# THE EFFECT OF PUBLIC HEALTH INFRASTRUCTURE ON HEALTH OUTCOMES IN ECOWAS

**BY**

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**AN M.Sc. DISSERTATION SUBMITTED TO THE DEPARTMENT OF ECONOMICS, FACULTY OF THE SOCIAL SCIENCES, UNIVERSITY OF NIGERIA, NSUKKA**

**IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE (M.SC) DEGREE IN ECONOMICS**

**September, 2019**

# TITLE

# THE EFFECT OF PUBLIC HEALTH INFRASTRUCTURE ON HEALTH OUTCOMES IN ECOWAS

# APPROVAL

The research work titled: **"The Effect of Public Health Infrastructure on Health Outcomes in ECOWAS Countries"** with Registration Number **PG/MSC/16/80704**has followed due process and has been approved to have met the minimum requirement for the award of the Master of Science degree in Economics, University of Nigeria, Nsukka.

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## CERTIFICATION

This is to certify that**OWOEYE, OLUWAFEMI JOEL**, a post graduate student in the department of economics with Registration number **PG/MSC/16/80704** has satisfactorily completed the requirement for Master's degree in Economics. This work embodied in this project report is original and has not been submitted in part or in full for any other degree of this or to any other University.

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## DEDICATION

This work is dedicated to the almighty God, the source of all things and to the lovers of knowledge.

**ACKNOWLEDGEMENTS**

I must first give thanks to God Almighty, the source of wisdom. I will also like to acknowledge my late dad, Elder OlusanyaOwoeye. The seed you planted is germinating rapidly. My profound appreciation also goes to my mum, Mrs Felicia DaisiOwoeye for your prayer, support and care. I also want to appreciate my siblings, Oluwasegun, Oluwaremilekun, Oluwasanya and Oluwatobiloba. I want to give special appreciation to my beautiful and lovely wife, OwoeyeOluwaseyifunmi. Your strength, support and prayers for me and the family as yielded good fruit. Oluwanifemi Praise and Oluwasanya Peace, my amiable kids, the Lord will overshadow with wisdom, knowledge and understanding.

I am highly indebted to my Uncle, Dr. NiyiAsegbeloyin and his wonderful wife, MrsFunkeAsegbeloyin. Your support, advice, care and love towards me in Nsukka is unquantifiable. I pray that the Lord will grant you all your heart desire.

I use this opportunity to express my intense gratitude to my project supervisor, Dr. Emmanuel Nwosu for his guidance, support, encouragement, prompt response to mails and above all his constructive criticisms. Indeed, your efforts are valuable in making this work best of its kind. I pray that God will grant you your earnest heart desires.

Special thanks to my Daddy in the Lord and mentor in persons of Dr. & Dr. Mrs. Anthony Orji. Your teachings and disposition towards excellence are greatly appreciated. I equally want to extend my appreciation to my lecturers, Associate Professor Chukue Jude and Professor Maduame. I will also like appreciate my friendsMr. God's time O., Miss Ogo, and Mr Seyi.

I also appreciate my friends who have shown great concern for my career pursuits and have equally supported me morally and academically in persons of Mrs. Bimbo Akinwande, MrObasi Basil, Mr. Chinedu J. Ogbodo, Mr. Samuel Cosmos, Miss. Johnson Idongesit, Miss Peace, Mrs Jennifer Ukandu, Miss. Alisigwe Jennifer. I also appreciate all my members of the Redeemed Christian Church of God (City of Favour). I appreciate you all.

Owoeye Oluwafemi Joel

## ABSTRACT

This study examines the effect of healthcare infrastructure on health outcomes in ECOWAS with data from all member state. The countries used in the study include Nigeria, Ghana, Senegal, Mali, Benin, Niger, Cote D'Ivoire, Gambia, Guinea, Guinea Bissau, Burkina Faso, Sierra Leone, Carbo Verde, Togo, and Liberia. The data spanned from 1970 to 2017. Random Effect Model was used to analyze the first objective. Driscoll and Kraay Fixed Effect estimation technique were applied in the data analysis of second and third objectives. Pre-estimation and post estimation test were also carried out to ascertain the nature of the data and to examine the robustness of the regression result. The result indicated that physician and skilled birth workers have a significant effect on health outcomes. The result further shows that more health facilities and other amenities are also important determinants of health outcomes among member states. There is a need to improve the available healthcare infrastructureso as to reduce mortalities in the region.

