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Healthcare financing: A trend analysis of Liberia's health system

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Abstract
Identifying the financing of health care services in Liberia has a distinct set of differences in health outcomes ever since the adoption of changes in the health system in the 1980s. This paper studied the changing patterns and expenditures of Liberia and projected future spending. The data was retrieved from the government expenditures for the fiscal periods 2000 to 2024. Multiple regression and trend analysis determined relationships between variables and trends over time. Major spending imbalance with significant disparities in the government health budget, concentrated on curative services (58.7%) and a much smaller preventive service (4.4%). Driver spending is explained by 93% variability in health spending, which denotes a spending pattern strongly influenced by poor performance on key health indicators, especially slow progress in life expectancy at birth and uncontrolled maternal and child health mortality. The trend analysis forecasts, at 95 percent seasonally adjusted confidence, that the set of 10-year per capita spending increases will reach $146.76 in 2036, with the upper and lower boundaries set at $181.90 and $111.70. The projected increase in health spending necessitates a health system that is ready to absorb and utilize funds effectively, resulting in reallocating future spending growth towards preventive and primary healthcare.

Keywords: Healthcare, financing, curative, preventive, outcomes

Introduction

Models of health and healthcare delivery are changing significantly in health systems, particularly in the area of health spending, which is vital for general health (Darrudi *et al*., 2022) [1]. There are obstacles in this process that prevent universal health coverage from being achieved. These issues differ from nation to nation worldwide, with attempts to meet health objectives by outsourcing both internal and external resources, particularly in underserved and remote populations (Tagne *et al*., 2025) [2]. As a nation or region invests in the health of its people, the focus of health financing moves toward per capita health spending (Hanson *et al*., 2022) [3]. Per capita spending offers crucial context for resource allocation, distribution, and utilization, even though it does not always directly result in improved health outcomes (González-de-Julián *et al*., 2024) [4]. In addition to resources collected and pooled by public agencies from all revenue sources, this spending also includes resources managed through government budgets, agencies, extrabudgetary funds, and mandatory health insurance (WHO, 2025c) [5].

Global health delivery is being shaped by a number of important trends, such as the rise in technology use, the increased focus on mental health, and the move toward preventive care (Gillies, 2024). The double burden of diseases is also being addressed, health systems are being strengthened, and health equity is being promoted (Thacharodi *et al*., 2024; Rad, 2025; Chang, 2025) [7, 8, 9]. According to a study of 63 nations, government health spending varies by country, with low-income countries spending between $10.1 and $10.2 and low-middle-income countries spending between $54.5 and $57.6. The annual percentage of government spending on health is 4.7% (Kurowski *et al*., 2024) [10]. India's per capita spending is expected to gradually decline over the Sustainable Development Goals years, while several BRICKS countries exhibit a long-term upward trend in this area (Sahoo *et al*., 2023) [11]. According to Sahoo *et al*., Russia is attaining the highest absolute value, while China will see the steepest increase until 2035.

Lassa, Ebola, and Marburg viruses (Knobloch *et al*., 1982) [12] as well as Lassa, Chikungunya, Mokola, Bwandba, Bunyamwera, and dengue viruses (Bloch, 1976) [14] were among the infectious disease outbreaks that occurred in Liberia between the 1960s and 1970s. According to the U.S. Department of Health, Eradication, and Awareness, the Ministry of Health and Social Welfare in Liberia, the Ministry of Health in Sierra Leone, and the Grand Gedeh County health system in Liberia, four cases of smallpox were reported to the National Public Health Services in 1970. These groups reported a nine-year-old boy, a six-year-old girl, a four-year-old girl, and a four-year-old boy who were not vaccinated (Curry, n.d.; Maffioli and Yu, 2024; Kentoffio *et al*., 2016) [16, 17]. WHO considers the worldwide smallpox eradication to be a major public health accomplishment. The outbreaks of infectious disease, between 1960 – 1970, led to integrating health plans into economic development in Liberia and other African countries (Manton & Gorsky, 2018) [18].

The 1980s saw a decline in the framework of the health system as a result of growing inequalities in access to basic health services, especially in rural areas, and a critical health delivery situation that was made worse by the diseases and growing insecurity that would ultimately spark the Liberian civil war (Kruk *et al*., 2011) [19]. The Bureau of Public Health and Sanitation was established in the 1940s as a result of organizations, including American settlers and missionary groups, providing health services like garbage management and debris removal from homes as Liberia's health system deteriorated in the early 1900s (Kanagasabai and Ballah, 2022) [20]. The first widespread public health campaign involved spraying mosquitoes with dichloro-diphenyl-trichloroethane (Maffioli and Yu, 2024; Shobayo *et al*., 2022) [16].

