health Financing at the District and Facility Level in India**. Health Systems & Reform, *7*, e1924934.

Chernew, M. E. and Newhouse, J. P. (2011). **Health Care Spending Growth.** In: Pauly, M. V., Mcguire, T. G. and Barros, P. P. (eds.) Handbook of Health Economics. Elsevier.

Chile Ministry of Finance. (2020). **Economic and Social Stabilization Fund.** URL: https://www.hacienda.cl/english/work-areas/international-finance/sovereign-wealth-funds/economic-and-social-stabilization-fund [last accessed 8 October 2022].

Chilufya, C. and Kamanga, M. (2018). **Crunch Time: the transformational Universal Health Coverage agenda for Zambia**. Health Systems & Reform, *4*, 272-276.

Chipunza, T. and Nhamo, S. (2023). **Fiscal capacity and public health expenditure in Zimbabwe**. Cogent Economics & Finance, *11*, 2175459.

Chisholm, D. and Evans, D. B. (2010). **Improving health system efficiency as a means of moving towards universal coverage**. URL: https://cdn.who.int/media/docs/default-source/health-financing/technical-briefs-background-papers/whr-2010-background-paper-28.pdf [last accessed 16 November 2017].

Clements, M. P. and Hendry, D. F. (2011). **The Oxford handbook of economic forecasting.** Oxford University Press: USA.

Colombier, C. and Weber, W. (2011). **Projecting health-care expenditure for Switzerland: further evidence against the 'red-herring'hypothesis**. The International journal of health planning and management, *26*, 246-263.

Culyer, A. J. (1988). **Health Care Expenditures in Canada: Myth and Reality; Past and Future**. Toronto: Canadian Tax Foundation.

David, A. C. (2009). **Fiscal space and the sustainability of HIV/AIDS programs in sub-Saharan Africa.** In: Lule, E. L., Seifman, R. M. and David, A. C. (eds.) The Changing HIV/AIDS Landscape: Selected Papers for the World Bank's Agenda for Action in Africa, 2007-2011. Washington DC: World Bank.

De la Maisonneuve, C. and Martins, J. O. (2013a). **A Projection Method for Public Health and Long-Term Care Expenditures**. OECD Economics Department Working Papers, No. *1048*, doi: 10.1787/5k44v53w5w47-en.

De la Maisonneuve, C. and Martins, J. O. (2013b). **Public spending on health and long-term care: A new set of projections**. OECD Economic Policy Papers, No. *6*, doi: 10.1787/5k44t7jwwr9x-en.

de Meijer, C., O'Donnell, O., Koopmanschap, M. and van Doorslaer, E. (2013). **Health expenditure growth: Looking beyond the average through decomposition of the full distribution**. Journal of Health Economics, *32*, 88-105.

Di Matteo, L. (2003). **The income elasticity of health care spending: A comparison of parametric and nonparametric approaches**. The European Journal of health economics, *4*, 20-29.

Dieleman, J., Campbell, M., Chapin, A., et al. (2017). **Evolution and patterns of global health financing 1995-2014: development assistance for health, and government, prepaid private, and out-of-pocket health spending in 184 countries**. The Lancet, *389*, 1981-2004.

Doherty, J., Kirigia, D., Okoli, C., Chuma, J., Ezumah, N., Ichoku, H., Hanson, K. and McIntyre, D. (2018). **Does expanding fiscal space lead to improved funding of the health sector in**

developing countries?: lessons from Kenya, Lagos State (Nigeria) and South Africa. Global health action, *11*, 1461338.

Dormont, B., Grignon, M. and Huber, H. (2006). **Health expenditure growth: reassessing the threat of ageing**. Health Economics, *15*, 947-963.

Dunn, A., Liebman, E. and Shapiro, A. H. (2018). **Decomposing Medical Care Expenditure Growth.** In: Aizcorbe, A., Baker, C., Berndt, E. R. and Cutler, D. M. (eds.) Measuring and Modeling Health Care Costs. Chicago: University of Chicago Press.

Durairaj, V. and Evans, D. B. (2010). **Fiscal space for health in resource poor countries**. URL: https://cdn.who.int/media/docs/default-source/health-financing/technical-briefs-background-papers/whr-2010-background-paper-41.pdf?sfvrsn=ef456560_3&download=true [last accessed 16 November 2017].

Edeh, H. C. (2022). **Exploring dynamics in catastrophic health care expenditure in Nigeria**. Health Economics Review, *12*, 1-20.

Edoka, I., McPake, B., Ensor, T., Amara, R. and Edem-Hotah, J. (2017). **Changes in catastrophic health expenditure in post-conflict Sierra Leone: an Oaxaca-blinder decomposition analysis**. International journal for equity in health, *16*, 1-15.

Fagan, T. and Zeng, W. (2015). **Sustainable HIV financing in Zambia: Baseline analysis and prospects for new domestic resource mobilization.** URL: https://www.healthpolicyproject.com/pubs/2876_ZambiaHIVFinancingFeb.pdf [last accessed 16 November 2017].

Fan, V. and Savedoff, W. (2014). **The Health Financing Transition: A Conceptual Framework and Empirical Evidence.** URL: https://www.cgdev.org/sites/default/files/health-financing-transition-framework-evidence_1.pdf [last accessed 16 November 2017].

Farag, M., NandaKumar, A., Wallack, S., Hodgkin, D., Gaumer, G. and Erbil, C. (2012). **The income elasticity of health care spending in developing and developed countries**. International Journal of Health Care Finance and Economics, *12*, 145-162.

Federal Republic of Germany. (2020). **Economic Stabilisation Fund**. URL: https://www.deutsche-finanzagentur.de/en/esf/economic-stabilisation-fund [last accessed 16 April 2024].

Fogel, R. (2008). **Forecasting the cost of U.S. health care in 2040**. Cambridge, Massachussetts: National Bureau of Economic Research.

Fraser-Hurt, N., Hou, X., Wilkinson, T., Duran, D., Abou Jaoude, G. J., Skordis, J., Chukwuma, A., Lao Pena, C., Tshivuila Matala, O. O. and Gorgens, M. (2021). **Using Allocative efficiency analysis to inform health benefits package design for progressing towards universal health coverage: proof-of-concept studies in countries seeking decision support**. Plos one, *16*, e0260247.

Gbesemete, K. P. and Gerdtham, U.-G. (1992). **Determinants of health care expenditure in Africa: a cross-sectional study**. World development, *20*, 303-308.

Gerdtham, U.-G. and Jonsson, B. (2000). **International comparisons of health expenditure: Theory, data and econometric analysis.** In: Culyer, A. J. and Newhouse, J. P. (eds.) Handbook of Health Economics. Elsevier.

Gerdtham, U.-G. and Jönsson, B. (1991). **Conversion factor instability in international comparisons of health care expenditure**. Journal of health economics, *10*, 227-234.

Ghazy, N. H., Ghoneim, H. and Paparas, D. (2021). **The validity of Wagner's law in Egypt from 1960–2018**. Review of Economics and Political Science, *6*, 98-117.

Ghazy, R. M., El Saeh, H. M., Abdulaziz, S., Hammouda, E. A., Elzorkany, A. M., Khidr, H., Zarif, N., Elrewany, E. and Abd ElHafeez, S. (2022). **A systematic review and meta-analysis of the catastrophic costs incurred by tuberculosis patients**. Scientific Reports, *12*, 558.

Glassman, A. L. and Zoloa, J. I. (2014). **How Much Will Health Coverage Cost? Future Health Spending Scenarios in Brazil, Chile, and Mexico**. Center for Global Development Working Paper No. *382*, doi: 10.2139/ssrn.2622754

Gluzmann, P. and Panigo, D. (2015). **Global Search Regression: A New Automatic Model-selection Technique for Cross-section, Time-series, and Panel-data Regressions**. The Stata Journal, *15*, 325-349.

Government of Zambia. (2004). **Financial Sustainability Plan for the Immunization Programme in Zambia.** Lusaka: Ministry of Health.

Government of Zambia. (2024). **Statement on the Drought Response Appeal.** URL: https://www.cabinet.gov.zm/wp-content/uploads/2024/04/Statement-of-Drought-by-the-President-Mr.-H.H-2024.pdf [Accessed 24 May 2024].

Grépin, K. A. (2012). **Efficiency considerations of donor fatigue, universal access to ARTs and health systems**. Sexually Transmitted Infections, *88*, 75-78.

Gribble, J. N. and Preston, S. H. (1993). **Introduction.** In: Gribble, J. N. and Preston, S. H. (eds.) The Epidemiological Transition: Policy and Planning Implications for Developing Countries. Washington DC: National Academies Press.

Griffiths, U. K., Bozzani, F. M., Chansa, C., Kinghorn, A., Kalesha-Masumbu, P., Rudd, C., Chilengi, R., Brenzel, L. and Schutte, C. (2016). **Costs of introducing pneumococcal, rotavirus and a second dose of measles vaccine into the Zambian immunisation programme: Are expansions sustainable?** Vaccine, *34*, 4213-4220.

Grossman, M. (1972). **On the Concept of Health Capital and the Demand for Health**. Journal of Political Economy, *80*, 223-255.

Gupta, P. D. (1991). **Decomposition of the difference between two rates and its consistency when more than two populations are involved**. Mathematical Population Studies, *3*, 105-125.

Gupta, P. D. (1994). **Standardization and decomposition of rates from cross-classified data**. Genus, 171-196.

Gupta, A., Juneja, S., Sahu, S., Yassin, M., Brigden, G., Wandwalo, E., Rane, S., Mirzayev, F. & Zignol, M. (2022). **Lifesaving, cost-saving: Innovative simplified regimens for drug-resistant tuberculosis.** PLOS Global Public Health, *2*(11), e0001287. doi:10.1371/journal.pgph.0001287.

Gwatkin, D. R., Bhuiya, A. and Victora, C. G. (2004). **Making health systems more equitable**. The Lancet, *364*, 1273-1280.

Hafez, R. (2020). **Measuring health system efficiency in low-and middle-income countries: a resource guide.** . Washington DC: Joint Learning Network.

Hanson, K., Brikci, N., Erlangga, D., Alebachew, A., De Allegri, M., Balabanova, D., Blecher, M., Cashin, C., Esperato, A., Hipgrave, D., Kalisa, I., Kurowski, C., Meng, Q., Morgan, D., Mtei, G., Nolte, E., Onoka, C., Powell-Jackson, T., Roland, M., Sadanandan, R., Stenberg, K., Vega Morales, J., Wang, H. and Wurie, H. (2022). **The Lancet Global Health Commission on financing primary health care: putting people at the centre**. The Lancet Global Health, *10*, e715-e772.

Hartwig, J. (2008). **What drives health care expenditure? Baumol's model of unbalanced growth revisited**. Health Economics, *27*, 603-23.

Hartwig, J. and Sturm, J.-E. (2014). **Robust determinants of health care expenditure growth**. Applied Economics, *46*, 4455-4474.

Heller, P. S. (2005). **Understanding Fiscal Space**. Washington DC: International Monetary Fund.

Heller, P. S. (2006). **The prospects of creating 'fiscal space'for the health sector**. Health Policy and Planning, *21*, 75-79.

