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Impact of Health Expenditures on Infant Mortality Rates in Nigeria (1992-2023)

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Abstract

The World Development Indicators (2024) in 2023 revealed that infant mortality rates increased to 70.43 per 1,000 live births in Nigeria as compared to 5.4 per 1,000 live births in the United State of America, suggesting that structural health challenges persist despite various government interventions. This paper examines the impact of health expenditures on infant mortality rates in Nigeria between the period of 1992 and 2023. The paper used Descriptive analysis and the autoregressive distributive lag (ARDL) technique for analysis. The long-run result showed that Capital Health Expenditure showed a negative but statistically insignificant impact on infant mortality suggesting that capital health expenditure has a weak impact on reducing infant mortality rates in Nigeria. Similarly, Recurrent Health Expenditure showed negative and statistically significant impact on infant mortality indicating that increased recurrent health expenditure significantly contributes to reducing infant mortality in Nigeria. The coefficient value for Donor Health Expenditure showed a positive and statistically significant impact on infant mortality suggesting that donor health expenditure had increasing impact on infant mortality. In contrast the coefficient of Out-of-Pocket Health Expenditure showed a negative but statistically insignificant impact on infant mortality. This implied that out-of-pocket health expenditure has a weak impact on reducing infant mortality. High out-of-pocket costs may discourage healthcare utilization, but the effect is not statistically robust. The paper further recommended Federal Ministry of Health (FMOH), National Primary Health Care Development Agency (NPHCDA) to increase recurrent health expenditure to improve healthcare service delivery, Budget Office of the Federation (BOF), Independent Corrupt Practices Commission (ICPC) and Economic and Financial Crimes Commission (EFCC) should ensure that investments in health infrastructure and International donor funds should be better coordinated by National Agency for the Control of AIDS (NACA) and FMOH to ensure they align with national healthcare priorities. National Health Insurance Authority (NHIA) should expand health insurance coverage through the reduction of financial barriers in accessing healthcare services.

Background to the Study

Infant mortality remains a significant global public health challenge, despite substantial advancements in medical care and health policies. According to the World Health Organization (WHO, 2024), approximately 4.9 million children under the age of five died in 2021, with the majority of these deaths occurring in low- and middle-income countries. Sub-Saharan Africa remains the region with the highest infant mortality rate, accounting for nearly half of all global infant deaths. In contrast, developed countries such as USA and Sweden have significantly lower infant mortality rate of 5 and 2 per 1,000 live births respectively due to robust health care systems, effective immunization programs, and widespread access to maternal and child health services. The decline can be attributed to increased healthcare investments, maternal and child health initiatives, and better awareness of infant care practices. However, the 2023 figure suggests a slight slowing of progress compared to previous years. Factors such as the COVID-19 pandemic, economic recessions, and healthcare funding (Logarajan *et al.* 2022).

Nigeria continues grappling with alarmingly high infant mortality rates, making it one of the countries with the worst child survival indices globally. According to the World Bank (2024) early 1990s, experienced alarmingly high infant mortality rates (IMT), with values exceeding 120 deaths per 1,000 live births. In 1992, the IMT stood at 123.6, had a slight but consistent decline to 112.6 by 1999 due to poor healthcare infrastructure. From 2000 to 2010, the IMT continued to decline steadily from 109.6 in 2000 to 84.2 in 2010 due to persistent challenges such as weak health infrastructure, corruption, and a lack of healthcare personnel in rural areas. Between 2011 and 2019, according to World bank (2024) Nigeria witnessed a more rapid decline in infant mortality, from **82.9** in 2011 to **74.0** in 2019 due to increased funding in healthcare. Infant mortality from 2020 till date had downward trajectory, reaching its lowest level of 70.43 per 1,000 live births in 2023. (Eboh *et al.* 2022).).

The decline reflects the impact of international aid, health sector improvements, government policies like National Health Insurance Scheme (NHIS) in 2005, the Integrated Maternal, Newborn, and Child Health Strategy (IMNCH) introduced in 2007, and the 2001 Abuja Declaration that committed 15% of the national budget to health, which has not been consistently met (WHO, 2001), Saving One Million Lives Program for Results (SOML-PforR), the 1992 National Primary Health Care Development Agency (NPHCDA) programs, and the 2009 Midwives Service Scheme (MSS). Despite these efforts, systemic challenges such as weak implementation, inadequate funding, corruption, and poor health infrastructure have hindered their success in significantly reducing mortality rate (Owusu *et al.* 2021). as the rate remains high compared to global standards, indicating persistent challenges such as inadequate healthcare access, poverty, and insufficient funding.

Health expenditures play a critical role in reducing infant mortality by enhancing the quality and accessibility of maternal and child health services. Health capital expenditure, which includes investments in hospitals, medical equipment, and health

infrastructure, has a direct impact on neonatal survival by improving the delivery of essential health services. Health recurrent expenditure, which covers salaries, drugs, and routine medical supplies, ensures the continuous operation of health facilities, thereby reducing preventable infant deaths. Donor-funded health expenditures have been instrumental in supporting maternal and child health programs in Nigeria, but challenges such as poor fund utilization and corruption have limited their effectiveness (Oladosu *et al.,* 2022). Similarly, high out-of-pocket health expenditure remains a barrier for many Nigerian families, leading to delayed or inadequate health care for pregnant women and infants (Salinas-Rodríguez *et al.,* 2020). Existing literature has examined the relationship between health expenditure and infant mortality, yet gaps remain in understanding the specific impact of different types of health expenditures—capital, recurrent, donor, and out-of-pocket—on infant mortality rates in Nigeria. Many studies have focused on aggregate health spending without differentiating between these categories, limiting the ability to formulate targeted policy interventions (Sirag & Mohamed-Nor, 2021). This research is crucial as it will provide empirical evidence on the effectiveness of health spending components in reducing infant mortality, offering valuable insights for policymakers and stakeholders.

