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Impact of Capital Health Expenditure on Infant-Maternal Mortality in Nigeria

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Abstract

Government capital spending on healthcare and infant-maternal mortality are important indices to measure development. This study seeks to examine the relationship between capital health expenditure and infant-maternal mortality ratio (IMMR) by adopting the Grossman (1972) theoretical framework. It relied on the Autoregressive Distributed Lag (ARDL) technique using WDI data from 1980 to 2017. The impact of capital health expenditure (CHE) on IMMR is mixed in the short and long run. Also, the error correction model shows that it will take 23 years to reduce IMMR to its minimum. Thus, the study recommends that public-private-partnership targeted at increasing capital health spending would reduce the IMMR in tandem with the sustainable development goals.

Keywords

Infant-Maternal Mortality Ratio, Capital Health Expenditure, Autoregressive Distributed Lagged Model (ARDL), Nigeria

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1. Introduction

Fiscal financing is an important aspect of government obligation focused at providing a conducive policy environment for the citizenry. Here, the government expenditure is targeted at social investments, infrastructural investments and recurrent expenditures. Interestingly, the health sector is a pertinent segment which attracts funding through government spending in order to achieve general optimal health status. This is a crucial prerequisite to ensuring healthy and productive workforce, stimulation of productivity and growth in all sectors of the economy and attainment of the sustainable development goals. Unarguably, there exist paucity of government revenue to adequately fund the health care sector. However, in this era of limited national budgets and pressing health challenges, there is indeed a need to increase the flow of public spending towards achieving better health outcomes which is a global concern. This is because infant-maternal mortality is a fundamental development challenge especially in low and middle-income countries (Abdelhafidh, 2018; McCullough, 2019).

The above notwithstanding, Troiano and Witcher (2018) reiterates that maternal mortality can be defined as the death of a woman resulting from pregnancy or within 42 days after the termination of the pregnancy. Infant mortality on the other hand refers to the death of very young children under the age one per 1000 live births. In another dimension, theories are very important in aiding the understanding of relationships between economic phenomena. For instance, the Life cycle hypothesis opines that it is through the health status transmission pathway that the individuals` future earnings, savings and consumption patterns could be secured (Ilori *et al.,* 2017). Thus, the issue of health care cannot be overemphasized. Given the above hypothesis, the Keynesian theory summits that the value of government expenditure directed towards health care will determine infant-maternal mortality rates. In Musgrave and Musgrave (1973), Wagner`s theory posits that the severity of infant-maternal mortality rate within an economy would determine the value of government health expenditure channeled towards the provision of health care services. The weakness of this theory is that the effect will determine the cause.

Owing from the above, the relationship between public health spending and infant-maternal mortality is assumed to be negative, and is pitched on the argument that as government spends more on the provision of health infrastructure and recruitment of personnel into the business of health care service delivery; the lower the rates of mortality (Kim and Lane, 2013; Shetty and Shetty, 2014; Nwankwo, 2018). On the flipside, Ogbuagu *et al.* (2017) posits that the capital component of public spending on health have more significant impact than the recurrent component. In trying to examine the relationship between public health spending and infant mortality; some studies discovered that public health spending has positive impact on infant mortality (Yaqub *et al*., 2013; Meroyi, 2018). Furthermore, studies such as Edeme *et al.,* (2017) claims that health outcomes and public spending on health have a long run relationship.