HGPI (Health and Global Policy Institute). (n.d.). **Cost control**. URL: https://japanhpn.org/en/finan3/#:~:text=Central%20Social%20Insurance%20Medical%20Council%20(Chuikyou) [last accessed 16 April 2024].

Hjortsberg, C. and Mwikisa, C. (2002). **Cost of access to health services in Zambia**. Health policy and planning, *17*, 71-77.

Holman, H. R. (2020). **The Relation of the Chronic Disease Epidemic to the Health Care Crisis**. ACR Open Rheumatol, *2*, 167-173.

Hosoya, K. (2014). **Determinants of health expenditures: Stylized facts and a new signal**. Modern Economy, *5*, 1171.

Hou, J., Tian, L., Zhang, Y., Liu, Y., Li, J. and Wang, Y. (2020). **Study of influential factors of provincial health expenditure-analysis of panel data after the 2009 healthcare reform in China**. BMC Health Services Research, *20*, 1-8.

Hsiao, W. (2017). Pathways in Health Financing. Unpublished.

Huang, C.-J. (2006). **Government expenditures in china and taiwan: do they follow wagner's law?** Journal of economic development, *31*, 139-148.

Huber, C., Finelli, L. and Stevens, W. (2018). **The economic and social burden of the 2014 Ebola outbreak in West Africa**. The Journal of infectious diseases, *218*, S698-S704.

Huffstetler, H. E., Bandara, S., Bharali, I., Kennedy Mcdade, K., Mao, W., Guo, F., Zhang, J., Riviere, J., Becker, L., Mohamadi, M., Rice, R. L., King, Z., Farooqi, Z. W., Zhang, X., Yamey, G. and Ogbuoji, O. (2022). **The impacts of donor transitions on health systems in middle-income countries: a scoping review**. Health Policy and Planning, *37*, 1188-1202.

IHME (Institute for Health Metrics and Evaluation). (2017). **Disparities on the Path to Universal Health Coverage: Findings from Financing Global Health**. Seattle, WA: IHME.

IMF (International Monetary Fund). (2023a). **World Economic Outlook.** URL: https://www.imf.org/en/Publications/WEO/weo-database/2023/April [last accessed August 18 2023].

IMF. (2023b). **Zambia**. URL: https://www.imf.org/en/Countries/ZMB [last accessed 21 November 2023].

Jakovljevic, M., Lamnisos, D., Westerman, R., Chattu, V. K. and Cerda, A. (2022). **Future health spending forecast in leading emerging BRICS markets in 2030: health policy implications**. Health Research Policy and Systems, *20*, 23.

Jamison, D. T., Summers, L. H., Alleyne, G., Arrow, K. J., Berkley, S., Binagwaho, A., Bustreo, F., Evans, D., Feachem, R. G. A., Frenk, J., Ghosh, G., Goldie, S. J., Guo, Y., Gupta, S., Horton , R., Kruk, M. E., Mahmoud, A., Mohohlo, L. K., Ncube, M., Pablos-Mendez, A. and Reddy, K. S. (2013). **Global health 2035: a world converging within a generation**. The Lancet, *382*, 1898-1955.

Jowett, M., Brunal, M. P., Flores, G. and Cylus, J. (2016). **Spending targets for health: no magic number**. Geneva: World Health Organization. URL: https://iris.who.int/bitstream/handle/10665/250048/WHO-HIS-HGF-HFWorkingPaper-16.1-eng.pdf?sequence=1 [last accessed 12 May 2017].

Kabembo, I. M. (2024). **Forgone healthcare for medically vulnerable groups during the pandemic era: experiences of family caregivers of young adults with substance use disorders in Zambia**. Frontiers in Public Health, *12*, 1250608.

Kakietek, J. J., Eberwein, J. D., Stacey, N., Newhouse, D. and Yoshida, N. (2022). **Foregone healthcare during the COVID-19 pandemic: early survey estimates from 39 low-and middle-income countries**. Health Policy and Planning, *37*, 771-778.

Kapata, N., Chanda-Kapata, P., Ngosa, W., Metitiri, M., Klinkenberg, E., Kalisvaart, N., Sunkutu, V., Shibemba, A., Chabala, C., Chongwe, G., Tembo, M., Mulenga, L., Mbulo, G., Katemangwe, P., Sakala, S., Chizema-Kawesha, E., Masiye, F., Sinyangwe, G., Onozaki, I., Mwaba, P., Chikamata, D., Zumla, A. and Grobusch, M. P. (2016). **The Prevalence of Tuberculosis in Zambia: Results from the First National TB Prevalence Survey, 2013–2014**. PLOS ONE, *11*, e0146392.

Keegan, C., Brick, A., Bergin, A., Wren, M.-A., Henry, E. and Whyte, R. (2020). **Projections of expenditure for public hospitals in Ireland, 2018-2035, based on the Hippocrates Model**. Dublin: Economic and Social Research Institute. URL: https://www.esri.ie/system/files/publications/RS117_1.pdf [last accessed 16 April 2024].

Khadaroo, V. and Jaunky, A. (2008). **Health care expenditure and GDP: An African perspective**. Applied Econometrics and International Development, *8*, 130-146.

Kibasi, T., Teitelbaum, J. and Henke, N. (2012). **The Financial Sustainability of Health Systems: A case for change**. URL: https://www3.weforum.org/docs/WEF_HE_SustainabilityHealthSystems_Report_2012.pdf [last accessed 12 May 2017].

Kieny, M. P., Bekedam, H., Dovlo, D., Fitzgerald, J., Habicht, J., Harrison, G., Kluge, H., Lin, V., Menabde, N., Mirza, Z., Siddiqi, S. and Travis, P. (2017). **Strengthening health systems for universal health coverage and sustainable development**. Bull World Health Organ, *95*, 537-539.

Kouassi, E., Akinkugbe, O., Kutlo, N. O. and Brou, J. B. (2018). **Health expenditure and growth dynamics in the SADC region: Evidence from non-stationary panel data with cross section dependence and unobserved heterogeneity**. International journal of health economics and management, *18*, 47-66.

Kruk, M. E., Gage, A. D., Arsenault, C., Jordan, K., Leslie, H. H., Roder-DeWan, S., Adeyi, O., Barker, P., Daelmans, B., Doubova, S. V., English, M., García-Elorrio, E., Guanais, F., Gureje, O., Hirschhorn, L. R., Jiang, L., Kelley, E., Lemango, E. T., Liljestrand, J., Malata, A., Marchant, T., Matsoso, M. P., Meara, J. G., Mohanan, M., Ndiaye, Y., Norheim, O. F., Reddy, K. S., Rowe, A. K., Salomon, J. A., Thapa, G., Twum-Danso, N. A. Y. and Pate, M. (2018). **High-quality health systems in the Sustainable Development Goals era: time for a revolution**. The Lancet Global Health, *6*, e1196-e1252.

Kruk, M. E., Yamey, G., Angell, S. Y., Beith, A., Cotlear, D., Guanais, F., Jacobs, L., Saxenian, H., Victora, C. and Goosby, E. (2016). **Transforming Global Health by Improving the Science of Scale-Up**. PLOS Biology, *14*, e1002360.

Kumar, R. K. (2011). **Technology and healthcare costs**. Ann Pediatr Cardiol, *4*, 84-6.

Kurowski, C., Evans, D. B., Schmidt, M., Tandon, A., Hoang-Vu, E. P., Salcedo Cain, J. and Pambudi, E. S. (2024). **Global Health Spending Outlook to 2029: Persistent Divides**. Washington, DC: World Bank.

Laporte, A. (2014). **Should the Grossman model retain its iconic status in health economics**. Canadian Centre for Health Economics Working Paper, *4*, 2014. URL: https://www.canadiancentreforhealtheconomics.ca/wp-content/uploads/2015/01/Laporte-R.pdf [last accessed 12 May 2017].

Lee, R. and Miller, T. (2002). **An approach to forecasting health expenditures, with application to the U.S. Medicare system**. Health Serv Res, *37*, 1365-86.

Leu, R. E. (1986). **The public-private mix and international health care costs.** In: J, C. A. and Jönsson, B. (eds.) Public and Private Health Services Oxford: Basil Blackwell.

Li, J. (2017). **Rate Decomposition for Aggregate Data Using Das Gupta's Method**. The Stata Journal, *17*, 490-502.

Li, X., Zhang, Y., Zhang, X., Li, X., Lin, X. and Han, Y. (2022). **Effects of fee-for-service, diagnosis-related-group, and mixed payment systems on physicians' medical service behavior: experimental evidence**. BMC Health Services Research, *22*, 870.

Lindahl, J. F. and Grace, D. (2015). **The consequences of human actions on risks for infectious diseases: a review**. Infect Ecol Epidemiol, *5*, 30048.

Lindberg, C. and McCarthy, T. (2021). **Impact of Demographic Change on Health Expenditure 2022-2025**. URL: https://assets.gov.ie/162858/de26cd4f-9e4d-4628-80f2-0f1eebbccc53.pdf [last accessed 16 April 2024].

Lorenzoni, L., Dougherty, S., de Biase, P. and McCarthy, T. (2023). **Assessing the future fiscal sustainability of health spending in Ireland**. OECD Health Working Papers, No. *161*, doi: 10.1787/1f5fadbc-en.

Lorenzoni, L., Marino, A., Morgan, D. and James, C. (2019). **Health Spending Projections to 2030**. OECD Health Working Papers, No. *110*, doi: 10.1787/5667f23d-en..

Lu, C., Schneider, M. T., Gubbins, P., Leach-Kemon, K., Jamison, D. and Murray, C. J. (2010). **Public financing of health in developing countries: a cross-national systematic analysis**. The Lancet, *375*, 1375-1387.

Lungu, P., Kasapo, C., Mihova, R., Chimzizi, R., Sikazwe, L., Banda, I., Mucheleng'anga, L. A., Chanda-Kapata, P., Kapata, N., Zumla, A. and Mwaba, P. (2022). **A 10-year Review of TB Notifications and Mortality Trends Using a Joint Point Analysis in Zambia - a High TB burden country**. International Journal of Infectious Diseases, *124*, pp. S30-S40.

Lungu, P., Kerkhoff, A. D., Kasapo, C. C., Mzyece, J., Nyimbili, S., Chimzizi, R., Silumesii, A., Kagujje, M., Subbaraman, R., Muyoyeta, M. and Malama, K. (2021). **Tuberculosis care cascade in Zambia - identifying the gaps in order to improve outcomes: a population-based analysis**. BMJ Open, *11*, e044867.

Lv, Z. and Zhu, H. (2014). **Health care expenditure and GDP in African countries: evidence from semiparametric estimation with panel data**. Scientific World Journal, *2014*, 905747.

Maeda, A., Araujo, E., Cashin, C., Harris, J., Ikegami, N. and Reich, M. R. (2014). **Universal Health Coverage for Inclusive and Sustainable Development: A Synthesis of 11 Country Case Studies**. Washington, DC: World Bank.

Makuta, I. and O'Hare, B. (2015). **Quality of governance, public spending on health and health status in Sub Saharan Africa: a panel data regression analysis**. BMC Public Health, *15*, 932.

Marino, A. and Lorenzoni, L. (2019). **The impact of technological advancements on health spending**. OECD Health Working Papers No. *113*, doi: 10.1787/fa3bab05-en.