Liberia's health system suffered greatly as a result of the civil war (1989–2003), which led to the destruction of

health facilities and the loss of many medical personnel. Additionally, a weak public health system exacerbated the frequent outbreaks of cholera, yellow fever, Lassa fever, dengue fever, and typhoid (Kanagasabai and Ballah, 2022) [20]. One of the countries most affected by the West Africa Ebola epidemic (2014–2016) was Liberia, which had widespread transmission, particularly in urban areas. The disease overwhelmed the country's already fragile health system, prompting the creation of the National Public Health Institute (WHO, 2025b) [22]. The measles outbreak in 2022 and the COVID-19 pandemic in 2020 both hampered Liberia's attempts to reconstruct its healthcare system (Maffioli and Yu, 2024; Shobayo *et al*., 2022) [16].

When the civil war ended in 2003, there were gaps in the health workforce due to the departure of medical professionals, and an estimated 10% of the population, particularly in rural areas, lacked access to basic health services (Varpilah *et al*., 2011; Dahn *et al*., 2021) [23, 24]. Limited access to high-quality health care exacerbated poor health outcomes, including high rates of diseases like malaria, diarrhea, and acute respiratory infections that are preventable and treatable (Varpilah *et al*., 2011) [23]. Studies in the 1980s documented the presence of diseases like Ebola and antibiotic-resistant Salmonella outbreaks, indicating pre-existing health conditions that were likely exacerbated by the conflict (Kruk *et al*., 2011; Hadfield *et al*., 1985) [19, 25].

This study looked at government self-reliance, trends, and changes in health financing and forecasted future spending, despite the wide range and numerous sources that drive the health spending agenda to achieve universal health coverage and improve health outcomes.

Material and Methods

In order to find patterns, forecast future results, and guide decision-making, the study used health system trend analysis, which makes use of both historical and current data (Ingram *et al*., 2018) [26]. The study was able to anticipate changes and make proactive decisions regarding health spending by using historical data on the country's health system to identify trends and forecast the future.

Data Collection and Analysis

From 2000 to 2024, internal government (Ministry of Finance and Development Planning and Ministry of Health, 2000-2025) open-access health financing data were gathered from fiscal year budgets. To ascertain the degree of independence of health system spending, information on supplemental health financing provided by non-governmental organizations was not included. Data on health financing were also gathered from policy documents, demographic and health surveys (LISGIS, 2019), and government fiscal year budgets. Data from the government health system, such as life expectancy, maternal mortality, under-five mortality, per capita spending, and spending on preventive and curative programs.

In order to forecast per capita spending, the study used multiple linear regression, considering life expectancy, maternal mortality, under-five mortality, and spending on preventive and curative programs. Regression analysis was used as a statistical control to estimate relationships and account for variables that complicate the cause-and-effect relationship, as well as to account for country-specific confounders (Arkes, 2023) [30].

To ascertain Liberia's per capita health spending over time, trend analysis was done. For a ten-year forecast, regression is helpful. Seasonality was taken into consideration in the analysis, which included weather events, outbreaks, and peaks and valleys in the pattern of health utilization. Regression and trend analysis were performed using Excel ToolPak. According to Andrade (2019) [31], a 0.05 P value was employed as "a cut-off that indicates statistical significance."

Ethical Consideration

Data collected from an existing open-access government annual budget. Only necessary health spending data on curative and preventive health services were collected, avoiding the collection of excessive and irrelevant information. The research did not require ethical approval because it did not involve interaction or intervention with participants.

Results

Multiple linear regression and trend analysis were used to examine health spending data from 2000 to 2024. Per capita spending was predicted using a multiple linear regression model that included life expectancy, maternal mortality, under-five mortality, and spending on curative and preventive programs. A 10-year health spending forecast was determined through a trend analysis. Adjusted R2 = 0.9256 from the multiple linear regression shows that per capita health expenditure accounts for 93% of the variation in preventive and curative spending. The model appears to fit the data because the p-values are less than the 0.05 cutoff. Regardless of personal or governmental income levels, autonomous per capita health spending is 6.87 (Rocha *et al*., 2016) [34].