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**List of Acronyms**

| | |
|---|---|
| OECD | Organization for Economic Cooperation and Development countries |
| CBF | Congressional Budget Office |
| LDCs | Less Developed Countries |
| GDP | Gross Domestic Product |
| GCC | Gulf Cooperation Council |
| WHO | World Health Organization |
| UNMDP | United Nation Millennium development Project |
| ECOWAS | Economic Community of West African State |
| BOP | Balance of Payment |
| IMO | International Organization for Migration |
| ILO | International Labour Organization |
| GMM | Generalized Method of Moment |
| BD | Brain Drain |
| GFCF | Gross Fixed Capital Formation |

| | |
|---|---|
| LF | Labour Force |
| PGR | Population Growth Rate |
| REX | Real Exchange Rate |
| INF | Inflation Rate |
| EDU | Education |
| RGDP | Real Gross Domestic Product |
| TO | Trade Openness |
| PCI | Per Capita Income |
| REM | Remittances |
| Ln | Logarithm |
| RE*ED | Remittances multiplied by Education |
| ADF | Augmented Dicky-Fuller |
| LLC | Levine-Lin-Chu test |
| IPS | Im-Persiaran-Shin |
| OLS | Ordinary Least Square |
| GLS | Generalized Least Square |
| CD | Cross-sectional Dependence |
| NMA | Nigerian Medical Association |
| MDCN | Medical and Dental Council of Nigeria |

# CHAPTER ONE

# INTRODUCTION

## 1.1 BACKGROUND OF THE STUDY

Good health is acknowledged as a fundamental right of every human being with access to timely, acceptable, and affordable health care of appropriate quality (WHO 20017). Available data from World Health Statistics (2017) show that notwithstanding the headway made over the years, major challenges remain in terms of reducing maternal and child mortality, improving nutrition, and gaining more ground in the battle against contagious diseases such as HIV/AIDS, tuberculosis (TB), malaria, neglected tropical diseases and hepatitis. In ECOWAS countries, weak health systems and insufficient infrastructure remain a hurdle to progress and result in deficiencies in access to service delivery for even the most basic health services. According to the World Health Organization (WHO), good health is a state of complete physical, mental and social wellbeing and not just an absence of disease or infirmity. Which implies that exposure to an unhealthy environment, stressful living and working conditions can cause ill health and thereby reducing the productivity of labour.

As a result of this, delivering adequate and equitable healthcare services requires the collective effort of the government, private sector and the citizens with the singular purpose of deploying all available resources and infrastructure for easy access and collective benefit. Fowler et al (2014) asserted that the assemblage of slight public health infrastructure, little levels of health literacy, inadequate care and disease avoidance and control resources, thickly inhabited areas, and a highly contagious and deadly viral infection have led to thousands of confirmed, apparent, or suspected cases of diseases.

Factsheet of Health Statistics for 2018 released by African Health Observatory (AHO) and World Health Organization (WHO) for Nigeria, Sierra Leone, Burkina Faso, Ghana, Gambia, and other ECOWAS countries with exception of Carbo Verde revealed insufficient progress level towards the attainment of universal health coverage (UHC). While the Gambia achieved just 36% progress, Burkina Faso made 34% progress while Nigeria was 2% better than Sierra Leone that made 23% progress. The average progress attained in the UHC report in ECOWAS

countries was 32.7% in 2018. In a summary of Global Health Observatory (GHO) 2017, an average record for under-five mortality rate in African region was 74 per 1000 live births as against 9 per 1000 live births in the European region, revealing that under-five mortality rate is eight times greater than the rate in European countries. A report from WHO (2017) showed that about thirty-three percent of pregnant women did not receive antenatal care visits in the ECOWAS region. Likewise, UNICEF (2017) considered the high prevalence rate of tuberculosis which stood at 333 (per 1,000,000 population) unacceptably high.