Marino, A., Morgan, D., Lorenzoni, L. and James, C. (2017). **Future Trends in Health Care Expenditure: A Modelling Framework for Cross-country Forecasts**. Paris: OECD.

Mcintyre, D., Meheus, F. and Røttingen, J.-A. (2017). **What level of domestic government health expenditure should we aspire to for universal health coverage?** Health Economics, Policy and Law, *12*, 125-137.

McQuestion, M., Gnawali, D., Kamara, C., Kizza, D., Mambu-Ma-Disu, H., Mbwangue, J. and de Quadros, C. (2011). **Creating sustainable financing and support for immunization programs in fifteen developing countries**. Health Affairs, *30*, 1134-1140.

Melgar, M., Shiraishi, R. W., Tende, C., Mwanza, S., Mulenga, J., Khondowe, S., Mwakazanga, D., Kapungu, K., Tembo, M., Nota, A., Lungu, P., Moore, B. and Podewils, L. J. (2021). **Assessment of the tuberculosis case-finding and prevention cascade among people living with HIV in Zambia – 2018: a cross-sectional cluster survey**. BMC Public Health, *21*, 859.

Micah, A. E., Chen, C. S., Zlavog, B. S., Hashimi, G., Chapin, A. and Dieleman, J. L. (2019). **Trends and drivers of government health spending in sub-Saharan Africa, 1995–2015**. BMJ global health, *4*, e001159.

Ministry of Finance and National Planning. (2022). **Government Committed to Swift Return to Lower Middle-Income Country Status.** URL: https://www.mofnp.gov.zm/?p=5763 [last accessed 16 April 2024].

Ministry of Health. (2007). **Revised Guidelines on the Removal of User Fees at Government and Mission Health Facilities in Zambia**. Lusaka: Ministry of Health.

Ministry of Health. (2012). **National Health Policy**. Lusaka: Ministry of Health.

Ministry of Health (2017a). **Zambia National Health Accounts 2011/12.** Lusaka: Ministry of Health.

Ministry of Health. (2017b). **Zambia National Health Strategic Plan 2017–2021**. Lusaka: Ministry of Health.

Ministry of Health. (2018a). **The 2017 List of Health Facilities in Zambia showing revised codes: Preliminary Report**. Lusaka: Ministry of Health.

Ministry of Health. (2018b). **National Health Accounts 2013-2016**. Lusaka: Ministry of Health.

Ministry of Health. (2022). **National Health Strategic Plan 2022–2026**. Lusaka: Ministry of Health.

Ministry of Health. (2023a). **Health Sector Resource Mapping for Zambia: 2023–2027**. Lusaka: Ministry of Health.

Ministry of Health. (2023b). **National Health Accounts 2017-2021**. Lusaka: Ministry of Health.

Modibbo, H. U. and Saidu, A. M. (2020). **Health expenditure and economic growth nexus: a generalised method of moment approach for the case of selected Africa countries**. Lapai Journal of Economics, *4*, 12-21.

Morgan, D., Lorenzoni, L., Colombo, F., Scarpetta, S. and Pearson, M. (2022). **Understanding differences in health expenditure between the United States and OECD countries.** URL: https://www.oecd.org/health/Health-expenditure-differences-USA-OECD-countries-Brief-July-2022.pdf [last accessed 16 April 2024].

Moszynski, P. (2010). **Donor fatigue is slashing access to AIDS care in Africa, warns charity**. BMJ, *340,* doi: 10.1136/bmj.c2844.

Mulaga, A. N., Kamndaya, M. S. and Masangwi, S. J. (2022). **Decomposing socio-economic inequality in catastrophic out-of-pocket health expenditures in Malawi**. PLOS Global Public Health, *2*, e0000182.

Mulenga, L.B., Hines, J.Z., Stafford, K.A., et al. (2024). **Comparison of HIV prevalence, incidence, and viral load suppression in Zambia population-based HIV impact assessments from 2016 and 2021**. AIDS, *38*(6), pp.895–905. doi:10.1097/QAD.0000000000003834.

Murthy, V. N. and Okunade, A. A. (2009). **The core determinants of health expenditure in the African context: Some econometric evidence for policy**. Health policy, *91*, 57-62.

Nakazwe, C., Michelo, C., Sandøy, I.F. & Fylkesnes, K. (2019). **Contrasting HIV prevalence trends among young women and men in Zambia in the past 12 years: data from demographic and health surveys 2002–2014.** BMC Infectious Diseases, *19*(1). doi:10.1186/s12879-019-4059-3.

National Academies of Sciences, Engineering, and Medicine. (2018). **Crossing the global quality chasm: improving health care worldwide**. Washington DC: National Academies of Sciences, Engineering, and Medicine.

National Research Council (2010). **Improving Health Care Cost Projections for the Medicare Population: Summary of a Workshop.** Washington DC: National Academies Press.

Navarro, V. and Shi, L. (2001). **The political context of social inequalities and health**. Social Science & Medicine, *52*, 481-491.

Neel, A. H., Rodríguez, D. C., Sikazwe, I., Pillay, Y., Barron, P., Pereira, S. K., Makakole-Nene, S. and Bennett, S. C. (2024). **HIV programme sustainability in Southern and Eastern Africa and the changing role of external assistance for health**. Health policy and planning, *39*, i107-i117.

Neumann, P. J. and Weinstein, M. C. (1991). **The Diffusion of New Technology: Costs and Benefits to Health Care.** In: Gelijns, A. C. and Halm, E. A. (eds.) The Changing Economics of Medical Technology. Washington DC: National Academy Press.

Newhouse, J. P. (1977). **Medical-care expenditure: a cross-national survey**. The Journal of Human Resources, *12*, 115-125.

Nilsson, M., Griggs, D. and Visbeck, M. (2016). **Policy: Map the interactions between Sustainable Development Goals**. Nature, *534*, 320-322.

Njagi, P., Arsenijevic, J. and Groot, W. (2020). **Decomposition of changes in socioeconomic inequalities in catastrophic health expenditure in Kenya**. PLoS One, *15*, e0244428.

Oaxaca, R. (1973). **Male-female wage differentials in urban labor markets**. International economic review, 693-709.

Odhiambo, N. M. (2021). **Health expenditure and economic growth in sub-Saharan Africa: an empirical investigation**. Development Studies Research, *8*, 73-81.

OECD (Organisation for Economic Co-operation and Development). (2015). **Fiscal Sustainability of Health Systems.** Paris: OECD Publishing.

Okunade, A. A. (2005). **Analysis and Implications of the Determinants of Healthcare Expenditure in African Countries**. Health Care Management Science, *8*, 267-276.

Okwero, P., Tandon, A., Sparkes, S., McLaughlin, J. and Hoogeveen, J. G. (2010). **Fiscal space for health in Uganda**. Washington DC: World Bank.

Olaniyan, O., Onisanwa, I. D. and Oyinlola, A. (2013). **Health Care Expenditures and GDP in Sub-Saharan African Countries: Evidence from Panel Data**. Centre for the Study of African Economies. Department of Economics, University of Ibadan.

Owen, O., Van Doorslaer, E., Wagstaff, A. and Lindelow, M. (2007). **Analyzing health equity using household survey data: a guide to techniques and their implementation.** World Bank Publications. URL: https://documents1.worldbank.org/curated/en/633931468139502235/pdf/424800ISBN978011OFFICIAL0USE0ONLY10.pdf [Accessed 12 April 2017].

Pan, J. and Liu, G. G. (2012). **The determinants of Chinese provincial government health expenditures: evidence from 2002–2006 data**. Health economics, *21*, 757-777.

Peters, A. C. (1996). **An Application of Wagner's 'Law' of Expanding State Activity To Totally Diverse Countries.** URL: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.493.7556&rep=rep1&type=pdf [last accessed 12 May 2017].

Peters, M. D., Godfrey, C. M., Khalil, H., McInerney, P., Parker, D. and Soares, C. B. (2015). **Guidance for conducting systematic scoping reviews**. Int J Evid Based Healthc, *13*, 141-6.

Piatti-Fünfkirchen, M., Lindelow, M. and Yoo, K. (2018). **What are governments spending on health in East and Southern Africa?** Health Systems & Reform, *4*, 284-299.

Prakongsai, P., Patcharanarumol, W. and Tangcharoensathien, V. (2008). **Can earmarking mobilize and sustain resources to the health sector?** Bulletin of the World Health Organization, *86*, 898-901.

Prince, M. J., Wu, F., Guo, Y., Gutierrez Robledo, L. M., O'Donnell, M., Sullivan, R. and Yusuf, S. (2015). **The burden of disease in older people and implications for health policy and practice**. The Lancet, *385*, 549-562.

Ramezanian, M., Haghdoost, A. A., Mehrolhassani, M. H., Abolhallaje, M., Dehnavieh, R., Najafi, B. and Fazaeli, A. A. (2019). **Forecasting health expenditures in Iran using the ARIMA model (2016-2020)**. Med J Islam Repub Iran, *33*, 25.

Ranjan, R. and Chintu, A. K. (2013). **An Application of Wagner's Law in the Indian Economy: 1970-71 to 2010-11**. Knowledge Horizons. Economics, *5*, 138.

Rebba, V. (2014). **The long-term sustainability of European health care systems.** URL: http://economia.unipd.it/sites/decon.unipd.it/files/20140191.pdf [last accessed 12 May 2017].

Remme, M., Siapka, M., Sterck, O., Ncube, M., Watts, C. and Vassall, A. (2016). **Financing the HIV response in sub-Saharan Africa from domestic sources: Moving beyond a normative approach**. Social Science & Medicine, *169*, 66-76.

Rice, N. and Aragon, M. J. (2018). **The Determinants of Health Care Expenditure Growth**. York: Centre for Health Economics.

Rono, I. J. (2013). **The Determinants of public health care expenditure in Kenya**. Master Thesis, Unversity of Nairobi, Kenya.

Rossen, B. and Faroque, A. (2016). **Diagnosing the Causes of Rising Health-Care Expenditure in Canada: Does Baumol's Cost Disease Loom Large?** American Journal of Health Economics, *2*, 184-212.

Savedoff, W. D., Bitrán, R., de Ferranti, D., Fan, V. Y., Holly, A., Moreno-Serra, R., Saksena, P., Smith, A. L., Smith, P. C. and Ke, X. (2012). **Transitions in Health Financing and Policies for Universal Health Coverage: Final Report of the Transitions in Health Financing Project**. Washington DC: Results for Development Institute.

Saxenian, H., Alkenbrack, S., Attaran, M. F., Barcarolo, J., Brenzel, L., Brooks, A., Ekeman, E., Griffiths, U., Rozario, S. and Maele, N. V. (2024). **Sustainable financing for Immunization Agenda 2030**. Vaccine, *42*, S73-S81, doi: 10.1016/j.vaccine.2022.11.037

Scheirer, M. and Dearing, J. (2011). **An Agenda for Research on the Sustainability of Public Health Programs**. American journal of public health, *101*, 2059-67.

Schutte, C., Chansa, C., Marinda, E., Guthrie, T. A., Banda, S., Nombewu, Z., Motlogelwa, K., Lervik, M., Brenzel, L. and Kinghorn, A. (2015). **Cost analysis of routine immunisation in Zambia**. Vaccine, *33*, A47-52.