According to UNICEF (2017), approximately ten percent of infant deaths occurred in Nigeria in 2016. Here, Nigeria recorded a whopping 9 percent of the world`s infant death and as such ranked third on a list of five countries accounting for half of all new-born deaths. The other four countries on the list includes: India (24 percent), Pakistan (10 percent), the Democratic Republic of the Congo (4 percent) and Ethiopia (3 percent). Similarly, UNICEF (2016) posits that Nigeria is the highest contributor to maternal mortality in Central and Western Africa and contributes 14% to the global maternal mortality rate. This implies that one maternal death is recorded out of thirteen births. Earlier, the statistics on infant mortality was not any better. The World Health Organization (2015) reports as cited in Dhrifi (2018) posits that an estimated 80% of global deaths among children under the age of five occurred in sub-Saharan Africa and southern Asia; with Nigeria ranked second behind India contributing approximately half of global infant mortality in 2008. Heretofore, India and Nigeria contributed jointly more than a third of under-five deaths in 2013. Comparatively, government capital health spending as a percentage of the budget was 4.16%, 4.23% and 3.90% in 2016, 2017 and 2018 respectively. First, the trend above shows how severe the problem of infant-maternal mortality rate is in Nigeria and second, between 2016 and 2017 health spending witnessed 1.70% increment, while it plummeted by 7.80% between 2017 and 2018. This is despite the plea for an increased allocation to the health sector and the poor ranking recorded by Nigeria among the committee of nations.

The study therefore strives to present infant-maternal mortality ratio as a more effective panacea to measure health outcomes in Nigeria. This is achieved by introducing the infant-maternal mortality ratio as a control variable into the Grossman (1970) theoretical framework and applying the autoregressive distributive lag (ARDL) technique on time series data between 1980 and 2017. More so, the study targets capital components on health spending because of the argument that the recurrent component of health spending is usually insignificant (Ogbuagu *et al.,* 2017).