The primary objective of this study is to analyze the impact of health expenditures on infant mortality rates in Nigeria from 1992 to 2023. Specifically, the study examined the impact of health capital expenditure, health recurrent expenditure, health donor expenditure, and health out-of-pocket expenditure on infant mortality rate. Based on objective, the study hypothesizes that; The study hypothesizes the following:

H_{01}: Health capital expenditure has no significant impact on infant mortality rates in Nigeria.
H_{02}: Health recurrent expenditure has no significant impact on infant mortality rates in Nigeria.
H_{03}: Health donor expenditure has no significant impact on infant mortality rates in Nigeria.
H_{04}: health Out of pocket expenditure has no significant impact on infant mortality rates in Nigeria.

Conceptual Clarification and Literature Review

Health Expenditure

Health expenditure refers to the financial resources allocated to the healthcare sector by governments, organizations, and individuals. It includes spending on medical services, health facilities, medications, preventive healthcare, and related services which is categorized into public and private spending (out-of-pocket costs incurred by individuals and donor contributions). (World Health Organization [WHO], 2020; Akinyemi *et al*., 2022). The health expenditure includes capital expenditure, recurrent expenditure, donor expenditure, out-of-pocket expenditure (Chikezie & Ukpere, 2020; Ajayi *et al*., 2021; Ogunyemi *et al*., 2020; Ekpenyong *et al*., 2021). Health expenditure is positively correlated with better health outcomes (WHO, 2020), In Nigeria, health

expenditure has been a subject of discussion, as public health spending remains below the recommended threshold of 15% of national budget allocation by the Abuja Declaration (WHO, 2001). This underfunding has led to challenges in healthcare delivery, with many Nigerians resorting to out-of-pocket spending, which can lead to financial hardship, particularly for the poor (Oladosu & Ajayi, 2022). Overall, the allocation and effective utilization of health expenditure are vital for achieving sustainable healthcare development.

Capital Health Expenditure

Capital Health Expenditure refers to the funds used by a government or organization to acquire, maintain, or upgrade physical assets that are long term investment such as buildings, machinery, and infrastructure e.g., hospitals, clinics, acquisition of medical equipment, and development of technological infrastructures aimed at improving healthcare delivery (Ajayi *et al.,* 2021; Akinyemi *et al.*, 2022). In developing countries like Nigeria, capital expenditure in healthcare has significant implications for the accessibility and effectiveness of healthcare delivery, as limited resources often result in inadequate infrastructure to meet the needs of the population (Oladosu & Ajayi, 2022). The importance of capital expenditure in healthcare are infrastructure development which shows that capital expenditure is essential for expanding and improving healthcare infrastructure, which includes building and maintaining hospitals, clinics, laboratories, and pharmacies. The availability of modern and well-equipped healthcare facilities is crucial for providing high-quality care to the population (Ogunyemi *et al.*, 2020). Technological Advancements as capital expenditure also supports the integration of advanced technologies in healthcare. This includes purchasing medical equipment such as diagnostic machines, surgical tools, and electronic health record systems, which enhance the quality and efficiency of healthcare delivery (Ajayi *et al.,* 2021).

Recurrent Health Expenditure

Recurrent Health Expenditure refers to the ongoing costs incurred by governments or organizations for day-to-day operations and the maintenance of services, as opposed to capital expenditure, which focuses on long-term investments. In the context of healthcare, recurrent expenditure includes spending on salaries for healthcare workers, procurement of medical supplies, costs of maintaining health infrastructure, and funding for the operational aspects of healthcare facilities (Howdon & Rice, 2018). This type of expenditure is essential for the smooth functioning of the healthcare system, ensuring that medical personnel are compensated, healthcare facilities are adequately stocked with essential drugs and equipment, and routine healthcare services are delivered effectively.

The importance of recurrent expenditure in healthcare includes salaries and compensation as one of the largest components of recurrent expenditure in healthcare is personnel costs. This includes salaries and allowances for doctors, nurses, medical technicians, and administrative staff. Adequate payment ensures that healthcare professionals remain motivated and committed to delivering quality care (Adebayo &

Akinyemi, 2022); Healthcare service delivery as Recurrent expenditure is vital for maintaining the operational capacity of healthcare services. This includes the procurement of essential medicines, medical supplies, and consumables like bandages, syringes, and diagnostic tools. Without sufficient recurrent funding, healthcare facilities may struggle to provide adequate services, leading to suboptimal health outcomes (Ajayi *et al.*, 2021); Maintenance of health facilities as recurrent expenditure also covers the cost of maintaining existing healthcare infrastructure, such as hospitals, clinics, and medical equipment. Regular maintenance ensures that healthcare facilities are functional and equipped to provide proper care to patients, minimizing the risk of service disruptions (Oladosu & Ajayi, 2022) and also is public health programs which in addition to hospital care, recurrent expenditure is used to fund various public health programs, such as vaccination campaigns, disease prevention initiatives, and health education programs. These initiatives are essential for improving the overall health of the population and preventing the spread of infectious diseases (Akinyemi *et al.*, 2022).