Seshamani, M. and Gray, A. (2004). **Ageing and health-care expenditure: the red herring argument revisited**. Health Economics, *13*, 303-314.

Setia, M. S. (2016). **Cross-sectional studies**. Indian journal of dermatology, *61*, 261-264, doi: 10.4103/0019-5154.182410.

Setshegetso, N. (2020). **Financial risk protection, decomposition and inequality analysis of household out-of-pocket health payments**. PhD Dissertation, University of Pretoria.

Shao, Q., Tao, R. and Luca, M. M. (2022). **The Effect of Urbanization on Health Care Expenditure: Evidence From China**. Front Public Health, *10*, doi: 10.3389/fpubh.2022.850872.

Sinha, N. (2021). **Health Expenditure and GDP Growth in Botswana**. SDMIMD Journal of Management, *12,* 1-17, doi: 10.18311/sdmimd/2021/26140.

Stenberg, K., Hanssen, O., Edejer, T. T., Bertram, M., Brindley, C., Meshreky, A., Rosen, J. E., Stover, J., Verboom, P., Sanders, R. and Soucat, A. (2017). **Financing transformative health systems towards achievement of the health Sustainable Development Goals: a model for projected resource needs in 67 low-income and middle-income countries**. Lancet Glob Health, *5*, e875-e887.

Stucki, M., Schärer, X., Trottmann, M., Scholz-Odermatt, S. and Wieser, S. (2023). **What drives health care spending in Switzerland? Findings from a decomposition by disease, health service, sex, and age**. BMC Health Services Research, *23*, 1149.

Sweeney, S., Berry, C., Kazounis, E., Motta, I., Vassall, A., Dodd, M., Fielding, K. & Nyang'wa, B.T. (2022). **Cost-effectiveness of short, oral treatment regimens for rifampicin-resistant tuberculosis.** *PLOS Global Public Health*, 2(12), e0001337. doi:10.1371/journal.pgph.0001337.

Tandon, A., Cain, J., Kurowski, C. and Postolovska, I. (2018). **Intertemporal dynamics of public financing for universal health coverage: accounting for fiscal space across countries**. URL: https://documents1.worldbank.org/curated/en/639541545281356938/pdf/133115-19-12-2018-14-44-10-AccountingforFiscalSpaceinHealthFINAL.pdf [last accessed 20 March 2020].

Tandon, A. and Cashin, C. (2010). **Assessing public expenditure on health from a fiscal space perspective**. URL: https://documents1.worldbank.org/curated/en/333671468330890417/pdf/560530WP0Box341penditureFiscalSpace.pdf [last accessed 20 May 2017].

Thomas, M. R., Smith, G., Ferreira, F. H., Evans, D., Maliszewska, M., Cruz, M., Himelein, K. and Over, M. (2015). **The economic impact of Ebola on sub-Saharan Africa: updated estimates for 2015**. URL: https://documents1.worldbank.org/curated/en/541991468001792719/pdf/937210REVISED000Jan02002015000FINAL.pdf [last accessed 22 April 2024].

Tian, F., Gao, J. and Yang, K. (2018). **A quantile regression approach to panel data analysis of health-care expenditure in Organisation for Economic Co-operation and Development countries**. Health Econ, *27*, 1921-1944.

Torres-Reyna, O. (2007). **Panel data analysis fixed and random effects using Stata (v. 4.2)**. Data & Statistical Services, Priceton University, *112*, 49. URL: https://www.princeton.edu/~otorres/Panel101.pdf [last accessed 30 April 2018].

TRT Afrika. (2023). **Israel-Palestine, Russia-Ukraine wars affect Africa's health funding - UNICEF**. URL: https://www.trtafrika.com/africa/israel-palestine-russia-ukraine-wars-affect-africas-health-funding-unicef-15956464 [last accessed 22 April 2024].

Udeorah, S. A. F., Obayori, J. B. and Onuchuku, O. (2018). **Health care expenditure and economic growth in Nigeria**. International Journal of Research and Innovation in Social Science, *2*, 33-36.

UNAIDS, 2021. **Big drops in the cost of antiretroviral medicines, but COVID-19 threatens further reductions.** URL: https://www.unaids.org/en/resources/presscentre/featurestories/2021/may/20210503_cost-of-antiretroviral-medicines [last Accessed 2 June 2024].

Uneke, C. J., Sombie, I., Uro-Chukwu, H. C. and Johnson, E. (2018). **Using equitable impact sensitive tool (EQUIST) to promote implementation of evidence informed policymaking to improve maternal and child health outcomes: a focus on six West African Countries**. Globalization and Health, *14*, 104, doi: 10.1186/s12992-018-0422-1.

UNICEF (United Nations Children's Fund) and WHO (World Health Organization). (2020). **Progress and challenges with achieving universal immunization coverage**. Geneva: World Health Organization.

United Nations. (2015a). **The Millennium Development Goals Report 2015**. New York: United Nations.

United Nations. (2015b). **Transforming our world: the 2030 Agenda for Sustainable Development.** URL: https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf [Accessed 12 April 2017].

van Elk, R., Mot, E. and Franses, P. H. (2009). **Modelling health care expenditures: Overview of the literature and evidence from a panel time series model.** URL: http://www.albacharia.ma/xmlui/bitstream/handle/123456789/31935/healthexpenditures.pdf?sequence=1 [Accessed 12 April 2017].

Van Seventer, J. M. and Hochberg, N. S. (2017). **Principles of infectious diseases: transmission, diagnosis, prevention, and control**. International encyclopedia of public health 22, 22-39, doi: 10.1016/B978-0-12-803678-5.00516-6.

Wagner, A. (1892). **Grundlegung der politischen oekonomie**. Leipzig: C.F. Winter'sche verlagshandlung.

Wagstaff, A. (1993). **The demand for health: an empirical reformulation of the Grossman model**. Health Economics, *2*, 189-198.

Wagstaff, A. (2009). **Social Health Insurance Vs. Tax-Financed Health Systems: Evidence from the OECD**. Washington DC: The World Bank. URL: https://documents1.worldbank.org/curated/en/545121468028868365/pdf/WPS4821.pdf [Accessed 12 April 2017].

Wagstaff, A., Paci, P. and Van Doorslaer, E. (1991). **On the measurement of inequalities in health**. Social science & medicine, *33*, 545-557.

Wang, K.-M. (2011). **Health care expenditure and economic growth: Quantile panel-type analysis**. Economic Modelling, *28*, 1536-1549.

Wang, L. and Chen, Y. (2021). **Determinants of China's health expenditure growth: based on Baumol's cost disease theory**. Int J Equity Health, *20*, 213.

Watkins, D. A., Jamison, D. T., Mills, T., Atun, T., Danforth, K., Glassman, A., Horton, S., Jha, P., Kruk, M. E., Norheim, O. F., Qi, J., Soucat, A., Verguet, S., Wilson, D. and Alwan, A. (2017). **Universal Health Coverage and Essential Packages of Care.** In: Jamison, D. T., Gelband, H., Horton, S., Jha, P., Laxminarayan, R., Mock, C. N. and Nugent, R. (eds.) Disease Control Priorities. 3rd ed. Washington, DC: World Bank.

Weisbrod, B. A. (1991). **The health care quadrilemma: an essay on technological change, insurance, quality of care, and cost containment**. Journal of economic literature, *29*, 523-552.

Willemé, P. and Dumont, M. (2015). **Machines that go 'ping': medical technology and health expenditures in OECD countries**. Health economics, *24*, 1027-1041.

Wooldridge, J. M., Wadud, M. and Lye, J. (2017). **Introductory econometrics.** South Melbourne: Cengage Learning Australia.

World Bank. (2016a). **7th Zambia Economic Brief: Beating The Slowdown - Making Every Kwacha Count**. Washington DC: World Bank. URL: https://documents1.worldbank.org/curated/en/804591467989562427/pdf/106508-WP-P157243-PUBLIC.pdf [last accessed 15 April 2017].

World Bank. (2016b). **Background Paper - First Universal Health Coverage Financing Forum: Raising Funds for Health.** URL: http://pubdocs.worldbank.org/en/103621460561160053/DRM-policy-note-041216-clean.pdf [last accessed 15 October 2017].

World Bank. (2017a). **9th Zambia Economic Brief: Reaping richer returns from public expenditures in Agriculture**. Washington DC: World Bank. URL: https://documents1.worldbank.org/curated/en/130381498665479930/pdf/117003-WP-P157243-PUBLIC-World-Bank-9th-Zambia-Economic-Brief-June-2017-FINAL-WEB.pdf [last accessed 24 August 2018].

World Bank. (2017b). **Fiscal Space for Health in Malawi and Revenue Potential of Innovative Financing**. Washington DC: World Bank. URL: https://documents1.worldbank.org/curated/en/732571500362623050/pdf/117511-WP-P157774-PUBLIC-Malawi-Health-Financing-ASA.pdf [last accessed 24 August 2018].

World Bank. (2018). **Zambia Health Sector Public Expenditure Review**. Washington DC: World Bank. URL: https://documents1.worldbank.org/curated/en/756921559624225552/pdf/Zambia-Health-Sector-Public-Expenditure-Review.pdf [last accessed 19 May 2019].

World Bank. (2020). **Public Spending in the Health Sector in Malawi**. Washington DC: World Bank. URL: https://documents1.worldbank.org/curated/en/327741628496404356/pdf/Public-Spending-In-Health-Sector-in-Malawi.pdf [last accessed 11 December 2021].

World Bank. (2022). **World Bank Welcomes the Common Framework Statement by Zambia's Creditors**. Washington, DC: World Bank. URL: https://www.worldbank.org/en/news/statement/2022/07/30/world-bank-welcomes-the-common-framework-statement-by-zambia-s-creditors# [date accessed 21 November 2023].

World Bank. (2024). **Uganda Public Expenditure Review 2022-23**. Washington DC: World Bank. URL: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099041224173069109/p177182155e1ca0ae1bf4914f98462c26bf [last accessed 15 June 2024].

World Bank. (n.d.). **Zambia Selected Indicators**. URL: https://pubdocs.worldbank.org/en/359911492207299026/data-zmb.pdf [date accessed 15 July 2024].

World Bank and WHO (World Health Organization). (2016). **Universal Health Coverage in Africa: A Framework for Action**. URL: https://documents1.worldbank.org/curated/en/735071472096342073/pdf/108008-v1-REVISED-PUBLIC-Main-report-TICAD-UHC-Framework-FINAL.pdf [last accessed 05 May 2017].

WHO (World Health Organisation). (2015). **Health in 2015: from MDGs, Millennium Development Goals to SDGs, Sustainable Development Goals**. URL: https://iris.who.int/bitstream/handle/10665/200009/9789241565110_eng.pdf?sequence=1&isAllowed=y [last accessed 12 June 2017].

WHO. (2023). **Global Health Expenditure database**. URL: https://apps.who.int/nha/database [Accessed August 18 2023].

WHO. (2007). **Everybody's business: Strengthening health systems to improve health outcomes**. URL: https://iris.who.int/bitstream/handle/10665/43918/9789241596077_eng.pdf [last accessed 12 June 2017].