In the work ofEttarh and Kimani (2014) in Kenya, it was discovered that women who live five kilometers or less from the nearest health facility were more likely to use skilled care at delivery than women living at a far distance. Information by Nigeria Demography and Health Survey (2013) discovered that 35% of pregnant women in Nigeria did not give birth at a health facility because of the far distance of health facility. Also in Ghana, the survey released by Ghana Demography and Health Survey (GDHS) in 2014 indicated that only 65% of births are delivered in a public health facility. Further review of the GDHS report revealed that there was a sharp drop in the percentage of women that received antenatal care from a skilled provider and those that delivered in a health facility. In Sierra Leone, (the country with the highest maternal death in the world), only fifty-four percent of births are delivered in a health facility (Sierra Leone Demography and Health Survey, 2013). Translating to 11% less to the number of women that give birth in a health center in Nigeria and Ghana.

WHO (2018) data showed that Guinea Bissau had more hospitals per 100,000 population than any other ECOWAS country. However, this does not transform to improve services as the country was still classified among countries that made insufficient progress in universal health coverage.

In Uganda, only 19% of homes in use enhanced sanitation as of 2015.Urban households are more expected than rural households to use improved sanitation (27% versus 16%) according to Uganda Demography and Health Survey (2016). Countries such as Australia and Cyprus recorded 100% performance in terms of drinking water and sanitation (UNICEF, 2017). United Nation (2018) while evaluating report on sustainable development goal stated that to make progress on sanitation and access to drinking water, there must be holistic investment in

controlling of freshwater ecosystems and sanitation facilities on a resident level in more than a few developing countries within South-Eastern Asia, Central Asia, Southern Asia, Eastern Asia and South-Eastern Asia, Sub-Saharan Africa.

Access to antenatal care by pregnant women is another important indicator of the state of the health care system in ECOWAS countries. Only 48 percent of women in Senegal received antenatal care (at least 4 visits) during pregnancy from 2004 to 2016. The figure was a little bit higher in Togo, Uganda, Gambia, and Liberia ranging from 57% to 78% (GHO, 2018). Developed countries such as France, Canada, and Iceland covered more ground as they recorded 99.5%, 98.9% and 97.7% individually (GHO, 2018). Report from World Health Statistics in 2018 revealed that these three countries spend more than 15.5% proportion of their total government expenditure on crucial services (health, education and social protection). This was however not the case in African as countries such as Liberia, Eritrea, and South Sudan expend less than 2.7% of total government expenses on needed services.

Another major concern of health care seekers in ECOWAS countries border on the payment and getting of essential drugs for treatment (SLDHS, 2013). The availability of essential medicine in Uganda, Sierra Leone, and Burkina Faso is not up to forty percent (Service Availability and Readiness Report, 2017). In a report conducted in Uganda which investigated vaccine stock-out in health, facilities showed that 42% of health facilities were shocking out of polio drugs while 16% of the surveyed health centers lacked measles drugs in the last six months preceding the survey. In Nigeria, a report by the National Health Facilities Survey (NHFS) showed that only 35.5% of the primary health facilities surveyed have oxytocin. The survey further stated that drugs like Magnesium sulfate (MgSO4) were only available in 8.8% of primary health centers nationwide. The report from NHFS through Nigeria Federal Ministry of Health discovered that drug availability across all the geographical zone in Nigeria was less than forty percent and the report further indicated that the availability of drugs in primary health facilities was 20% less than drugs available in secondary health facilities.

In 2015, close to 303,000 women die globally as a result of hitches before, during or after childbirth, translating to an alarming 830 women per day (WHO &UNICEF, 2017). More than half of the ninety-nine percent maternal death occurring in developing countries are in Africa. Sierra Leone, with 1360 maternal mortality ratio per 100 000 live births, has the worst recorded

cases of maternal mortality in the world, followed by the Central African Republic and Nigeria (UNICEF, UNFPA, WHO, UNPD, and World Bank Group, 2015). Cape Verde's maternal death ratio of 42 maternal mortality ratio per 100,000 live births was the least among amongst other ECOWAS countries of Sierra Leone (1360), Nigeria (814), the Gambia (706), and Burkina Faso (371). On the scale of life expectancy at births which average 72 years globally in 2016, none of these ECOWAS countries surpassed 72 years (GHO, 2016). The only country close to the world average was Cape Verde with 71.8 years for males and females. In addition, the tendency of a child dying before reaching the age of five is common in Africa (51 per 1000 live births), eight times higher what is obtainable in European countries (8 per live births).