Donor Health Expenditure

Donor Health Expenditure refers to financial contributions made by foreign governments, international organizations, and non-governmental organizations (NGOs) to support health systems in developing countries. These expenditures are typically directed towards funding healthcare programs, projects, and services that are deemed critical to improving health outcomes, especially in countries with limited domestic resources for health financing. In the context of Nigeria, donor expenditure plays a pivotal role in addressing the country's healthcare challenges, including high mortality rates, inadequate infrastructure, and the burden of infectious diseases (Owusu *et al.* 2021). The importance of donor expenditure in healthcare include filling funding gaps as donor expenditure is crucial in countries like Nigeria, where domestic healthcare funding is often insufficient to meet the needs of the population. These funds can bridge gaps in public health financing, enabling governments to implement and scale up essential healthcare services, such as vaccination campaigns, maternal and child health programs, and disease control initiatives (Jiang & Liu, 2021); support for health programs as donor funds are often channeled into specific health programs, such as HIV/AIDS treatment, malaria control, and tuberculosis management (Chima *et al.*, 2022).

Out of Pocket Health Expenditure

Out-of-Pocket (OOP) Health Expenditure refers to the direct payments made by individuals or households for healthcare services at the time of use, without any reimbursement or external financial support. This includes payments for medical consultations, medications, diagnostic tests, hospital stays, and other healthcare-related expenses that are not covered by insurance, government funding, or donor support (Liu *et al.*, 2020). In many low- and middle-income countries like Nigeria, out-of-pocket expenditure is a significant source of healthcare financing, particularly in the absence of comprehensive health insurance coverage and limited government funding for public healthcare systems. Out-of-pocket expenditure plays a crucial role in determining individuals' access to healthcare services. High out-of-pocket costs can create financial

barriers, especially for low-income households, leading to delays in seeking care, underutilization of services, or even catastrophic health spending (Mills *et al.,* 2021). In Nigeria, where healthcare financing is predominantly dependent on personal payments, this has resulted in many individuals opting out of necessary medical treatments due to the high cost of care (Akinyemi *et al.*, 2022). The level of OOP expenditure disproportionately affects vulnerable groups in society, including low-income individuals, rural populations, and the elderly. In Nigeria, as in many other developing countries, the burden of OOP payments falls heaviest on those who can least afford it, exacerbating health inequalities (Ogunbekun *et al.,* 2021). Those unable to pay out-of-pocket for health services often experience poor health outcomes due to delayed or lack of treatment.

Infant Mortality

Infant mortality is defined as the death of a child before reaching the age of one year, expressed as the number of deaths per 1,000 live births in a given year or period (WHO, 2023). UNICEF (2022) described infant mortality as the probability of a newborn dying between birth and exactly one year of age, measured per 1,000 live births. The organization emphasized that infant mortality reflects the overall health and development status of a nation (UNICEF, 2022) while in the Global Burden of Disease study, Murray and Lopez define infant mortality as the total number of deaths of infants under one year of age in a given population, often used as an indicator of public health and socio-economic conditions. According to Mosley *et al*. (2003), infant mortality is a critical demographic indicator influenced by biological, socioeconomic, and environmental factors, serving as a measure of healthcare accessibility and child well-being. Infant mortality is also seen as the proportion of newborns who do not survive beyond their first year of life, largely influenced by maternal health, nutrition, infectious diseases, and healthcare system effectiveness (Mishiwo *et al.* 2023). Infant mortality is influenced by various factors, including maternal health, access to medical care, socioeconomic status, sanitation, nutrition, and immunization rates (United Nations Children's Fund [UNICEF], 2022).

Theoretical Framework

The theoretical framework for this study will be anchored on the grossman health theory, proposed by Michael Grossman in 1972 in his work on the health production function. Grossman's theory provides a robust foundation for understanding the relationship between health expenditure and infant mortality rates, making it a suitable framework for this research. The grossman health theory posits that individuals invest in their health as a form of human capital, with health serving as both a consumption good and an investment good. As a consumption good, health directly contributes to an individual's well-being. As an investment good, health influences productivity, earning capacity, and life expectancy. Grossman's model suggests that health is a stock variable that depreciates over time and can be replenished through investments such as healthcare spending, lifestyle choices, and preventive measures. The grossman health theory is typically expressed as: H=f(M,L,E,Z), Where: H = Health status, M = Medical care (health

expenditure), L = Lifestyle factors (e.g., nutrition, exercise), E = Environmental factors, Z = Socioeconomic factors (e.g., income, education) In this framework, health expenditure is a key input that enhances the stock of health capital, leading to improved health outcomes and reduced infant mortality rates. Grossman's Health theory is particularly relevant to this study because it emphasizes the role of health expenditure in influencing infant mortality rates. The study examines health expenditure in Nigeria through the proxies of capital health expenditure, recurrent health expenditure, donor health expenditure, and out-of-pocket health expenditure. These expenditures represent investments in healthcare infrastructure, personnel, external aid, and household spending, all of which are critical for improving healthcare delivery and reducing infant mortality.

Empirical Review

Ahonkhai *et al.* (2023) examined the relationship between government health expenditure (GHE) and health sector performance in Nigeria, focusing on its effects on infant mortality (IM) and life expectancy (LE) from 1981 to 2021. The study found that government health domestic spending and income per capita positively affected LE and reduced infant mortality. Additionally, foreign health grants were associated with increased LE but had a negative effect on IM. The study concludes that government health expenditure, especially domestic spending, income per capita, and foreign health grants, plays a significant role in improving life expectancy and reducing infant mortality in Nigeria. In another studies, Musa (2022) explored the relationship between government spending on the health sector and health status in Nigeria from 1986 to 2020 The study used quantitative methodology, co-integration and the error correction model (ECM) and found that health capital expenditure and recurrent expenditure significantly reduced infant mortality in Nigeria during the study period.

Also, Oladosu *et al.* (2022) explored the impact of public health expenditure on health outcomes in Nigeria and Ghana. The study employed linear regression analysis to analyze the data and found that public health expenditure in both Nigeria and Ghana remained low despite these commitments. While, Attamah (2021) investigated the impact of government health expenditure on infant mortality rates in Nigeria from 1981 to 2018. The study employed Vector Error Correction Model (VECM). The result indicated that government health expenditure had a positive and significant long-term impact on infant mortality in Nigeria. The study recommended the establishment of an inclusive health insurance scheme to enhance healthcare accessibility for all Nigerians.