WHO. (2018). **Public spending on health: a closer look at global trends**. URL: https://iris.who.int/bitstream/handle/10665/276728/WHO-HIS-HGF-HF-WorkingPaper-18.3-eng.pdf [last accessed 19 May 2019].

WHO. (2022). **Global spending on health: Rising to the pandemic's challenges**. URL: https://iris.who.int/bitstream/handle/10665/365133/9789240064911-eng.pdf?sequence=1&isAllowed=y [last accessed 13 September 2023].

WHO. (2023). **Universal health coverage.** URL: https://www.who.int/health-topics/universal-health-coverage#tab=tab_1 [Accessed 2 August 2023].

WHO and World Bank. (2021). **Tracking Universal Health Coverage: 2021 global monitoring report**. URL: https://cdn.who.int/media/docs/default-source/world-health-data-platform/events/tracking-universal-health-coverage-2021-global-monitoring-report_uhc-day.pdf [Accessed 2 August 2023].

Xu, K., Saksena, P. and Holly, A. (2011). **The determinants of health expenditure: a country-level panel data analysis**. URL: https://www.r4d.org/wp-content/uploads/TransisitionsInHealthFinancing_DeterminantsofExpenditures.pdf [Accessed 12 April 2017].

Yang, Z., Norton, E. C. and Stearns, S. C. (2003). **Longevity and Health Care Expenditures: The Real Reasons Older People Spend More**. The Journals of Gerontology: Series B, *58*, S2-S10.

Yin, R. K. (1994). **Case study research: design and methods.** Thousand Oaks, California: Sage Publications.

Yusufu, F., Awoyemi, O. B. and Komolafe, K. J. (2022). **The Effects of Total Health Expenditure on Economic Growth in Central and Eastern Sub-Sahara African Regions**. International Journal of Economics Development Research, *3*, 102-121.

Zambia Statistics Agency. (2022). **Census of Population and Housing: Preliminary Report**. Lusaka: Zambia Statistics Agency.

Zambia Statistics Agency. (2023). **Highlights of the 2022 Poverty Assessment in Zambia**. Lusaka: Zambia Statistics Agency.

Zambia Statistics Agency, Ministry of Health and ICF. (2019). **Zambia Demographic and Health Survey 2018**. Lusaka, Zambia and Rockville, Maryland, USA: Zambia Statistics Agency, Ministry of Health, and ICF.

Zambia Statistics Agency and Ministry of Labour and Social Security. (2020). **2019 Labour Force Survey**. Lusaka: Zambia Statistics Agency.

Zhai, T., Goss, J. and Li, J. (2017). **Main drivers of health expenditure growth in China: a decomposition analysis**. BMC Health Services Research, *17*, 185.

Zhai, T., Wan, Q., Chai, P., Guo, F., Li, Y., Wang, R., Chen, C., Li, T. and Gao, R. (2020). **A decomposition analysis of recent health expenditure growth in China: is population ageing a significant effecting factor?** China Population and Development Studies, *4*, 45-57.

Zhao, J. (2015). **Forecasting health expenditure: Methods and applications to international databases.** Centre for Health Economics and Policy Analysis, McMaster University. URL: https://forecasters.org/wp-content/uploads/gravity_forms/7-2a51b93047891f1ec3608bdbd77ca58d/2013/07/Zhao_Junying_ISF2013.pdf [Accessed 12 April 2017].

Zheng, A., Fang, Q., Zhu, Y., Jiang, C., Jin, F. and Wang, X. (2020). **An application of ARIMA model for predicting total health expenditure in China from 1978-2022**. J Glob Health, *10*, 010803.

Zweifel, P. (2012). **The Grossman model after 40 years**. The European Journal of Health Economics, *13*, 677-682.

7. APPENDICES

Appendix 1: Residual Results from the National Level Decomposition Analysis

Appendix 2: Descriptive Statistics - Provincial Level Analysis

Appendix 3: Results From the Panel Regression Analysis - Provincial Level

Appendix 4: Results From the Decomposition Analysis - Provincial Level

Appendix 5: Robustness Checks - Provincial Level Panel Regression Analysis

Appendix 6: Robustness Checks - ARIMA Forecasting

Appendix 7: Data extraction sheet - Analytical framework for Fiscal Sustainability Analysis

Appendix 1: Residual results from the national level decomposition analysis

Table A1: Prevalence Rate and Expenditure per Prevalent Case by Disease and Age-group

Disease	**Age Group**	**Prevalence rate**		**Expenditure per prevalent case (US$)**	
		2013	**2018**	**2013**	**2018**
HIV/AIDS and sexually transmitted infections	0~4	1,042	870	1.09	0.42
	5~14	3,120	2,457	3.26	1.19
	15~49	55,584	53,505	58.10	25.93
	50~69	66,211	67,721	69.21	32.82
	70+	61,605	60,447	64.40	29.30
Injuries	0~4	1,148	1,312	0.27	0.23
	5~14	3,067	3,431	0.71	0.60
	15~49	10,494	11,400	2.44	2.01
	50~69	22,409	24,299	5.22	4.28
	70+	44,232	46,614	10.30	8.21
Malaria and neglected tropical diseases	0~4	31,746	26,485	8.73	4.30
	5~14	50,629	41,185	13.92	6.69
	15~49	51,023	40,236	14.02	6.53
	50~69	41,276	33,372	11.35	5.42
	70+	43,208	34,347	11.88	5.58
Maternal and neonatal disorders	0~4	3,771	3,896	11.94	8.90
	5~14	1,241	1,507	3.93	3.44
	15~49	2,712	2,818	8.59	6.44
	50~69	1,004	1,142	3.18	2.61
	70+	876	877	2.78	2.00
Non-communicable diseases	0~4	96,810	95,574	3.24	1.99
	5~14	138,758	136,151	4.65	2.84
	15~49	230,501	234,523	7.72	4.89
	50~69	362,123	376,454	12.13	7.85
	70+	570,629	584,448	19.12	12.18
Nutritional deficiencies	0~4	42,872	42,263	1.19	0.66
	5~14	34,993	34,833	0.97	0.54
	15~49	22,253	22,859	0.62	0.36
	50~69	34,977	35,285	0.97	0.55
	70+	40,316	39,262	1.12	0.61
Respiratory infections and tuberculosis	0~4	17,127	15,251	0.22	0.17
	5~14	19,707	17,413	0.25	0.19
	15~49	31,610	26,950	0.41	0.30
	50~69	38,488	34,256	0.50	0.38
	70+	49,929	42,486	0.64	0.47
Other infectious diseases	0~4	7,980	7,579	14.28	9.17
	5~14	4,057	3,871	7.26	4.68
	15~49	3,148	3,177	5.63	3.84
	50~69	4,804	5,099	8.60	6.17
	70+	9,245	9,307	16.54	11.26
Other unspecified diseases and conditions	0~4	140	139	0.06	0.05
	5~14	1,416	1,396	0.57	0.51
	15~49	9,678	9,797	3.87	3.58
	50~69	6,469	6,766	2.59	2.47
	70+	6,993	7,142	2.80	2.61

Spending is expressed in real values (consumer price index, 2010 = 100).

rdecompose population agestr prevrate expprevcase, group(year) transform(population) sum(disease1 agegroup) detail

```
Decomposition between year==2013 (158976.03)
                  and year==2018 (83580.46)
Func Form=\sum(disease1)\sum(agegroup){population*agestr*prevrate*expprevcase}
------------------------------------------------------------------------
                Component        Absolute Difference    Proportion (%)
------------------------------------------------------------------------
            population(*)                       3252          -4.31
                   agestr                       3256          -4.32
                 prevrate                      -5238           6.95
              expprevcase                     -76666         101.68
------------------------------------------------------------------------
   Value of disease1 and Components          Detailed Contributions
------------------------------------------------------------------------
                1      population(*)            1889          -2.51
                              agestr            1892          -2.51
                            prevrate           -2115           2.80
                         expprevcase          -44027          58.39
                2      population(*)              21          -0.03
                              agestr              21          -0.03
                            prevrate            55.6          -0.07
                         expprevcase            -130           0.17
                3      population(*)             243          -0.32
                              agestr             243          -0.32
                            prevrate           -3739           4.96
                         expprevcase          -11916          15.80
                4      population(*)            6.49          -0.01
                              agestr            6.52          -0.01
                            prevrate            32.9          -0.04
                         expprevcase            -190           0.25
                5      population(*)            1075          -1.43
                              agestr            1075          -1.43
                            prevrate             580          -0.77
                         expprevcase          -19509          25.88
                6      population(*)           -5.07           0.01
                              agestr            -5.1           0.01
                            prevrate            4.32          -0.01
                         expprevcase            -360           0.48
                7      population(*)           -12.9           0.02
                              agestr             -13           0.02
                            prevrate           -21.4           0.03
                         expprevcase            -367           0.49
                8      population(*)              29          -0.04
                              agestr            29.1          -0.04
                            prevrate            11.1          -0.01
                         expprevcase           -69.9           0.09
                9      population(*)            6.98          -0.01
                              agestr            6.99          -0.01
                            prevrate           -46.8           0.06
                         expprevcase           -95.6           0.13
------------------------------------------------------------------------
```

1=HIV/AIDS and sexually transmitted infections, 2=Injuries, 3=Malaria and neglected tropical diseases, 4=Maternal and neonatal disorders, 5=Non-communicable diseases, 6=Nutritional deficiencies, 7=Other infectious diseases, 8=Other unspecified diseases and conditions, 9=Respiratory infections and tuberculosis