As reported by USAID (2012), Sub-Saharan Africa has the highest infant mortality death rate (34 deaths per 1,000 live births in 2011), which accounts for 38 percent of global neonatal deaths.Additionally, the United Nations Millennium development Project (UNMDP, 2012) assessed that malaria caused the demise of more than one million kids' in Africa, amounting to 90% of the death caused by malaria globally. These death are preventable and treatable if needed infrastructure and timely intervention are made available.

A general overview of the healthcare system in most developing countries indicates that the healthcare coverage area has not been proactive as it should be. From WHO estimates, more than 90% of the projected 300–500 million malaria incidence that happens universally yearly are in Africans, mainly in children under five years of age. Of the 20 countries worst hit by maternal death globally, 19 of them are in Africa coupled with the fact that Africa has the highest neonatal death rate in the world. Non-transmittable diseases, such as heart disease, diabetes, hypertension, and are on the rise, invariably increasing sources of death in the region (WHO, 2018).

From the aforementioned reasons, it becomes imperative to ask questions such as what is the level of public healthcare infrastructure that would be essential for efficient healthcare service delivery. Does service obtained from healthcare infrastructure affect healthcare outcome, this is a pointer that this work is worthy to investigate.

## 1.2 STATEMENT OF PROBLEM

Many ECOWAS countries have suffered setbacks as result of high rate of maternal mortality rate, infant mortality rate, Under-five mortality and life expectancy due to prevailing poor state of health infrastructure in the region. It is expected that these indicators are prevalent due inadequate basic amenities, equipment, proper diagnosis, essential medicines and as ECOWAS countries are globally perceived to be poorly developing.

The United Nations during a conference in the year 2000 adopted Millennium Development Goals (MDG) to reduce child mortality, improve maternal health and combat HIV/AIDS, malaria, and various diseases among other goals. The final MDG report in 2015 revealed that remarkable ground was gained in the fight against HIV/AIDS, malaria and tuberculosis. Similarly, the under-five mortality rate has dropped by more than half, and maternal mortality is down to 45 percent worldwide with more to be done (United Nations Development Program, 2016). At the continental level, African countries agreed in 2001 in Abuja to earmark 15% of their national budgets to health. Available data from WHO (2018) showed that none of the ECOWAS countries has devoted up to 15 percent of their general expenditure to health care expenditure.

Also, the Addis-Ababa Declaration of 2006 which recognizes the connection between health, poverty alleviation, peace and security seeks African nation's commitment towards easy access to health care. There was also the 2008 Ouagadougou Declaration. Ouagadougou Declaration (which aimed to mobilize fund from donors to support family planning) partners the nine French-speaking countries in West Africa, the AgenceFrançaise de Développement, the Gates and Hewlett Foundations, USAID, the United Nations Fund for Population Assistance (UNFPA), the French Ministry of Foreign Affairs, West African Health Organization (WAHO) and others (USAID, 2019).

At the country level, several healthcare policies were introduced to address the challenges in the health sector. For instance, in Mali, Health Policy Project (HPP) was established to strengthen health policy, advocacy, and governance at the national level and selected districts for strategic, equitable, and viable health programming. Ditto for Nigeria, National Health Policy was put in place in 2016 to promoting the health of Nigerians towards accelerating socio-economic development. This situation is not different in other West African countries where policies were structured to promote health care services.

The factsheet of health statistics released in 2018 by AHO and WHO was however doubtful of the possibility of ECOWAS countries (with the exception of Cape Verde) in meeting the target of United Nations Sustainable Development Goals (SDGs) of 2030. The report showed that the level at which these countries were moving in the reduction of maternal mortality ratio, neonatal mortality rate, under-five mortality rate, TB incidence rate, and other healthcare outcomes are not good enough to meet the 2030 SDG target. For instance, the report projected that for 90% of pregnant women in Nigeria to receive health aid by skilled health workers during delivery, there must be an annual reduction of about 6.8%. Achieving these targets hinges on recognizing obstacles militating against adequate service delivery and tracing the lapses in order to proffer meaningful and lasting measures to help curb further deterioration and close the existing holes.

Some literature has examined the determinant of service delivered in health sectors in these countries but health outcomes still remained poor. Such work includes Yusuke (2010), Deon Filmer and Lant Pritchett (1997), Zeynep (2000), David et al (2008). While the work of Yaqub, Ojapinwa and Yusuff (2010), Aduralere (2015), Eneji, Juliana and Onabe (2013), Okezie el al (2016), Igbinedion (2016) focused on the impact of government healthcare expenditure on economic growth and health outcomes. The effect of user fee on access to healthcare services was examined by Riman and Akpan (2012) andIsaac B. Oluwatayo (2016). Omitogun (2014), Bockerman and Ilmakunnas' (2007) analysis shows the relationship between unemployment and healthcare services.