On the other hand, Owusu *et al.* (2021) examined the effect of health expenditure on infant and maternal mortality rates across 177 countries from 2000 to 2015. The study employed panel Quantile Regression with bootstrapping which it was revealed that health expenditure consistently had negative relationship between health expenditures and mortality rates, Specifically, infant mortality rates declined by 0.19% to 1.45%, underscoring the critical role of health spending in improving health outcomes, As Ikechukwu *et al.* (2020) explored the relationship between capital health expenditure

(CHE) and the infant-maternal mortality ratio (IMMR) using Autoregressive Distributed Lag (ARDL) technique to analyze data from 1980 to 2017. The findings indicated a mixed impact of CHE on IMMR, with varying effects observed in the short run `compared to the long run. While some immediate benefits of increased capital health spending were evident, the full realization of its impact required sustained efforts.

Also, Karaman *et al.* (2020) investigated the impacts of selected healthcare spending indicators on health outcomes across OECD countries. The study employed stepwise multiple regression analysis to analyze the data. The results of the study revealed that public healthcare spending per capita significantly influenced maternal and infant mortality rates. They recommended that countries should increase public support for maternal and child health services to reduce maternal and infant mortality. Ogunjimi and Adebayo (2019) investigated the interplay among health expenditure, health outcomes, and economic growth in Nigeria from 1981 to 2017. The study employed Autoregressive Distributed Lag (ARDL) Bounds test confirmed the existence of a long-run relationship among the macroeconomic variables. The study health expenditure was found to cause a reduction in infant mortality, while no causal relationship was established between real GDP and infant mortality. Based on these findings, the study recommended that the Nigerian government should significantly increase health expenditure.

In exploring the impact of health expenditure on health outcomes across 14 West African countries from 2000 to 2018, Oluwaseun (2019) employed panel data estimation method for analysis. The findings demonstrated that a one-percentage-point increase in health expenditure significantly reduced infant mortality by 2.4%, under-five mortality by 3.9%, and maternal mortality by 4.9%. Eboh (2018) assessed the impact of public health expenditure on the infant mortality rate in Nigeria from 1994 to 2017. The Ordinary Least Squares (OLS) technique was used to estimate the model. The findings indicated that both HRE and HCE had significant negative effects on the infant mortality rate over the 24-year period. Similarly, Rahman *et al.* (2018) investigated the relationship between various types of healthcare expenditure (public, private, and total) and three key health status outcomes—life expectancy at birth, crude death rate, and infant mortality rate—in the SAARC-ASEAN region from 1995 to 2014. The study used panel data analysis with fixed and random effects models to analyze the data. The results showed that total health expenditure, public health expenditure, and private health expenditure all significantly reduced infant mortality rates.

Fullman *et al.* (2018) investigated the impact of public spending on social services in Nigeria from 2000 to 2013. The study utilized Pearson's moment correlation methodology. The findings revealed a statistically significant negative relationship between public health expenditure and infant mortality rates, indicating that increased government allocation to the health sector reduces child mortality while Edeme *et al.* (2017) investigated the effect of public health expenditure on health outcomes in Nigeria, specifically focusing on life expectancy at birth and infant mortality rates. The study employed time series data to analyze the relationship between public health expenditure

and these health outcomes. The results indicated a long-run equilibrium relationship between public health expenditure and health outcomes in Nigeria.

Nicholas *et al.* (2016) examined the effect of public and private health expenditures on selected maternal-child health outcomes in Sub-Saharan Africa (SSA). The study utilized panel data from 40 SSA countries, covering the period from 2000 to 2010. With fixed effects estimation technique, they found that public health expenditure had a significant and inverse relationship with infant and under-five mortalities in SSA, meaning that increased public health spending was associated with reduced mortality rates in these categories. Also, Yusuf (2016) assessed the impact of government expenditure on social services in Nigeria. The study employed Pearson's moment correlation technique to investigate the relationship between these variables. The findings revealed that government expenditure was inversely and significantly related to infant mortality rates, He recommended that the Nigerian government should allocate more funds to the health sector to improve health outcomes, particularly in reducing infant mortality.

Yaqup *et al.* (2016) explored the interplay between governance and the effectiveness of public health expenditure in Nigeria, focusing on health outcomes such as infant mortality, under-five mortality, and life expectancy. The study employed both ordinary least squares (OLS) and two-stage least squares (2SLS) regression methods to analyze the relationships. The findings revealed that public health expenditure has a negative effect on infant mortality and under-five mortality when governance factors are considered. They recommended significant governance reforms to reduce corruption levels, emphasizing that improved governance is critical to enhancing the efficiency of public health expenditure and achieving better health outcomes in Nigeria. Also, Bashir (2016) investigated the effect of government expenditure on social services in Nigeria, with a particular emphasis on health sector performance. The study employed Pearson's moment correlation technique the analysis revealed a significant inverse relationship between government expenditure and infant mortality. While Bidzha (2015) revealed that an increase in public health expenditure per capita generally leads to improvements in these health outcomes. The estimated impact was most significant for infant mortality, with an elasticity of −0.368, suggesting that a rise in health expenditure significantly reduces infant mortality rates.