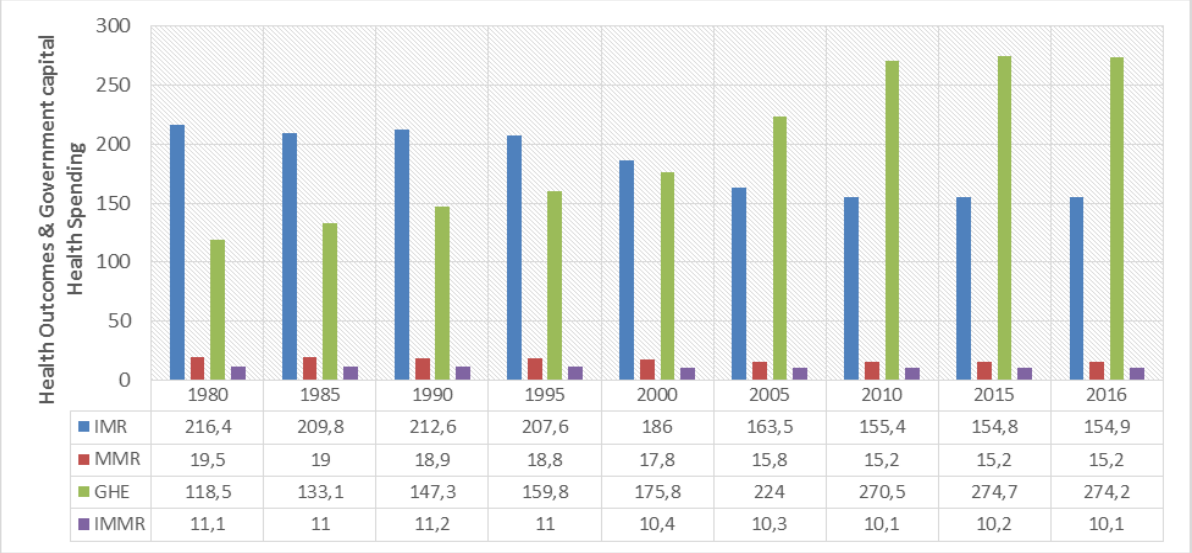
2. Literature review

2.1. Stylised facts of public health spending and infant-maternal mortality rate

Data from the World Development Indicators (WDI) 2018 shows that public capital spending on health increased from 118.5 million dollars to 133.1 million dollars from 1980 to 1985. Similarly, government expenditure on health continued the positive move in 1990, 1995 and 2000 at 147.3 million dollars, 159.8 million dollars and 175.8 million dollars respectively. In the same vein, 2005 experienced a more significant increase up to 224 million US dollars. This sharp upward movement in government health spending continued in 2010 at 270.5M USD. However, health spending eased at 274.7M USD and 274.2M USD in 2015 and 2016 respectively. Probing the public health spending, it could be argued that this increment was as a result of the boom in the oil sector. Also, it might be as a result of the initial plan to attain the millennium development goals (MDGs); and later an attempt to quickly log into the sustainable development goals (SDGs) programme with 2030 as the target. Most significantly, those economies that performed poorly in the MDGs programme in terms of infant-maternal mortality are working very hard to meet up with the former; as this is perceived as a measure of development. Contrary to the above, the infant mortality rate per 1000 live births in 1980, 1985, 1990, and 1995 was at 216.4 per 1000, 209.8 per 1000, 212.6 per 1000 and 186 per 1000 respectively. This is in exception to the value of infant mortality in 1990 which rather increased to 212.6 per 1000. However, year 2010, 2015 and 2016 maintained a stable decrease at a corresponding 155.4, 154.8 and 154.9 per 1000 live births. This improvement in infant mortality is not proportion to the increase in government health spending. Unfortunately, the value of maternal mortality stagnated at 19.5 per 1000 pregnant women and 15.2 per 1000 pregnant women in 1980 and 2016 making an interval of 36 years. Lastly, the infant-maternal mortality ratio index fell only slightly from 11.1 to 10.1 from 1980 to 2016. Evidently, the trends of these health outcomes explain the level of decay in the health care system because infant-maternal mortality not improved fairly compared to increment in health spending using data set between 1979 to 2016 (Figure 1).

2.2. Conceptual review

Public health expenditure consists of recurrent and capital spending from government budgets at all levels, external borrowings, grants and social health insurance funds. This consists of public and private health services with a small token financing from donors and non-governmental organizations (NGOs) (Ilori *et al*., 2017)). Also, Public health care expenditure is funded through general tax revenue while the private health care system is owned, financed and managed by private investors (Bidzha *et al.,* 2017). It could therefore be defined based on their primary purpose which includes: improvement in health and well-being, family planning, dietary and nutrition and provision of emergency aid. On the other hand, while healthcare consumption represents investment in health at the individual level, provision of healthcare infrastructure and improvement in healthcare infrastructure including healthcare personnel all constitute health investment (Edeme *et al.,* 2017).



	1980	1985	1990	1995	2000	2005	2010	2015	2016
IMR	216,4	209,8	212,6	207,6	186	163,5	155,4	154,8	154,9
MMR	19,5	19	18,9	18,8	17,8	15,8	15,2	15,2	15,2
GHE	118,5	133,1	147,3	159,8	175,8	224	270,5	274,7	274,2
IMMR	11,1	11	11,2	11	10,4	10,3	10,1	10,2	10,1

Figure 1. Chart of Government Spending on Health and Health Outcomes in Nigeria

Source: World Development Indicator, 2018.

Within the production function framework, healthcare is considered one of the several inputs in the health production function. Drawing from the above, healthcare is seen as input in the production of good health such as low infant-maternal mortality and higher life expectancy to mention only but a few. Here, healthcare is not only considered an input for production, but rather a tool towards the attainment of general and human capital development; through better health status which will result in lesser absence from work and reduces disease burden which translates into low economic cost in terms of providing health services. Thus, healthcare is considered an input in production. Regardless of the approach used, healthcare spending is one of the means for individuals to improve their health status (Shetty and Shetty, 2014).