Therefore, the present study will focus on the impact of healthcare infrastructure on healthcare outcome in ECOWAS states. For these reasons, this study will be geared towards adding to knowledge by analyzing the important roles healthcare infrastructure could have on healthcare service so as to prevent the conditions leading to increase mortalities in ECOWAS countries.

## 1.3 RESEARCH QUESTIONS

This research posed the following questions which could act as a guide in understanding the effect of public healthcare infrastructure on healthcare outcomes within ECOWAS countries. They are as follows:

1. What is the effect of the density of health personnel on health outcomes in ECOWAS countries?
2. How does health facilities affect health outcomes in ECOWAS countries?
3. What is the effect of basic amenities on health outcomes in ECOWAS countries?

## 1.4 OBJECTIVES OF THE STUDY

The broad objective is to evaluate the effect of public health infrastructure on health outcomes in ECOWAS member countries. The specific objectives are:

1. To ascertain the impact of health personnel on healthcare outcomes in ECOWAS countries.
2. To verify the effect of health facilities on healthcare outcomes in ECOWAS countries.
3. To determine the effect of basic amenities on health outcomes in ECOWAS countries.

## 1.5 RESEARCH HYPOTHESIS

The research hypothesis is in accordance with the objectives of the study

Ho 1: Health personnel has no significant effect on health outcomes in ECOWAS Countries.

Ho 2: Healthcare facilities have no significant effect on health outcomes in ECOWAS Countries.

Ho 3: Basic amenities has no significant effect on health outcomes in ECOWAS Countries.

## 1.6 SIGNIFICANCE OF THE STUDY

The findings of this research work will show the relationship between healthcare infrastructure, health outcomes and coverage level in ECOWAS countries. It will be of immense benefits to federal government agencies and policymakers in formulating sustainable macroeconomic policies that will increase healthcare infrastructure procurement so as to boost human capital development, curb brain drain in the health sector, and set ECOWAS countries towards rapid economic growth and human capital development. It will also be of immense benefits to intellectuals and researchers' think tanks that occasionally prescribe and suggest policies option

to the government by promoting physical, human and labour augmenting healthcare infrastructure, quality of service and coverage.

The present study will also be significant in charting a new path for promoting sustainable macroeconomic policies of growth and development in ECOWAS counties, by providing adequate information on health sector interrelationship of these countries and the rest of the world. It will be paramount in developing foreign policies measures which can influence good health in the long-run. On this note, policymakers will find this research useful in analyzing health sector in ECOWAS countries most especially the importance of health care infrastructure and its impacts on economic growth and sustainability.

## 1.7 SCOPE OF THE STUDY

This study will cover ECOWAS countries from 1990 to 2017. Data from the WHO Global Health Observatory (GHO), World Bank and World Health Statistics repository will be used for reliability. Variables will include the density of physicians, number of nurses and midwives, birth assisted by skilled health personnel, out-of-pocket expenditure, improved drinking water source, mobile cellular subscriber, basic sanitation services, immunization, hospital centers, hospital beds and health outcomes (proxy by infant mortality rate and Under-five mortality rate).

# CHAPTER TWO

# LITERATURE REVIEW

The review of related literature is essential because it provides relevant information about the previous studies and the conventional theories and hypothesis in the academic field of study. This related literature can be obtained from published journals, articles, books, magazines, unpublished write-up by other researchers. This chapter is divided into a conceptual framework, theoretical literature, and empirical literature

## 2.1. CONCEPTUAL LITERATURE

### 2.1.1 PUBLIC HEALTH INFRASTRUCTURE

Public health infrastructure can be defined as health structures, both human and physical established for the benefit of the society to promote health through the prevention of disease and to provide quick response to acute and chronic health challenges (Ridderhof et al, 2013).Obviously, public health infrastructure does not only entails physical facilities through which health care services could be delivered. It includes skill workers, good roads, water supply, reliableelectricity and information, and knowledge systems. To promote adequate and quality healthcare production, strong infrastructure is needed as the foundation to create a platform for improved healthcare outcomes. While on the other hand, poor health infrastructure will ultimately produce poor health outcome. Enhanced health outcomes are primarily the function of the type of health infrastructure put in place. According to WHO (2017), health infrastructural is needed to provide health service that is safe, accessible and of high quality critical for moving towards universal health coverage.