Methodology

This paper used ex post facto research design and time series data from 1992 to 2023. The data for health expenditures, specifically Capital Health Expenditure (CHX), Recurrent Health Expenditure (RHX), Donor Health Expenditure (DHX), and Out-of-Pocket Health Expenditure (OPT) were obtained from Central Bank of Nigeria (CBN) Statistical Bulletin 2024, the National Bureau of Statistics (NBS) 2024, NPHCDA database and the World Bank's World Development Indicators 2024 and infant mortality (IMT) was sourced from the world bank's world development indicators (2024). These sources offer robust and internationally comparable data on infant mortality rates, reflecting changes in health outcomes over the study period. The study employed the Autoregressive Distributed

Lag (ARDL) method, introduced by Pesaran and Pesaran in the late 1990s. The ARDL technique is particularly useful for analysing the dynamic relationships between variables, as it allows for the examination of both short-run and long-run effects within a single framework.

Model Specification

This paper employed the Autoregressive Distributed Lag (ARDL) methodology, aligning with the theoretical framework established herein. The model adapted from Awoyemi *et al.* (2023) where they investigated the linkages between government expenditure and health outcomes in Nigeria from 1995 to 2018 and the functional relationship model is stated as:

$$MR_t = f(PHE\_GDP_t, PRHE\_GDP_t, CHE\_GDP_t, RHE\_GDPt, RGDP_t, \varepsilon_t) \quad (1)$$

Where:
MRt denotes Mortality Rate.
PHE_GDPt is Public Health Expenditure as a percentage of GDP.
PRHE_GDPt represents Private Health Expenditure as a percentage of GDP.
CHE_GDPt is Capital Health Expenditure as a percentage of GDP.
RHE_GDPt is Recurrent Health Expenditure as a percentage of GDP.
RGDPt is Real Gross Domestic Product.
εt is the error term.

Equation (1) was modified to align with the objectives of this research and to establish the functional relationship between health expenditures variables and infant mortality rate in Nigeria. Consequently, the functional form of the model for this study, which included health expenditures variables and infant mortality rate indicator, is expressed in the following implicit model:

$$IMT = f(CHX, RHX, DHX, OPT) \quad (2)$$

Where; IMT: Infant Mortality at time (dependent variable) and independent variable are CHX: Capital Health Expenditure at time. RHX: Recurrent Health Expenditure at time, DHX: Donor Health Expenditure at time, OPT: Out-of-Pocket Health Expenditure at time.

The study further specifies equation (2) in a stochastic (linear regression) form to gives:

$$IMT_t = \beta_0 + \beta_1 CHX_t + \beta_2 RHX_t + \beta_3 DHX_t + \beta_4 OPT_t + \varepsilon_t \quad (3)$$

Where;
The β_0: Intercept term, $\beta_1, \beta_2, \beta_3, \beta_4$: Coefficients of the independent variables, ε_t : Error term capturing unobserved factors at time t. The Autoregressive Distributed Lagged (ARDL) model that was used in this paper is specified as follows:

$$\Delta IMT_t = \beta_0 + \sum_{i=1}^{m} \beta_{1i} IMT_{t-1} + \sum_{i=1}^{m} \beta_{2i} CHX_{t-1} + \sum_{i=1}^{m} \beta_{3i} RHX_{t-1} + \sum_{i=1}^{m} \beta_{4i} DHX_{t-1} + \sum_{i=1}^{m} \beta_{5i} OPT_{t-1} + \beta_{6i} \Delta IMT_{t-1} + \beta_{7i} \Delta CHX_t + \beta_{8i} \Delta RHX_t + \beta_{9i} \Delta DHX_t + \beta_{10i} \Delta OPT_t + \varepsilon_t \quad (4)$$

Equation (5) was employed to assess both the short-run and long-run relationships, as well as the impact of health expenditure variables on infant mortality rate in Nigeria. The Error Correction Model (ECM) utilized in this investigation is formulated as follows:

$$\Delta IMT_t = \beta_0 + \sum_{a=1}^{p} \beta_{1i} \Delta IMT_{t-1} + \sum_{b=1}^{q} \beta_{2i} \Delta HCX_{t-1} + \sum_{c=1}^{q} \beta_{3i} \Delta HRX_{t-1} + \sum_{d=1}^{q} \beta_{4i} \Delta HDX_{t-1} + \sum_{e=1}^{q} \beta_{5i} \Delta OPT + ecm \quad (5)$$

Equation (5) was employed to assess both the short-run and long-run relationships, as well as the impact of health expenditure variables on infant mortality rate in Nigeria.

Variable Description, Measurements and Apriori Expectation

Table 1: Description of the Variables Used for the Model

Variable	Description/Measure	Type	Source	Apriori Expectation
IMT	Infant Mortality (per 1,000 live births)	Dependent	World Bank data, 2024	Not Applicable
CHX	Capital Health Expenditure (₦' Billion)	Independent	Central Bank of Nigeria (CBN)	Negative
RHX	Recurrent Health Expenditure (₦' Billion)	Independent	Central Bank of Nigeria (CBN)	Negative
DHX	Donor Health Expenditure (₦' Billion)	Independent	Central Bank of Nigeria (CBN)	Negative
OPT	Out-of-Pocket Expenditure ((₦' Billion)	Independent	CBN Statistical Bulletin, 2024	Negative

Source: Author Compilation, 2025

The apriori expectation for this paper's coefficients for independent variables $\beta_1 < 0$ coefficients of capital health expenditure are expected to have negative impact on infant mortality. $\beta_2 < 0$ coefficients of recurrent health expenditure are expected to have negative impact on infant mortality rate in Nigeria. $\beta_3 < 0$ coefficients of Donor Health Expenditure are expected to have negative impact on infant mortality rate in Nigeria. $\beta_4 < 0$ coefficients of Out-of-Pocket Health Expenditure is expected to have negative impact on infant mortality rate in Nigeria.