According to the coefficient of 5.21, the average amount spent on preventive health programs is expected to rise by $5.21 for every $100 increase in per capita spending. With a coefficient of 2.83, the average spending on curative health programs is expected to rise by $2.83 for every $100 increase in per capita spending. A statistically significant difference from 0 is indicated by the coefficients of 54.23, 5.21, and 2.83 being greater than their respective standard errors. The coefficients are statistically significant, and the p-values are less than 0.05. 95% of the time, the real underlying values of the slope fall between 0.12 and 1.2, and the real underlying values of the interception fall between 50.3 and 58.1. Likewise, the 0.0002 p-value life expectancy versus 0.001 p-value under-five and 0.013 p-value maternal mortality demonstrate a strong relationship with per capita health spending and the health status within these populations, Table 1.

Table 1: Preventive/Curative/Life Expectancy/Under-five, and Maternal Mortality Predicting Per Capita Spending

Indicator	Coefficient	SE	t Stats.	P value	Lowe 95%	Upper 95%
Intercept	6.8670	2.3045	2.979874	0.0027	50.330	58.143
Preventive	5.209	5.1708	0.10056	0.0009	0.1070	1.1307
Curative	2.8308	4.3708	0.64744	0.0144	0.3080	1.1907
Life Expect.	1.2125	0.2595	4.67303	0.0002	.66517	1.7599
Under-Five Mort.	0.0590	0.1544	3.82354	0.0010	0.0250	0.0929
Maternal Mort.	4.7907	1.7894	2.67738	0.013	0.9769	8.6034

This graph shows the trend in spending on curative and preventive health services from 2000 to 2024, with a 10-year spending forecast. The forecast shows upper and lower bounds at 95% CI and is displayed by thick and thin orange lines. By 2036, Liberia's per capita health spending is expected to reach $146.76, with a lower bound of $111.68 and an upper bound of $181.88, if it continues at its current rate of growth as shown in Figure 1.

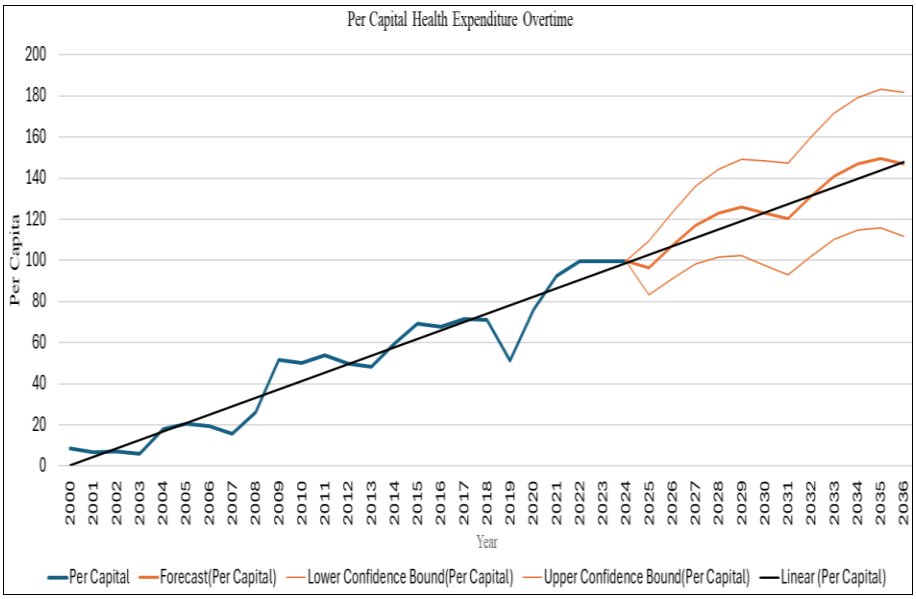

Fig 1: Per Capita Health Spending (USD) Over Time and Forecast

The graph shows the trend over time for curative and preventive health spending. As indicated in the graph, spending on curative services increased significantly between 2000 and 2024, while spending on preventive services shows slow growth. This finding indicates that the health system prioritizes and allocates more funds to programs that promote curative rather than preventive services. Figure 2 illustrates a disproportionate health policy spending decision.