Given the foregoing, Nurudeen and Usman (2010) opines that there are three crucial controversies which include: i) In the business of health delivery, between the private and public health care system which is expanding faster? ii) Is it the health status that causes increment in government health expenditure or government health spending that causes improvement in health outcomes? iii) What component of public spending on health impact the most on health outcome? More significantly, this study adopts the definition of infant mortality as under one-year deaths per thousand life births. Unlike Dhrifi (2018) whose study measures child mortality. Lastly, the issue of infant-maternal mortality is very crucial on the agenda of the United Nations (UN), African Union (AU), European Union (EU) and the World Health Organization (WHO) to mention but a few. For instance, these issues have well-defined targets, goals and indicators in the UN Sustainable Development Goals (SDGs) and the defunct Millennium Development Goals (MDGs).

2.3. Empirical and methodological review

Research in the health and fiscal economics has been intense. This is evident in the review of empirics. For instance, Ilori *et al.* (2017) relies on autoregressive distributive lag (ARDL) technique to examine the public health spending-life expectancy relation between 1980 and 2015; found cointegrate in the long run. On the other hand, in the case of Olarinde & Bello (2014), the ARDL and vector error correction model (VECM) were employed to examine the effect of health spending on health outcomes in Nigeria. Their results showed presence of causality between the variables. Using a broader scope, Shetty and Shetty (2014) tried to examine the correlation between health spending and infant mortality rate using the descriptive and correlation regression coefficient in 34 Asian countries. The study concluded that infant mortality in Afghanistan is higher because it has experienced a prolonged unrest as a result of terrorism; while in Qatar it is higher because hitherto enjoys huge revenue racked in from the sales of crude oil. On a different perspective, Nwankwo (2018) attempts to establish the relationship between fiscal health spending and maternal mortality in Nigeria using panel data of about 25 states from 2003 to 2015. Using the panel autoregressive distributed lagged model (PARDL), they concluded that public health spending is a crucial tool towards attaining the SDGs.

Furthermore, Kim and Lane (2013) strive to evaluate the impact of the United States health care reform using 17 OECD countries between 1973 and 2000 using the mixed-effect model. Their result shows that health spending has a positive impact on life expectancy. However, the fiscal spending exhibited a rather negative impact on infant mortality rate. The study concluded that a judicial utilization of the public health spending targeted at providing medical care would surely

improve the state of the health system. Dhrifi (2018), using the three-stage least square to examine the relationship between public health spending, growth and infant mortality using evidences from both developed and developing countries, they concluded that in more developed countries private health spending exerted more positive effect compared to the developing economies where public health spending impacts more on infant mortality rate.

Edeme *et al.* (2017) examined the impact of public health spending on health outcomes in Nigeria utilizing the ordinary least square (OLS) technique. The study discovered that positive relationship exists between health spending and life expectancy in Nigeria. Heretofore, in an attempt to examine the relationship between government spending on health and health sector performance, Muftadeen and Bello (2014) adopted the ARDL, vector error correction model (VECM) and Granger causality estimation techniques. Here, they found that the lagged value of infant mortality positively impacted on its current value. Ogbuagu *et al.* (2017) focused on the relationship between health spending and life expectancy in Nigeria using both OLS and ARDL models built on the Grossman (1972) theoretical framework. They concluded that in the disaggregated model, the impact of capital spending on life expectancy is more significant than that of recurrent spending on health. Eneji *et al.* (2013) examining the nexus between health care expenditure, health status and national production in Nigeria, adopted the OLS technique of analysis and discovered that public health spending becomes effective only through national investment, human capital development and technology. The above notwithstanding, Meroyi (2018) relying on the two-stage least square method, the study discovered that per capital income and educational attainment have significant impact on infant mortality. In the case of Bhalotra *et al.* (2018), the study examined the impact of political participation on maternal mortality using the two-stage least square (2SLS) methods and discovered that political participation reduces maternal mortality. Lastly, Yaqub *et al.* (2013) focused on impact of governance and public health spending on health outcomes in Nigeria using the OLS and 2SLS methods. The study concluded that infant and maternal mortality have positive relationship with public spending on health.