Presentation and Discussion of Results

Descriptive Statistics

Table 2: Descriptive Statistics

	IMT	CHX	RHX	DHE	OPT
Mean	93.70719	24.12250	142.9200	0.517438	70.95719
Median	88.55000	20.65500	86.05500	0.162000	71.73000
Maximum	123.6000	53.87000	459.3300	4.075000	77.39000
Minimum	68.50000	0.540000	0.150000	0.000000	60.16000
Std. Dev.	18.34088	18.86885	149.4884	0.826994	4.642038
Skewness	0.354434	0.288446	0.839718	2.822186	-0.765929
Kurtosis	1.696456	1.677828	2.381945	12.01615	2.719815
Jarque-Bera	2.935628	2.774589	4.269995	150.8665	3.233459
Probability	0.230429	0.249750	0.118245	0.000000	0.198547
Sum	2998.630	771.9200	4573.440	16.55800	2270.630
Sum Sq. Dev.	10428.02	11037.04	692750.1	21.20150	668.0040
Observations	32	32	32	32	32

Source: Researcher's computation using EViews 12, 2025

Table 2 showed the descriptive as the mean for infant mortality rate is 93.70719, indicating that, on average, there were about 94 deaths per 1,000 live births annually over the study period. The minimum recorded infant mortality rate is 68.50000, while the maximum is 123.6000, The standard deviation of 18.34088 suggested moderate variability in infant mortality over the years. The skewness value of 0.354434 indicated a positive skew, meaning that the distribution is slightly right-tailed. While the capital health expenditure mean's value of 24.12 with a median of 20.66. The minimum value is 0.54, while the maximum is 53.87. The standard deviation of 18.87 suggests high variability, showing inconsistent investments in health infrastructure. The skewness value of 0.29 suggests a slight rightward distribution, meaning occasional high capital expenditures.

The recurrent health expenditure mean's value of 142.92, reflecting the substantial role of recurrent expenditure in Nigeria's healthcare system. The minimum expenditure recorded is 0.15, while the maximum is 459.33. A high standard deviation of 149.49 suggests significant fluctuations in recurrent spending. The skewness value of 0.84 indicated a right-skewed distribution, meaning some years experienced much higher spending. Likewise, donor health expenditure's mean of 0.52, shows that donor contributions are relatively small compared to other types of health expenditures. The minimum value is 0.00, while the maximum is 4.08. The standard deviation of 0.83 indicates considerable variations in donor funding. The skewness value of 2.82 suggests a strong rightward skew, meaning that most years had low donor funding, but a few had significant contributions.

Out-of-pocket health expenditure's mean of 70.96 with a median of 71.73. The minimum recorded value is 60.16, while the maximum is 77.39, indicating relatively less variability compared to other health expenditures. The standard deviation of 4.64 further supports

the stability of out-of-pocket expenses over time. The skewness value of -0.77 suggests a slight leftward skew, indicating that lower out-of-pocket expenditures were more frequent. Furthermore, the kurtosis values for IMT (1.7), HCX (1.68), and HRX (2.38) indicated that these variables have a platykurtic distribution, meaning they are less peaked and have lighter tails than a normal distribution, suggesting a more evenly spread data distribution. Conversely, OPT (2.72) has a kurtosis value closer to 3, implying it is approximately normal. In contrast, DHE (12.02) exhibited leptokurtic characteristics, indicating a highly peaked distribution with extreme values, meaning donor expenditure is concentrated in a few years with sharp variations.

Table 3: Correlation Analysis

Correlation Probability	**IMT**	**CHX**	**RHX**	**DHE**	**OPT**
IMT	1.000000				

CHX	-0.906400	1.000000			
	0.0000	-----			
RHX	-0.871017	0.865800	1.000000		
	0.0000	0.0000	-----		
DHE	-0.460686	0.496724	0.405097	1.000000	
	0.0080	0.0038	0.0214	-----	
OPT	-0.607863	0.616617	0.582635	0.189310	1.000000
	0.0002	0.0002	0.0005	0.2994	-----

Source: Author's Computation, using E-Views 12 (2025)

Table 3 shows correlation result on this paper as the correlation analysis examines the relationship between Infant Mortality Rate (IMT) and various health expenditure components, including Capital Health Expenditure (CHX), Recurrent Health Expenditure (RHX), Donor Health Expenditure (DHX), and Out-of-Pocket Expenditure (OPT). As the correlation coefficient between IMT and CHX is -0.906400, indicating a strong negative relationship. While IMT and RHX have a correlation of -0.871017, also showing a strong negative association. Also, the correlation coefficient between IMT and DHE is -0.460686, suggesting a moderate negative relationship. Likewise, the correlation between IMT and OPT is -0.607863, indicating a moderate negative relationship. However, all the probability value confirmed statistical significance at the 5% level.

Stationary Tests (Unit Root Tests)

This part of the paper looked at the unit root of each of the variable using the augmented dickey-fuller (ADF) test to ascertain stationarity of the data at 5% level of significance.

Table 4: Unit Root Test Result

Variable	Augmented Dickey-Fuller (ADF) Test		
	ADF	Critical Value	Status
IMT	-8.892350	-1.952066	1(0)
CHX	-5.505494	-2.963972	1(1)
RHX	-6.184162	-2.963972	1(1)
DHE	-5.934237	-3.580623	1(0)
OPT	-5.317743	-2.963972	1(1)

significant level is 5% level

Source: Researcher's Computation Using EViews-12 (2025)

The augmented dickey-fuller (ADF) test as seen in table 4 is used to examine the stationarity of the variables in the study. the unit root test results showed a mixed order of integration, with infant mortality and donor health expenditure stationary at level I(0), while capital health expenditure, recurrent health expenditure, and out-of-pocket expenditure are stationary at first difference I(1). this implies the study may require a Johansen cointegration test to determine the presence of a long-run equilibrium relationship among the variables.