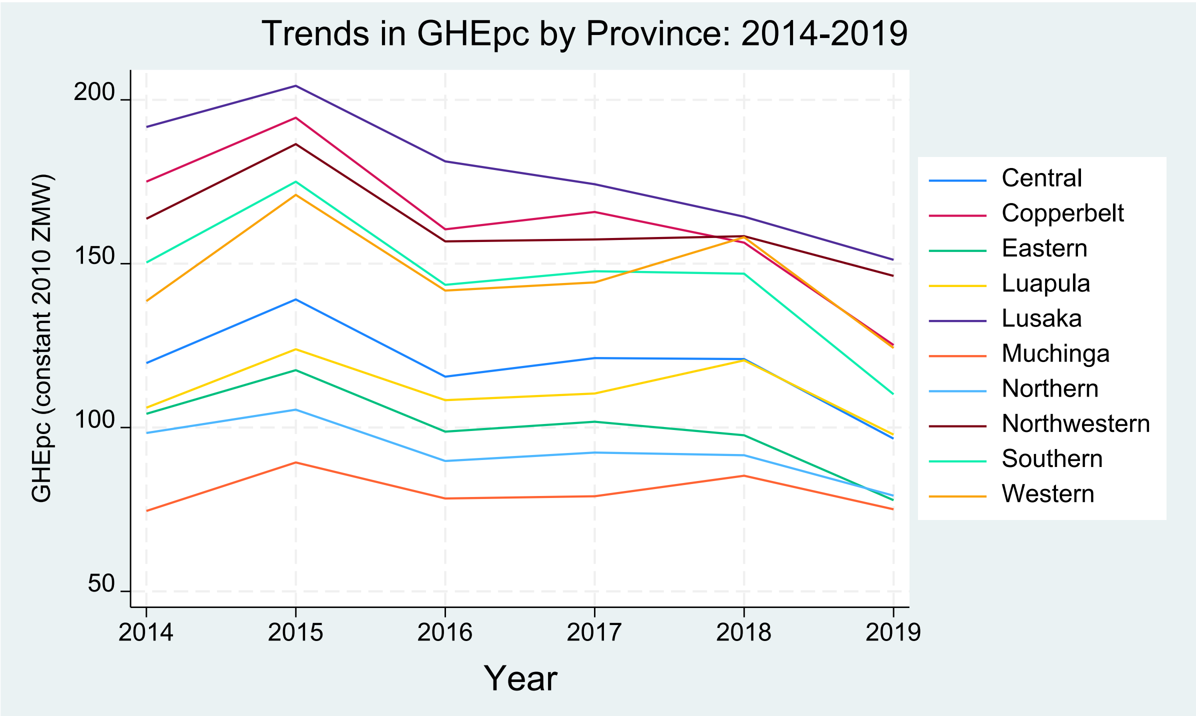
rdecompose population agestr prevrate expprevcase, group(year) transform(population) sum(agegroup disease1) detail

```
Decomposition between year==2013 (158976.03)
                  and year==2018 (83580.46)
Func Form=\sum(agegroup)\sum(disease1){population*agestr*prevrate*expprevcase}
------------------------------------------------------------------------
                Component          Absolute Difference    Proportion (%)
------------------------------------------------------------------------
            population(*)                         3252          -4.31
                   agestr                         3256          -4.32
                 prevrate                        -5238           6.95
              expprevcase                       -76666         101.68
------------------------------------------------------------------------
   Value of agegroup and Components          Detailed Contributions
------------------------------------------------------------------------
              0-4      population(*)              -141           0.19
                              agestr              -141           0.19
                            prevrate              -138           0.18
                         expprevcase             -1060           1.41
            15-49      population(*)              3463          -4.59
                              agestr              3470          -4.60
                            prevrate             -4166           5.52
                         expprevcase            -68153          90.39
             5-14      population(*)              -216           0.29
                              agestr              -217           0.29
                            prevrate             -1002           1.33
                         expprevcase             -5629           7.47
            50-69      population(*)               143          -0.19
                              agestr               142          -0.19
                            prevrate              65.6          -0.09
                         expprevcase             -1718           2.28
              70+      population(*)              3.13          -0.00
                              agestr              1.72          -0.00
                            prevrate              1.66          -0.00
                         expprevcase              -106           0.14
------------------------------------------------------------------------
```

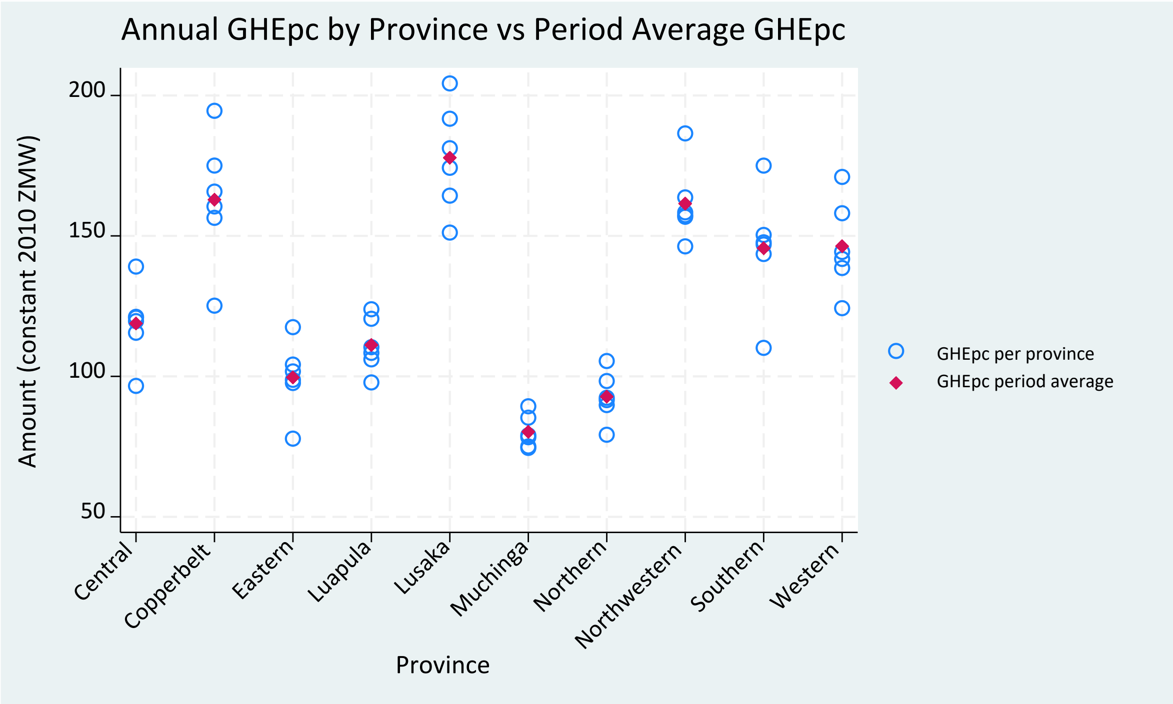
Appendix 2: Descriptive Statistics - Provincial level analysis

Table A2: Descriptive Statistics – Provincial Level Analysis

	2014	2015	2016	2017	2018	2019
Per capita government health expenditure (ZMW)	132	151	127	129	130	108
Economic growth (income variable)						
Provincial GDP per capita (ZMW)	7491	7169	7002	7749	7782	7460
Demographic						
Population density (No. of people per sq. km)	20	21	21	22	22	23
Population under 15	0.49	0.48	0.46	2.08	0.48	0.48
Population over 65	0.03	0.03	0.03	0.03	0.03	0.03
Institutional						
No. of health facilities per 10,000 population	1.4	1.3	1.3	1.6	1.6	1.1
No. of skilled health providers per 10,000 population	10.5	9.7	9.4	13.3	14.5	16.0
Population health status (disease burden)						
Outpatient and inpatient attendances per 10,000 population	14937	15452	13984	15039	14354	15195
TB notifications per 10,000 people	24	23	20	18	18	18
Social						
Urbanisation (share of the population in urban residence)	33	34	34	34	34	35



GHEpc=Government Health Expenditure per capita



GHEpc=Government Health Expenditure per capita

Appendix 3: Results from the panel regression analysis - Provincial level

```
. regress lnghepc lngdppc i.province1
```

Source	SS	df	MS
Model	3.94068477	10	.394068477
Residual	.639876205	49	.013058698
Total	4.58056097	59	.077636627

Number of obs	=	60
F(10, 49)	=	30.18
Prob > F	=	0.0000
R-squared	=	0.8603
Adj R-squared	=	0.8318
Root MSE	=	.11427

lnghepc	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
lngdppc	-.0537237	.1534939	-0.35	0.728	-.3621811	.2547337
province1						
Copperbelt	.3596143	.1500921	2.40	0.020	.0579929	.6612356
Eastern	-.2006076	.0921961	-2.18	0.034	-.3858827	-.0153325
Luapula	-.0947608	.1096282	-0.86	0.392	-.3150669	.1255453
Lusaka	.4481629	.1424202	3.15	0.003	.1619588	.7343671
Muchinga	-.4052197	.0808147	-5.01	0.000	-.567623	-.2428164
Northern	-.2710942	.0983494	-2.76	0.008	-.4687347	-.0734538
Northwestern	.3612719	.1612797	2.24	0.030	.0371682	.6853756
Southern	.2113099	.0735826	2.87	0.006	.06344	.3591797
Western	.1865324	.0916258	2.04	0.047	.0024035	.3706612
_cons	5.237457	1.330411	3.94	0.000	2.563895	7.911018

```
. estimates table, star(.05 .01 .001)
```

Variable	Active
lngdppc	-.0537237
province1	
Copperbelt	.35961427*
Eastern	-.20060761*
Luapula	-.09476081
Lusaka	.44816295**
Muchinga	-.40521967***
Northern	-.27109422**
Northwest..	.36127189*
Southern	.21130988**
Western	.18653236*
_cons	5.2374565***

Legend: * p<.05; ** p<.01; *** p<.001

__Note__: lnghepc=log of provincial government health expenditure per capita, lngdppc=log of provincial GDP per capita.

Fixed Effects Regression Model

```
. xtreg lnghepc lngdppc lnpopden lnu15 lno65 lntotalhfs lnskilled lnopd_ip lntb lnurban,
>  fe robust

Fixed-effects (within) regression               Number of obs     =         40
Group variable: province1                       Number of groups  =         10

R-squared:                                      Obs per group:
     Within  = 0.5580                                         min =          4
     Between = 0.0051                                         avg =        4.0
     Overall = 0.0022                                         max =          4

                                                F(9, 9)           =      64.38
corr(u_i, Xb) = -0.9619                         Prob > F          =     0.0000

                             (Std. err. adjusted for 10 clusters in province1)
------------------------------------------------------------------------------
             |               Robust
     lnghepc | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
     lngdppc |   -.212891   .1868603    -1.14   0.284    -.6355984    .2098164
    lnpopden |  -1.392115   1.446525    -0.96   0.361    -4.664382    1.880152
       lnu15 |   .4780845   4.805451     0.10   0.923     -10.3926    11.34877
       lno65 |  -.6216952    1.27428    -0.49   0.637    -3.504318    2.260927
  lntotalhfs |   .1894528   .0596243     3.18   0.011     .0545732    .3243323
   lnskilled |   .0157914   .3490078     0.05   0.965    -.7737191    .8053018
    lnopd_ip |  -.2436247   .1584256    -1.54   0.158    -.6020083    .1147589
        lntb |  -.0087474   .0712004    -0.12   0.905    -.1698139    .1523191
     lnurban |   1.040617    .506736     2.05   0.070    -.1056996    2.186933
       _cons |   8.608073   20.26334     0.42   0.681     -37.2308    54.44694
-------------+----------------------------------------------------------------
     sigma_u |  1.0031085
     sigma_e |  .08561472
         rho |  .99276816   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Note: lnghepc=log of provincial government health expenditure per capita; lngdppc=log of provincial GDP per capita; lnpopden=log of population density (No. of people per sq. km); lnu15=log of population under 15; lno65=log of population over 65; lntotalhfs=log of number of health facilities per 10,000 population; lnskilled=log of number of skilled health providers per 10,000 population; lnopd_ip=log of outpatient and inpatient attendances per 10,000 population; lntb=log of TB notifications per 10,000 people; lnurban=log of urbanisation (share of the population in urban residence).

Random Effects Regression Model

```
. xtreg lnghepc lngdppc lnpopden lnu15 lno65 lntotalhfs lnskilled lnopd_ip lntb lnurban,
>  re robust

Random-effects GLS regression                   Number of obs     =         40
Group variable: province1                       Number of groups  =         10

R-squared:                                      Obs per group:
     Within  = 0.1903                                         min =          4
     Between = 0.9858                                         avg =        4.0
     Overall = 0.8805                                         max =          4

                                                Wald chi2(9)      =   84306.50
corr(u_i, X) = 0 (assumed)                      Prob > chi2       =     0.0000