2.4. Gap in the empirical literature

First, this brief review of literature shows clearly that empirical studies conducted in both developing and less developed countries on governing health spending and health outcomes did very little at examining the infant-maternal mortality and capital health spending relation. Second, the study seeks to promote the proposition that infant-maternal mortality ratio is a better index to proxy health outcomes. In addition, the study strongly focused on capital expenditure and infant-maternal mortality which other studies have neglected to the best of our knowledge.

3. Theoretical framework

The theoretical base of this study is adopted from Grossman (1972) who developed a theoretical health production function, which is specified as:

$$H = F(X) \quad (1)$$

Where H is a measure of individual health output and X is a vector of individual inputs to the health production function F. The elements of the vector include: literacy rate, government health expenditure, numbers of medical physicians, real per capita income and female labor participation. To capture both the consumption and investment aspects of health inputs, the demand for health by an individual is analyzed via the utility optimization framework. This is represented in equation as:

$$H_t = \beta X_t + \varepsilon_t,\ t = 1 \ldots T \quad (2)$$

Where H_t is the explained variable (Health Status), X_t is a vector of explanatory variables which can determine the health outcomes, t is the time series, β represent the coefficient of the vector of explanatory variables and ε_t is the random variable with zero mean and constant variance. Introducing other variables into the equation II, the resultant functional model is specified as:

$$IMMR = F\ (CHE, FLPR, RPCI, EDU) \quad (3)$$

Applying transformation to the equation III, the resultant econometric equation is specified as represented:

$$IMMR_t = \beta_0 + \beta_1\ CHE_t + \beta_2 FLPR_t + \beta_3\ RPCI_t + \beta_4\ EDU_t + \varepsilon_t \quad (4)$$

Where IMMR is the infant-maternal mortality rate, FLFR is the female labour participation rate, RPCI is the real per capita income, EDU stands for level of education (secondary school enrolment).

3.1. Sources of data

The study utilized mainly secondary data sourced from the World Bank World Development Indicators (WDI) 2017 from 1980 to 2017.

3.2. Technique for analysis

The estimation technique for analysis in the study adopted the autoregressive distributed lag (ARDL) model (Pesaran and Shin, 2001). Studies such as Ilori *et al*. (2017) and Olarinde and Bello (2014) have adopted the ARDL technique to achieve their objectives which is mainly to ascertain the short and long run coefficients; since the variables were integrated of order one and zero. Re-specification of equation IV into an ARDL model, the resultant equation is

$$IMMR_t = \beta_0 + \sum_{i=1}^{h} \beta_1 IMMR_{t-i} + \sum_{i=1}^{h} \beta_2 GHE_{t-i} + \sum_{i=1}^{h} \beta_3 FLPR_{t-i} + \sum_{i=1}^{h} \beta_4 EDU_{t-i} + \beta_5 InIMMR_{t-1} + \beta_6 InGHE_{t-1} + \beta_7 InFLPR_{t-1} + \beta_8 InEDU_{t-1} + \varepsilon_t \quad (5)$$

From equation IV, where i represents the lag value and it ranges from 1 to 2. Note that β_0 is the intersect, the first part of the equation represents the short run coefficients while the second part of the equation are the long run coefficients. The a priori expectation include: $\beta_1 > 0$, $\beta 2 < 0$, $\beta_3 < 0$, $\beta_4 < 0$. Note that the value of β_1 determines the error correction mechanism (ECM) or the speed of adjustment.

4. Analysis and discussion of results

In order to achieve the above, the study conducted descriptive statistics; units root tests, ARDL bounds test, short-run and long-run ARDL regression. In addition to the above, diagnostics were observed from the results and interpretations provided. Lastly, the major finding arising from the results were highlighted.