Co-integration of ARDL-Bounds Test

This section shows the ARDL co-integration bounds test of the variables used in this paper.

Table 5: Ardl-Bound Testing

Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	K
F-statistic	98.46811	4
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

Source: Researcher's Computation Using EViews-12 (2025)

Table 5 of the ARDL bound test shows that at 5 per cent level of significant that the F statistics 98.46811 is greater than the lower critical bound 1(0) value of 2.86 and upper critical bound 1(1) value of 4.01 signifying that the overall model has a long run impact.

Auto regressive Distributed Lag (ARDL) Regression Results

This part of the paper shows the shortrun, longrun impact ARDL regression analysis, the error correction and the model fit.

Table 6: Autoregressive Distributed Lag (ARDL) Model Results
Dependent Variable: AMT

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(IMT(-1))	3.796027	0.845035	4.492151	0.0109
D(IMT(-2))	-2.134062	1.121280	-1.903237	0.1298
D(IMT(-3))	-1.239501	0.695808	-1.781383	0.1494
D(CHX)	0.004308	0.010616	0.405827	0.7056
D(CHX(-1))	0.075962	0.012604	6.026602	0.0038
D(CHX(-2))	-0.009499	0.011893	-0.798746	0.4692
D(CHX(-3))	-0.033762	0.019426	-1.737984	0.1572
D(RHX)	-0.004783	0.003118	-1.534156	0.1998
D(RHX(-1))	-0.003559	0.002689	-1.323858	0.2561
D(RHX(-2))	0.006152	0.002849	2.159243	0.0970
D(RHX(-3))	-0.018185	0.004450	-4.086843	0.0150
D(DHE)	-0.734634	0.108497	-6.771024	0.0025
D(DHE(-1))	0.241773	0.101300	2.386694	0.0754
D(DHE(-2))	0.813835	0.100028	8.136080	0.0012
D(OPT)	-0.001086	0.018889	-0.057520	0.9569
D(OPT(-1))	-0.118218	0.030224	-3.911427	0.0174
D(OPT(-2))	0.045893	0.028038	1.636802	0.1770
D(OPT(-3))	-0.025082	0.015114	-1.659509	0.1724
CointEq(-1)	-0.100081	0.011597	8.629891	0.0010
R-squared	0.999989			
Adjusted R-squared	0.999923			
F-statistic	15311.06			
Prob(F-statistic)	0.000000			
Durbin-Watson stat	3.724323			
Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
CHX	-0.292750	0.426886	-0.685781	0.5305
RHX	-0.181093	0.039273	-4.611090	0.0099
DHE	16.017558	4.144562	3.864717	0.0181
OPT	-0.754850	0.586327	-1.287422	0.2674
C	169.511847	39.482200	4.293374	0.0127

Source: Researcher's Computation Using EViews-12 (2025)

Table 6 showed the coefficient of the error correction term (CointEq (-1)) is -0.100081, which signifies negative and statistically significant with probability value of 0.0010. The magnitude of -0.100081 suggests that about 10% of the previous year's disequilibrium is corrected each year, indicating a slow speed of adjustment toward long-run equilibrium. Capital Health Expenditure with coefficient of -0.292750 showed a negative but statistically insignificant with probability value of 0.5305 impact on infant mortality. This suggests that capital health expenditure has a weak impact on reducing infant mortality rates in Nigeria. This may be due to inefficiencies in healthcare infrastructure spending. Similarly, Recurrent Health Expenditure with coefficient of -0.181093 showed negative

and statistically significant impact on infant mortality. This indicated that increased recurrent health expenditure significantly contributes to reducing infant mortality in Nigeria.

While the coefficient value for Donor Health Expenditure is 16.017558 which shows a positive and statistically significant impact on infant mortality. This suggested that donor health expenditure had increasing impact on infant mortality. This counterintuitive result may be due to inefficiencies in foreign aid utilization or misallocation of donor funds. In contrast the coefficient of Out-of-Pocket Health Expenditure with value of 0.754850 showed aa negative but statistically insignificant impact on infant mortality. This implied that out-of-pocket health expenditure has a weak impact on reducing infant mortality. High out-of-pocket costs may discourage healthcare utilization, but the effect is not statistically robust. Also, the R-Squared (0.999989) and Adjusted R-Squared (0.999923) indicated that the model explains nearly 100% of the variations in infant mortality rates, which suggested a strong explanatory power. While the F-Statistic (15311.06, p = 0.0000) confirmed that the overall model is statistically significant, meaning the independent variables jointly influence infant mortality. Durbin-Watson Statistic (3.724323) suggested the presence of autocorrelation, which could indicate that the model might require additional modifications or robust standard errors to address serial correlation.

Furthermore, H_{01}: capital health expenditure has no significant impact on infant mortality in Nigeria. So therefore, base on the probability for CHX is 0.5305, which is greater than 0.05. the null hypothesis is accepted. for H_{02} which state recurrent health expenditure has no significant impact on infant mortality in Nigeria and base on the probability value 0.0099, which is less than 0.05. the null hypothesis is rejected. for the H_{03}: donor health expenditure has no significant impact on infant mortality in Nigeria. the probability is 0.0181, which is greater than 0.05 is rejected. in the same vein H_{04} that state out-of-pocket health expenditure has no significant impact on infant mortality in Nigeria is accepted based on the probability for OPT that is 0.2674, which is greater than 0.05 signifying that out-of-pocket health expenditure does not have a statistically significant impact on infant mortality.