                             (Std. err. adjusted for 10 clusters in province1)
```

lnghepc	Coefficient	Robust std. err.	z	P>|z|	[95% conf.	interval]
lngdppc	.1897717	.0733099	2.59	0.010	.046087	.3334564
lnpopden	.0334069	.0402074	0.83	0.406	-.0453982	.1122121
lnu15	.1332447	.8541846	0.16	0.876	-1.540926	1.807416
lno65	-.0047868	.2094767	-0.02	0.982	-.4153535	.4057799
lntotalhfs	.2749919	.062342	4.41	0.000	.1528039	.3971799
lnskilled	.0718916	.0913838	0.79	0.431	-.1072174	.2510007
lnopd_ip	-.1413952	.1123034	-1.26	0.208	-.361506	.0787155
lntb	.3309908	.0337094	9.82	0.000	.2649216	.39706
lnurban	-.0884632	.0243314	-3.64	0.000	-.136152	-.0407745
_cons	2.976455	3.103575	0.96	0.338	-3.10644	9.059349
sigma_u	0					
sigma_e	.08561472					
rho	0	(fraction of variance due to u_i)				

Note: *lnghepc=log of provincial government health expenditure per capita; lngdppc=log of provincial GDP per capita; lnpopden=log of population density (No. of people per sq. km); lnu15=log of population under 15; lno65=log of population over 65; lntotalhfs=log of number of health facilities per 10,000 population; lnskilled=log of number of skilled health providers per 10,000 population; lnopd_ip=log of outpatient and inpatient attendances per 10,000 population; lntb=log of TB notifications per 10,000 people; lnurban=log of urbanisation (share of the population in urban residence).*

Correlated Panels Corrected Standard Errors Regression Model

```
. xtpcse lnghepc lngdppc lnpopden lnu15 lno65 lntotalhfs lnskilled lnopd_ip lntb lnurban

Number of gaps in sample = 10

Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   province1                     Number of obs     =        40
Time variable:    year                          Number of groups  =        10
Panels:           correlated (balanced)         Obs per group:
Autocorrelation:  no autocorrelation                          min =         4
                                                              avg =         4
                                                              max =         4
Estimated covariances      =        55          R-squared         =    0.8805
Estimated autocorrelations =         0          Wald chi2(9)      =   5669.07
Estimated coefficients     =        10          Prob > chi2       =    0.0000
```

lnghepc	Coefficient	Panel-corrected std. err.	z	P>|z|	[95% conf.	interval]
lngdppc	.1897717	.0636296	2.98	0.003	.06506	.3144834
lnpopden	.0334069	.0783984	0.43	0.670	-.1202512	.187065
lnu15	.1332447	1.107735	0.12	0.904	-2.037875	2.304365
lno65	-.0047868	.1907429	-0.03	0.980	-.378636	.3690624
lntotalhfs	.2749919	.0511254	5.38	0.000	.1747881	.3751958
lnskilled	.0718916	.075585	0.95	0.342	-.0762523	.2200355
lnopd_ip	-.1413952	.0914202	-1.55	0.122	-.3205755	.037785
lntb	.3309908	.0307477	10.76	0.000	.2707264	.3912552
lnurban	-.0884632	.0290875	-3.04	0.002	-.1454738	-.0314527
_cons	2.976455	4.468056	0.67	0.505	-5.780775	11.73368

Note: lnghepc=log of provincial government health expenditure per capita; lngdppc=log of provincial GDP per capita; lnpopden=log of population density (No. of people per sq. km); lnu15=log of population under 15; lno65=log of population over 65; lntotalhfs=log of number of health facilities per 10,000 population; lnskilled=log of number of skilled health providers per 10,000 population; lnopd_ip=log of outpatient and inpatient attendances per 10,000 population; lntb=log of TB notifications per 10,000 people; lnurban=log of urbanisation (share of the population in urban residence).

Appendix 4: Results from the decomposition analysis - Provincial level

```
.  rdecompose gdppc totalhfs tb urban, group(year) sum(province1) detail

Decomposition between year==2014 (106927075.56)
                  and year==2019 (99069461.23)
Func Form=\sum(province1){gdppc*totalhfs*tb*urban}
```

Component	Absolute Difference	Proportion (%)
gdppc	-7217789	91.86
totalhfs	22774530	-289.84
tb	-27059647	344.37
urban	3645292	-46.39

Value of province1	and Components	Detailed	Contributions
1	gdppc	91009	-1.16
	totalhfs	-409468	5.21
	tb	-1850861	23.56
	urban	4.66e-10	-0.00
2	gdppc	-12007690	152.82
	totalhfs	16774034	-213.47
	tb	-5591244	71.16
	urban	583956	-7.43
3	gdppc	-26096	0.33
	totalhfs	28956	-0.37
	tb	-315806	4.02
	urban	23435	-0.30
4	gdppc	204259	-2.60
	totalhfs	-426018	5.42
	tb	-229539	2.92
	urban	138637	-1.76
5	gdppc	1086509	-13.83
	totalhfs	16306828	-207.53
	tb	-14483304	184.32
	urban	221150	-2.81
6	gdppc	-154976	1.97
	totalhfs	-442214	5.63
	tb	-181406	2.31
	urban	179136	-2.28
7	gdppc	-23312	0.30
	totalhfs	-86471	1.10
	tb	407384	-5.18
	urban	19845	-0.25
8	gdppc	3817566	-48.58
	totalhfs	-8007869	101.91
	tb	-2126376	27.06
	urban	2396264	-30.50
9	gdppc	-165218	2.10
	totalhfs	67855	-0.86
	tb	-1848542	23.53
	urban	195715	-2.49
10	gdppc	-39839	0.51
	totalhfs	-1031102	13.12
	tb	-839952	10.69
	urban	-112847	1.44
Overall		-7857614	100.00

1=Central, 2=Copperbelt, 3=Eastern, 4=Luapula, 5=Lusaka, 6=Muchinga, 7=Northern, 8=Northwestern, 9=Southern, 10=Western

Appendix 5: Robustness checks - Provincial level panel regression analysis

Hausman Test

```
. hausman fixed random

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference       Std. err.
-------------+----------------------------------------------------------------
     lngdppc |   -.212891      .1897717      -.4026627        .2094173
    lnpopden |  -1.392115      .0334069      -1.425522        1.346207
       lnu15 |   .4780845      .1332447       .3448398         5.22037
       lno65 |  -.6216952     -.0047868      -.6169084        1.376657
  lntotalhfs |   .1894528      .2749919      -.0855392        .0177657
   lnskilled |   .0157914      .0718916      -.0561002        .3362589
    lnopd_ip |  -.2436247     -.1413952      -.1022295        .1568344
        lntb |  -.0087474      .3309908      -.3397382        .1089208
     lnurban |   1.040617     -.0884632        1.12908        .6447298
------------------------------------------------------------------------------
                          b = Consistent under H0 and Ha; obtained from xtreg.
           B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

    chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
            =  21.62
Prob > chi2 = 0.0102
```

Conclusion: The fixed effects model is more appropriate for the data.

Testparm Test for Time-Fixed Effects

```
. testparm i.year

 ( 1)  2017.year = 0
 ( 2)  2018.year = 0
 ( 3)  2019.year = 0

       F(  3,     9) =   13.92
            Prob > F =    0.0010
```

Conclusion: Inclusion of time-fixed effects (year dummies) in the model is justified.

BP-LM Test for Random Effects

```
. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        lnghepc[province1,t] = Xb + u[province1] + e[province1,t]

        Estimated results:
                         |       Var     SD = sqrt(Var)
                ---------+-----------------------------
                 lnghepc |   .0735745       .2712461
                       e |   .0073299       .0856147
                       u |          0              0

        Test: Var(u) = 0
                             chibar2(01) =     0.00
                          Prob > chibar2 =   1.0000
```

Conclusion: A random effects model is not necessary.

BP-LM Test for Cross-Sectional Dependence

```
. xttest2

Correlation matrix of residuals:

             |       __e1        __e2        __e3        __e4        __e5        __e6
-------------+------------------------------------------------------------------------
        __e1 |   .0061883
        __e2 |   .0027277    .0338038
        __e3 |   .0058717    .0249105    .0208555
        __e4 |   .0002832   -.005042   -.0032818    .0067634
        __e5 |   .0054605  -.0070325   -.0012762   -.0010052    .0088273
        __e6 |   .0008979  -.0194538   -.0127471    .0068544    .0048385    .0144833
        __e7 |    .002112    .0022962    .0029372    .0005849    .0011415   -.0000892
        __e8 |  -.0042636    .0060952    .0014152   -.0016665   -.0059748   -.0056023
        __e9 |   .0109198    .0289634    .0268907    -.000557    .0013579   -.0114065
       __e10 |   .0081258   -.008222   -.0003824     .007023    .0083705    .0113214

             |       __e7        __e8        __e9       __e10
-------------+------------------------------------------------
        __e7 |   .0008616
        __e8 |  -.0011458    .0048954
        __e9 |   .0050672   -.0017132    .0384525
       __e10 |   .0028467    -.008653    .0078276    .0187961

          __e1      __e2      __e3      __e4      __e5      __e6      __e7      __e8      __e9
  __e1  1.0000
  __e2  0.1886    1.0000
  __e3  0.5169    0.9382    1.0000
  __e4  0.0438   -0.3335   -0.2763    1.0000
  __e5  0.7388   -0.4071   -0.0941   -0.1301    1.0000
  __e6  0.0948   -0.8792   -0.7334    0.6925    0.4279    1.0000
  __e7  0.9146    0.4255    0.6929    0.2423    0.4139   -0.0252    1.0000
  __e8 -0.7746    0.4738    0.1401   -0.2896   -0.9089   -0.6653   -0.5579    1.0000
  __e9  0.7079    0.8033    0.9496   -0.0345    0.0737   -0.4833    0.8803   -0.1249    1.0000
 __e10  0.7534   -0.3262   -0.0193    0.6229    0.6498    0.6862    0.7074   -0.9021    0.2912

         __e10
 __e10  1.0000

Breusch-Pagan LM test of independence: chi2(45) =    59.048, Pr = 0.0780
Based on 4 complete observations over panel units
```

Conclusion: No cross-sectional dependence.

Pasaran CD Test for Cross Sectional Dependence

```
. xtcsd, pesaran abs


Pesaran's test of cross sectional independence =     1.820, Pr = 0.0688

Average absolute value of the off-diagonal elements =     0.490
```

Conclusion: No cross-sectional dependence.

Modified Wald Test for Heteroskedasticity

```
. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (10)  =    1692.15
Prob>chi2 =      0.0000
```

Conclusion: There is significant heteroskedasticity in the data.

Wooldridge Test for Autocorrelation in Panel Data

```
. xtserial lnghepc lngdppc lnpopden lnu15 lno65 lntotalhfs lnskilled lnopd_ip lntb lnurb
> an

Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,       9) =      0.399
           Prob > F =      0.5433
```

Conclusion: There is no autocorrelation in the data.

Appendix 6: Robustness checks – ARIMA forecasting

Dickey-Fuller test for stationarity - Per capita Spending

```
. dfuller chepc, trend regress

Dickey–Fuller test for unit root          Number of obs  = 26
Variable: chepc                           Number of lags =  0

H0: Random walk with or without drift

                                       Dickey–Fuller
                   Test         ───────── critical value ─────────
              statistic           1%           5%          10%
──────────────────────────────────────────────────────────────────
 Z(t)            -3.601       -4.371       -3.596       -3.238
──────────────────────────────────────────────────────────────────
MacKinnon approximate p-value for Z(t) = 0.0297.