Table 1. Descriptive Statistics

	Mean	Maximum	Minimum	Std. Dev.	Sum	Observations
IMMR	1.007897	1.076265	0.987860	0.020555	37.29220	37
CHE	52.43807	237.0800	0.041315	77.04911	1940.209	37
FLPR	45.25811	50.36000	36.70000	5.006075	1674.550	37
EDU	95.38522	119.3699	78.45744	10.38536	3529.253	37
PCI	252119.1	385227.6	173011.9	71227.57	9328405	37

Source: Author's Computations (2019)

The table I above exhibits the descriptive statistics for the variables which appeared in the equation III. Here, the mean value of infant-maternal mortality ratio (IMMR) is 1.01; the maximum value is 1.08; while the minimum value is 0.99. Here, it is obvious that infant mortality has more intensity than maternal mortality in Nigeria. In addition to the above, the mean of the public capital health spending is 52.43 billion naira; while the maximum and minimum values are 237.08 and 0.04 billion naira respectively. Furthermore, the mean value of public health spending at 52.44 billion is very small compared to the amounted channel to health spending in the industrialized countries. Undoubtedly, the data on WDI 2018 shows that on the average, less than 4.5% of the GDP is spent on health care. To worsen the case, over 70% of public health budget is channeled to running and personnel costs.

Probing the table II, the unit roots test shows that IMMR, government health expenditure (GHE), female labour participation rate (FLPR) and per capita income (PCI) are integrated of order one (I (1)) and zero (I (0)) at one percent and five percent levels.

Table 2. Unit Roots Test (Augmented Dickey-Fuller)

Variables	Coefficient	t-stats	Probability Value	Level of Integration
IMMR	-1.1018***	-5.3231	0.0001	I (1)
CHE	-1.1912***	-6.8980	0.0000	I (1)
EDU	-0.2415**	-2.6295	0.0968	I (0)
FLPR	-1.0578***	-6.0828	0.0000	I (1)
PCI	-0.7282***	-4.8981	0.0000	I (1)

Source: Author's Computations (2019)

***, * represents 1% and 5% significance

Since it has been proven that the variables are integrated of order one (I (1)) and zero ((0)), it is important for the study to ascertain whether or not the variables have a long run relationship (cointegration). The ARDL bounds test result in table III below shows that the variables have a long run relationship since the upper critical value bounds (5.06) is less than the F-statistics at 12.44. This result is in credence with the works of Ilori *et al.* (2017), Edema *et al.* (2017) (Table 3).

Table 3. ARDL Bounds Test Result (Cointegration Test)

Null Hypothesis: No long-run relationships exist		
Test Statistic	***Value***	***K***
F-statistic	12.44499	4
Critical Value Bounds		
Significance	***I (0) Bound***	***I (1) Bound***
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

Source: Author`s Computation (2019)

Drawing from the above, the researcher estimates the short-run and long-run ARDL regression. This is presented in Table 4.

Table 4. Auto Regressive Distributive Lag (ARDL) Result (Dependent Variable: IMMR)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (IMMR (-1))	2.832288***	0.621513	4.557089	0.0019
D (IMMR (-2))	2.823028***	0.584870	4.826763	0.0013
D(CHE)	0.000144	0.000228	0.631208	0.5455
D (CHE (-1))	0.001898***	0.000370	5.135816	0.0009
D(FLPR)	0.002991	0.001701	1.757829	0.1168
D (FLPR (-1))	-0.001006	0.001300	-0.773953	0.4612
D(EDU)	-0.001719**	0.000627	-2.741992	0.0254
D (EDU (-1))	-0.000636	0.000939	-0.677329	0.5173
D(PCI)	0.000001**	0.000000	2.782634	0.0238
D (PCI (-1))	-0.000000	0.000000	-1.025616	0.3351
CointEq (-1)	-0.043721***	0.792443	-5.517253	0.0006
CHE	-0.000386***	0.000039	-9.851937	0.0000
FLPR	0.001016**	0.000386	2.632649	0.0301
EDU	0.000216	0.000215	1.005739	0.3440
PCI	0.000000***	0.000000	9.685454	0.0000
C	0.850217***	0.035454	23.980542	0.0000