Post-Estimation Checks (ARDL Diagnostic Test)
The ARDL result in table 6 is hereby validated in this section

Table 7: Results of ARDL Diagnostic Checks

Tests		**Outcomes**	
		Coefficient	**Probability**
Breusch-Godfrey-Serial-Correlation Test	F-stat.	51.24749	0.0191
Heteroscedasticity-Breusch-Pagan-Godfrey Test	F-stat.	2.619677	0.1806
Normality Test	Jarque-Bera	0.085359	0.958218

Source: Author's Computation Using EViews-9 (2025)

The post-estimation diagnostic tests were conducted to assess the validity and reliability of the estimated model. The Breusch-Godfrey Serial Correlation Test was used to check for autocorrelation in the residuals. The results table 8 showed an F-statistic of 51.24749 with a probability value of 0.0191, which is greater than the 5% significance level. This indicates that the null hypothesis of no serial correlation cannot be rejected, confirming that the residuals are free from autocorrelation, ensuring unbiased estimates. Similarly, the Breusch-Pagan-Godfrey test was conducted to check for heteroscedasticity, revealing an F-statistic of 2.619677 with a probability value of 0.1806. Since the probability is greater than 0.05, we fail to reject the null hypothesis, suggesting that the residuals exhibit homoscedasticity, meaning the variance of errors remains constant across observations. Furthermore, the Jarque-Bera normality test was employed to assess whether the residuals follow a normal distribution. The test yielded a statistic of 0.085359 with a probability of 0.958218, which is also greater than the 5% significance level. As a result, the null hypothesis of normality cannot be rejected, confirming that the residuals are normally distributed. These findings indicated that the estimated model meets the key econometric assumptions, reinforcing the reliability of the results for policy recommendations and economic interpretations.

Discussion of Findings

The long-run coefficients from the ARDL model provided insights into the impact of different components of health expenditure on infant mortality in Nigeria. The findings from the ARDL model provided insights into the impact of different components of health expenditures on infant mortality in Nigeria. The study found that capital health expenditure has negative and no significant impact on infant mortality in Nigeria. This suggests that investments in health infrastructure, such as hospital buildings, equipment, and new medical facilities, have not translated into immediate reductions in infant mortality. One possible explanation is that the mere existence of infrastructure does not guarantee improved health outcomes unless complemented by adequate staffing, maintenance, and operational efficiency. This finding aligns with the study by Eboh *et al.* (2022) which argued that Government capital expenditure has a negative and insignificant impact on under-five child mortality in Nigeria.

Recurrent health expenditure was found to have a significant negative impact on infant mortality, meaning that increased spending on salaries for healthcare workers, medical supplies, and facility maintenance leads to improved infant survival rates. This indicated that operational expenditures, which ensure continuous provision of healthcare services, play a more direct role in reducing infant mortality than infrastructure investments. This finding is consistent with Owusu et al. (2021). who found that Health expenditure negatively affects infant mortality rates, with declines ranging from 0.19%-1.45%. Donor health expenditure had a significant positive impact on infant mortality, implying that increases in donor funding were associated with higher infant mortality rates. This counterintuitive result suggested that donor funds may not be effectively utilized, or that dependency on external aid creates inefficiencies in the healthcare system. Contrasting Literature by Batbold (2017) argued that annual health grant of one percent of GDP

decreases infant mortality by over 3% and increases life expectancy by approximately 2% over the five years

Out-of-pocket health expenditure was found to have negative and no significant impact on infant mortality. This suggested that individual household spending on healthcare does not play a major role in reducing infant deaths, possibly due to financial barriers that limit access to quality healthcare services. High out-of-pocket spending can also indicate weak public health systems, forcing individuals to pay for services that should be publicly funded. Supporting Literature by Logarajan *et al.* (2022) said that Out-of-pocket health expenditure deteriorates the under-five mortality rate in Malaysia, while public and private health expenditures are statistically insignificant.

Conclusion and Recommendations

This study examined the impact of different health expenditure components on infant mortality in Nigeria from 1992 to 2023. The findings showed that recurrent health expenditure significantly reduces infant mortality, indicating the importance of continuous investment in healthcare personnel, medical supplies, and service delivery. Capital health expenditure and out-of-pocket health expenditure were found to be insignificant, suggesting that infrastructure investment alone does not guarantee improved infant health outcomes, and household healthcare spending does not substantially reduce infant mortality. Donor health expenditure was found to have a counterintuitive positive impact on infant mortality, possibly due to inefficiencies in the utilization and allocation of foreign aid. These results emphasize the need for targeted health policies to enhance the efficiency and effectiveness of healthcare spending in Nigeria. The study recommended based on each finding.

i. The Nigerian government should increase recurrent health expenditure to improve healthcare service delivery, including better salaries for healthcare workers, timely procurement of essential drugs, and maintenance of medical facilities through the Federal Ministry of Health (FMOH), National Primary Health Care Development Agency (NPHCDA) for effective delivery of maternal and child health services.
ii. The Federal and State Ministries of Health, Budget Office of the Federation (BOF), Independent Corrupt Practices Commission (ICPC) and Economic and Financial Crimes Commission (EFCC) should ensure that investments in health infrastructure, such as hospitals and medical facilities, are complemented with adequate staffing, equipment, and maintenance. Health projects should be monitored to prevent abandoned or non-functional facilities.
iii. International donor funds should be better coordinated by National Agency for the Control of AIDS (NACA) and FMOH to ensure they align with national healthcare priorities. The government should establish a transparent framework for tracking donor health expenditure, ensuring that funds are directed toward impactful programs such as immunization, maternal health, and infant care.
iv. The government should expand health insurance coverage through the National Health Insurance Authority (NHIA) to reduce financial barriers to healthcare.

Subsidized maternal and child health services should be prioritized to ensure that infants from low-income households receive adequate medical care.

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