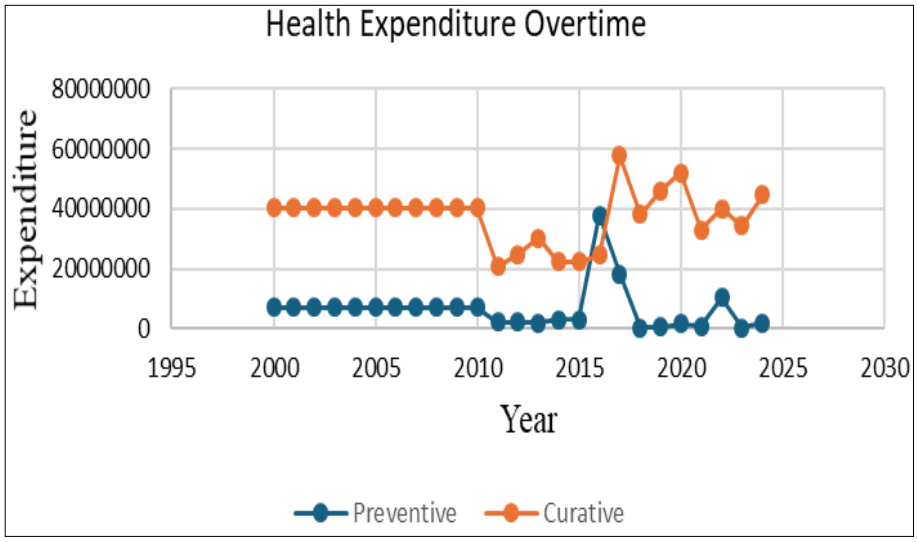

Fig 2: Health Spending Over Time on Preventive and Curative Services

Discussion

With the exception of supplemental spending by non-governmental organizations (NGOs), this study examined data taken from the Liberian government's health spending budget on curative and preventive health services. The trend analysis displayed Liberia's health spending, and the regression analysis considered the connections between maternal, under-five, and preventive and curative health spending. This analysis shed important light on the performance of the health system as well as current variations and challenges.

The disparity between preventive and curative services in Liberia's health spending policy has widened over time, with a stronger emphasis on curative services. A few years ago, the Ministry of Health was forced to assess health indicators more frequently due to the civil crisis and disease outbreaks like COVID-19 and the Ebola virus. The budget for preventive health services is even smaller, despite data showing health indicators of health system performance. According to this study, Liberia spent significantly less on preventive health services when comparing the total amount spent on curative and preventive services across national budgets over time.

Donors are now more weighted on preventive health services as a result of rising spending on curative services. The prevalence of avoidable illnesses, which overburden the healthcare system with unintended health consequences, is a clear indication of this risk strategy. For instance, 52% of health services spending in the 2017–2018 fiscal year budget went toward curative services, while 1% went toward public health. As of right now, the 2025 health budget shows no discernible increase in spending on preventive health services, which account for 5% of total spending, and curative services, which account for 58.7%. These results show that Liberia's transcription was reversed, with a greater focus on preventive health services like Southeastern Regional Primary Healthcare (SRPHP) in the 1970s and 1980s. By allocating sufficient funds for primary healthcare, the SRPHP sought to lower mortality and morbidity (Chieh-John *et al*., 1986) [32]. The change was planned but halted during the civil war and has not yet been implemented.

Liberia is heavily dependent on donors without optimizing and fairly allocating its internal resources in anticipation of donor burnout, even though donor pooling into health spending is relevant to financing the health system. A health system in free fall with significant variability in unfavorable health outcomes is one that primarily depends on donor support without optimizing and equitably allocating its resources toward health and healthcare. The health spending policy is still on a very slow trend to increase spending on preventive health services, even though the Ministry of Health continues to report that preventable diseases like respiratory infections, diarrheal illnesses, and malaria are major contributors to the population's disease burden. Malaria is the primary cause of hospitalized patient deaths and outpatient visits, according to WHO (2023d) [33] statistics. According to WHO data, there were 3,578 fatalities, 1.9 million cases, and 5.1 million people at risk in 2022. Although Liberia's health spending policy places more emphasis on curative services, the trend also raises public health concerns.

Inadequate investment in preventive health will fetter the ability of the government-run preventive disease programs to drive maternal and child morbidity and mortality to acceptable international levels and improve life expectancy. Access to curative care, such as CT/MRI imaging and therapy, surgery, and management of non-communicable diseases, in contrast, is still limited and is often paid for as out-of-pocket payments that are deferred by donor projects or by care in other countries. This development uncovers health coverage gaps and investment challenges originating from structural obstacles related, among others, to donor dependence, lack of decentralization of the management of the margin of urban and rural health systems, or to entrenched corruption.