Regression table
──────────────────────────────────────────────────────────────────────────────
     D.chepc │ Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
─────────────┼────────────────────────────────────────────────────────────────
       chepc │
         L1. │  -.7130812   .1980052    -3.60   0.002    -1.122686   -.3034762
             │
      _trend │    1.84908   .5702462     3.24   0.004     .6694356    3.028724
       _cons │   9.260593   4.547441     2.04   0.053    -.1465051    18.66769
──────────────────────────────────────────────────────────────────────────────
```

Phillips–Perron test for stationarity - Per capita Spending

```
. pperron chepc, trend regress

Phillips–Perron test for unit root       Number of obs    = 26
Variable: chepc                          Newey–West lags =  2

H0: Random walk with or without drift

                                       Dickey–Fuller
                   Test         ───────── critical value ─────────
              statistic           1%           5%          10%
──────────────────────────────────────────────────────────────────
 Z(rho)         -18.647      -22.628      -17.976      -15.648
 Z(t)            -3.607       -4.371       -3.596       -3.238
──────────────────────────────────────────────────────────────────
MacKinnon approximate p-value for Z(t) = 0.0293.

Regression table
──────────────────────────────────────────────────────────────────────────────
       chepc │ Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
─────────────┼────────────────────────────────────────────────────────────────
       chepc │
         L1. │   .2869188   .1980052     1.45   0.161    -.1226861    .6965238
             │
      _trend │    1.84908   .5702462     3.24   0.004     .6694356    3.028724
       _cons │   9.260593   4.547441     2.04   0.053    -.1465051    18.66769
──────────────────────────────────────────────────────────────────────────────
```

Portmanteau (Ljung-Box) test for white noise white noise - Per capita Spending

```
. wntestq error1

Portmanteau test for white noise
───────────────────────────────────────
 Portmanteau (Q) statistic =     6.7028
 Prob > chi2(11)           =     0.8226
```

Post-estimation tests for stability and stationarity - Per capita Spending

```
. estat aroots

   Eigenvalue stability condition
```

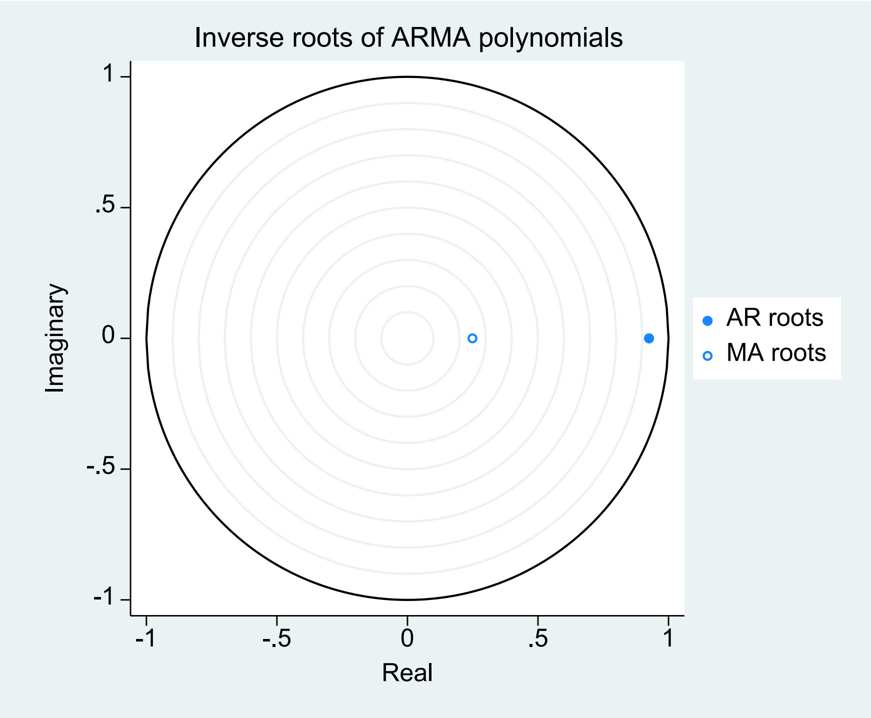
Eigenvalue	Modulus
.925367	.925367

```
   All the eigenvalues lie inside the unit circle.
   AR parameters satisfy stability condition.

   Eigenvalue stability condition
```

Eigenvalue	Modulus
.2489365	.248937

```
   All the eigenvalues lie inside the unit circle.
   MA parameters satisfy invertibility condition.
```



Appendix 7: Data extraction sheet - Analytical framework for Fiscal Sustainability Analysis

Author(s)	
Title of Study	
Country/Region	

THEME	**Diagnosis**			
Sub-theme	**Adequacy of funding**	**Efficiency and Effectiveness**	**Equity and Access**	**Policy and Governance**

THEME	**Mitigation**					
Sub-theme	**Revenue Generation**	**Reprioritise health in government budget**	**Cost Containment and Efficiency**	**Contracting, Risk Pooling and Insurance**	**Public Financial Management**	**Demand Creation and Performance-Based Financing**

THEME	**Forecasting**			
Sub-theme	**Economic Projections**	**Total Financing Need**	**Expected Funding**	**Health Expenditure Projections**
			Government	*Government*
			Donor	*Donor*
			Household	*Household*
			Employer	*Employer*

8. CURRICULUM VITAE

Personal Information

Name:	Collins Chansa
Date of Birth:	30th September 1974
Place of Birth:	Mufulira, Zambia
Nationality:	Zambian
Marital Status:	Married

Summary Profile

Collins is a Health Economist with wide-ranging experience in undertaking health sector development and analytical work in Western, Eastern and Southern Africa, particularly: Liberia, Kenya, Uganda, Malawi, Mozambique, South Africa, Zambia, and Zimbabwe. His key areas of specialisation include: policy and strategic planning, health systems development and governance, health financing (as well as results-based financing), fiscal policy and health, and health systems research. Collins has published over 30 articles on health systems and health financing in peer reviewed journals.

Education

- PhD Candidate (Health Economics), Heidelberg University, Germany (May 2017 to date)
- Masters in Public Health in Health Economics, University of Cape Town, South Africa (2005-2006)
- Degree in Economics and Statistics, University of Zambia, Zambia (1994-1999)

Professional Membership

- International Health Economics Association (IHEA)
- Health Systems Global Society
- Regional Network on Equity in Health in Southern Africa
- Economics Association of Zambia
- Global Burden of Disease collaborator, Institute for Health Metrics and Evaluation
- Independent Reviewer - Bill & Melinda Gates Foundation
- ORCID http://orcid.org/0000-0003-0982-5087

Professional Work Experience

- Senior Health Economist and Task Team Leader, World Bank Group, Central and Western Africa: *June 2022 to date*
- Senior Health Economist and Task Team Leader, World Bank Group, Eastern and Southern Africa: *October 2017 to May 2022*

- Health Specialist, World Bank Group, Zambia Country Office: *February 2015 to September 2017*
- Consultant – Health Systems, World Bank Group, Zambia Country Office: *July 2011 to January 2015*
- Chief Planner – Development Cooperation, Ministry of Health, Government of Zambia: *October 2008 to June 2011*
- Sector Wide Approach (SWAp) Co-ordinator, Ministry of Health, Government of Zambia: *September 2003 to September 2008*
- Marketing and Entrepreneurship Development Officer, Ministry of Agriculture, Government of Zambia: *July 1999 to August 2003*

Consultancies

2014 *Local research team leader:* Mid-term review of the Adolescent Girls Empowerment Programme in Zambia (Part of a team from HLSP Institute, UK).

2012 *Local research team leader:* Analysis of the costs and financing of routine immunisation programmes and new vaccines introduction in Zambia (Gates Foundation, Gavi, and World Health Organisation). Similar studies were conducted in Uganda, Honduras, Moldova, Ghana, and Benin.

2009-2010 *Team member:* Evaluation of the Impact of the 2008 Global Financial Crisis in the Health Sector in Zambia (Overseas Development Institute, UK and the University of Zambia (UNZA)).

2008-2010 *Team member:* Process and Impact Evaluation of the Removal of User Fees in rural and peri-urban areas of Zambia (London School of Hygiene & Tropical Medicine and UNZA).

Conference Presentation

- *Oral Presenter* – 13th IHEA World Congress on Health Economics, University of Basel, Basel, Switzerland (July 13-17, 2019).

  Chansa, C., *Mukanu, M.M., Chama-Chiliba, C.M., Kamanga, M., Chikwenya, N., Bellows, B. and Kuunibe, N., (2020). Looking at the bigger picture: effect of performance-based contracting of district health services on equity of access to maternal health services in Zambia. Health Policy and Planning, 35(1), pp.36-46*

- *Oral Presenter* – 11th IHEA World Congress on Health Economics, Bocconi University, Milan, Italy (July 12-15, 2015).
- *Oral Presenter* – Third Global Symposium on Health Systems Research, University of Cape Town, South Africa (September 30 to October 3, 2014).
- *Oral Presenter* – Second Global Symposium on Health Systems Research, Beijing, China (October 31 to November 3, 2012).

- *Oral Presenter* - 7th IHEA World Congress on Health Economics and Pre-Congress Session on National Health Accounts, Beijing, China (July 12-15, 2009)

Recent Conferences Attended

15th International Health Economics Association World Congress on Health Economics, University of Cape Town, South Africa (July 8-12, 2023).

Professional Awards

- World Bank Group *2021 Africa Human Development Team Recognition Award for Multisectoral Efforts* on the Malawi Investing in Early Years for Growth and Productivity Project
- World Bank Group *2018 Health Nutrition and Population Knowledge Management Good Practice Recognition Program Award*
- Health Policy and Planning Journal – *2018 top peer reviewers' recognition award*
- World Bank Group Human Development Vice President's 2018 Team Award for *Outstanding Team Achievement* for work on the Zimbabwe Health Sector Development Project
- World Bank Group Human Development Vice President's 2017 Team Award for *Outstanding Team Achievement* for work on the Southern Africa Tuberculosis and Health Systems Support Project
- Zambia Federation of Employers/International Organization of Employers 2009 Award for the *Most Hardworking Employee*
- Zambia Federation of Employers/International Organization of Employers 2001 Award for the *Most Hardworking Employee*

Referees

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Heidelberg, July 30, 2024

Date and place

Signature

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10. EIDESSTATTLICHE VERSICHERUNG

1. Bei der eingereichten Dissertation zu dem Thema

FISCAL SUSTAINABILITY OF HEALTH SYSTEMS IN SUB-SAHARAN AFRICA: AN ANALYTICAL FRAMEWORK AND EVIDENCE FROM ZAMBIA

handelt es sich um meine eigenständig erbrachte Leistung.

2. Ich habe nur die angegebenen Quellen und Hilfsmittel benutzt und mich keiner unzulässigen Hilfe Dritter bedient. Insbesondere habe ich wörtlich oder sinngemäß aus anderen Werken übernommene Inhalte als solche kenntlich gemacht.

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