Source: Author`s Computation (2019)

(***), (**), 1% and 5% Level of Significance

In addition to the above, Table 4 which exhibits the short run and long run coefficients of the independent variables on the dependent shows that first year lagged values of IMMR has a positive impact on current value of IMMR. This result is in tandem with the work of Muftadeen and Bello (2014). Here, a percentage increase in the first-year lag of IMMR will increase current value of IMMR by 2.83 percent holding other variables constant. This is because it takes some time lag to proffer solution to disease and epidemics and to fully implement new policies and methods.

Also, the impact of current year public health expenditure and its lagged values on IMMR is positive, but only the impact of the first is significant; which is similar to the results of Kim and Lane (2013). This might be as a result of the fact that a large proportion of the public health expenditure is spent on wages and salaries, stationeries, diesel and other consumables. More so, current and lagged values of FLPR have positive and negative impacts on IMMR respectively; though their impacts are significant. In addition, education (school enrolment) has a negative impact on IMMR. A percentage increase in educational attainment reduces IMMR by 0.0017percent, holding other variables constant. The above finding is in tandem with a priori expectations. Contrary to the above, a unit increase in PCI increases IMMR by 0.000001 units holding other variables constant. This result is in credence with Meroyi (2018) and Bidzha, Greyling and Mahabir (2017). The above results represent the short-run period.

Probing the results in table IV further, it is obvious that in the long-run period public health expenditure has a significant negative impact on IMMR. Here, a unit increase in public health spending reduces IMMR by approximately 0.0004 percent. Since the variables are cointegrated in the long-run, it is important to compute the speed of convergence. Here, it will take approximately 23 years for the gap in health spending and facilities to be filled in order to reach equilibrium. At equilibrium, infant-maternal mortality ratio (IMMR) would have reduced below two-third and three-quarter of their current levels respectively. Drawing from the above, workable recommendations would be tactically drafted from the results and interpretation.

5. Conclusions and policy implications

This menace of high death rate in children between ages 0-5 should be taken seriously under the current United Nations Sustainable Development Goals (SDGs). Recall that Nigeria fell very much below the Millennium Development Goals (MDGs) targets which ended in 2015. Thus, deliberate efforts should be put in place such as the public-private-partnership (see Cutler et. al., 2019) targeted at reducing malaria, diarrhea, pneumonia, malnutrition and those communicable and non-communicable diseases which are the highest causes of infant-maternal mortality in Nigeria. Also, modern facilities required in meeting world class health care delivery which is usually absent or in short supply should be provided in order to meet up with the sustainable development goals (SDGs) targets on infant-maternal mortality rates. These are the reasons why currently most of the politicians and their families and other wealthy individuals prefer to seek health care services abroad, which in turn trigger off unfavourable balance of payment deficits. If this is the case, then the government`s efforts at achieving this crucial macroeconomic objective is frustrated.

More so, recent World Health Organization report ranked Nigeria at 187th out of 191st member states in terms of health system delivery (WHO 2015). Building on the above proposition, the government has to increase and monitor health spending in order to improve on the above health care (Dutton et. al., 2018). Reiterating the above, the regression results shows that given the current levels of spending, infant-maternal mortality will reach minimum in approximately 23 years. The implication of the above finding is that Nigeria as a nation would also miss the 2025 targets of reducing infant-maternal mortality rates by two-third and three-quarter respectively. In addition, the government should provide adequate essential and infrastructural facilities to attract private individuals and international agencies/donors into the business of providing health care services for the citizenry. Lastly, the government should increase and monitor the implementation of capital health expenditure so as to shorten the period of convergence towards achieving minimum infant-maternal mortality ratio in Nigeria. This is the only pathway to attaining the SDGs goals and targets of improving the quality of life.

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