Those efforts to promote the multidisciplinary, intersectoral approach to health policy analysis emphasize health equity, capability-building, and sustainable financing to enhance the system by supporting randomized research studies. Effective financing for community-led health needs to focus on sustained financing mechanisms that ensure that government investment in health and healthcare as a share of GDP is increasing. In the same way, new models of care delivery, such as the integration of community health workers in primary care, the delivery of health education and communication via mobile technology, and other such innovations, are essential in creating access to care and improving health outcomes. Invest in contemporary health technology and extend digital health management data across all county health systems.

The health system must, however, efficiently provide a wider range of medical services, such as palliative, curative, preventive, and rehabilitation care, in all of the nation's geographical areas. Improving the socioeconomic determinants of health should be prioritized in addition to using health services. According to a study, increasing health coverage through public funding for medical expenses reduces mortality (Moreno-Serra and Smith, 2012) [36]. Furthermore, to enhance the delivery of health services, a consistent combination of the WHO's (2007) [35] health system building blocks—leadership and governance, health information systems, health workforce, financing, medical products, vaccines, and technology—is necessary.

In order to guarantee timely and appropriate care across health settings, continuity of care in the health system is essential and calls for a more comprehensive approach. While accounting for improper use of health services, including discrimination, overprescription of antibiotics and other medications, medical products, overcharging for inappropriate services, emergency service misuse, and medical record falsification, these inputs increase demand for services. Health workers should receive proper training in clinical specialty areas, receive timely and adequate compensation, and have a better-skilled-mix distribution throughout the nation.

Table 3: Implications for Public Health Practice

Indicators	Implications	Actions for Practitioners
Reallocation of health expenditure	Government health spending budget is heavily skewed towards curative services (58.7%) compared with preventive services (4.4%)	Advocate for funds to strengthen preventive services. Develop a health benefit analysis for long-term health savings and preventive health services gains.
Focus on maternal and child health	Slow progress towards improving life expectancy and high maternal/infant mortality linked to health spending.	Prioritize preventive interventions (e.g., maternal literacy, prenatal care, skilled birth attendants, and neonatal care.
Use of data and forecasting for planning	Health spending projection to rise by $146.76 per capita by 2036	Utilize trend analysis and forecasting to plan resource allocation, workforce training, and infrastructure development. Preparation for increased health demand as health spending grows
Policy advocacy for balancing health spending	Current health spending may not optimally increase health outcomes	Stakeholder engagement for a more balanced approach between curative and preventive services.
Strengthening health	Findings based on government health	Improve data collection from all funding sources (e.g.,

information system	expenditure data, excluding external funding	donor funds, private spending). Increase monitoring and evaluation to track the impact of health spending on health outcomes
Capacity building and training	Increase in health spending, as projected, necessitates health system readiness to absorb and utilize funds effectively	Invest in training health workers, especially in preventive and community health roles. Build leadership, management, and governance capacity for budget execution and accountability
Emphasis on equity and access	Increased per capita spending should translate to better access and reduce disparity	Make sure new investment targets underserved populations and rural areas

Table 3 shows implications for public health practitioners and public health practice. Although these implications are complementary, the key implication requires that national stakeholders should strategically reallocate future spending growth towards preventive and primary care. Despite strengthening data systems and capacity building being supportive public health actions, the central and transformative action is future budg*et al*locations are spent. Moreover, the choice to invest in preventive services is significant to reduce the poor health outcomes that are linked to Liberia's current health financing model.

Moreover, the projected increase in health spending is a window of opportunity. If used to double down on the inefficient curative model, it will yield minimal health gains at a high cost. However, if strategically directed toward building a preventive, primary-care-oriented system, it has the potential to significantly improve the health and well-being of the population and create a more sustainable and effective health system for the long term.

Limitations

Since it takes into consideration additional factors that may affect per capita spending, such as the availability of health services, income inequality, lifestyle, health capacity, and the structure of the health system, it is essential to adjust for country-specific factors when making international comparisons. Due to the unavailability or inconsistency of data from various sources, data before 2000 were excluded from the historical trend. Due to the limited availability of health insurance opportunities for the general population, which is primarily employment-based, the study was unable to account for seasonality associated with insurance cycles.

Conclusion

With the exception of NGOs' supplementary spending, Liberia's health spending policy has been insensitive over time because it has not significantly reduced the burden of diseases or made the right decisions regarding preventive health financing. Similarly, there is consistency in unidimensional growth in spending on curative services because randomized health policy spending studies are extremely rare in Liberia. This permeates a complex historical context but promising prospects for adjusting disproportionate spending on curative and preventive services. Reducing the disproportion in per capita spending on preventive and curative services through policy reforms and concerted efforts can improve health outcomes and decrease morbidity and mortality rates.

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