### 2.1.2 HEALTH OUTCOMES

Health Outcome is of the result of inputs into health systems such as procurement and supplies, health workforce and financing (WHO, 2010). In other words, inputs devoted to healthcare determine the outcome derivable from the healthcare system. Increasing input is expected to enhanced service delivery that will lead to improved health outcomes. In this study, healthcare will be measured by infant mortality rate and under-five mortality rate. If healthcare services supplied through health inputs are comprehensive and accessible, there will be a reduction in the

number of women that die giving birth and mortality among the populace would reduce considerably.

### 2.1.3 BASIC HEALTH AMENITIES

**B**asic health amenities is of the major determinants of wellbeing of the society and this includes safe drinking water, sanitation, housing , electrification, all weather road to the village, fuel , connectivity, healthcare center, schools, playground and recreational centers. It is on the other hand measured in terms of self-reported illness within a specific period. Affordable physical access to jobs, health, educations and other social wellbeing is also very vital to the development and health conditions of any society especially, people in rural areas.

Basic amenities are essential foundation for a decent living which also enhances economic growth and development as well as quality of life. Put differently, unless these basic issues are solved, it will be very difficult to ensure an inclusive growth. Basic amenities are usually linked to the qualitative and developed human living, and the modern state should ensure that this is adequately addressed through institutional development and arrangement. The living condition of the society reflects on the socio-economic, political and environmental development of any country.

## 2.2 THEORETICAL LITERATURE

The theoretical model that support this work was from the work of AvedisDonabedian developed in 1966. Other theories are Andersen and Newman framework of Health Service Utilization (1973), Health Belief Model (1952) and Nursing Service Delivery Theory (1978). These theories are explained below.

### 2.2.1 AVEDIS DONABEDIAN MODEL

The model that was developed in 1966 examined healthcare services and quality of health. According to the model, the framework for quality of care is based on three categories which are structure, process, and outcome. Structure, according to Donabedian describe the means through which they are carried out. Which includes physical facility, human resources, equipment, and staff training. He emphasized that these factors demonstrate how providers and patients act

which serves as the quality of care within a system. In furtherance to the framework, process (healthcare services) was defined as the addition of actions such as diagnosis, treatment and preventive care that makes up health care. He stressed that the process means how health care services are delivered by providers to patients throughout the duration of receiving service. The third category was outcomes, which he referred to as the effects or impact of healthcare on the health condition of patients and populations. The inputs are expected to affect the outcome through changes in health status, behavior or knowledge, measurement of the outcome from the process invested in health may take time to be observable. The application of Donabedian applies to how physician duty may be enhanced through the coordinated action. Donabedian thus underscored his belief that efforts to improve the structure, processes, and outcomes of health care must be associated with genuine care and concern about the needs of patients (John et al, 2016).

### 2.2.2 ANDERSEN AND NEWMAN FRAMEWORK OF HEALTH SERVICE UTILIZATION

The model which was developed by Andersen and Newman in 1973 gave three dynamics for health care usage to include predisposing factors, enabling factors and need factors. The authors explained further that predisposing factors to be the socio-cultural characteristics of an individual that was ingrain in them before they became ill such as age, race and health beliefs. For instance, a person that doesn't believe health services are effective may not access it compare to an individual that believes in the efficiency of health service. Andersen and Newman believed that enabling factor in the usage of health care could be family support, access to health insurance and the community. For example, family support can encourage an ill individual to seek health care while health insurance takes care of the financial burden of the patient. Finally, the perceived need will better help to understand care-seeking and adherence to a medical regimen, while evaluated need will be more closely related to the kind and amount of treatment that will be provided after a patient has presented to a medical care provider (Andersen, 1995).

### 2.2.3 HUMAN CAPITAL MODEL OF DEMAND FOR HEALTH

In the model, which was published by Grossman in 1972. He constructed a model where there is a commodity called "good health". According to this model, health can be seen as a durable capital stock that produces an output of healthy time. Health capital is considered both as

consumption and an investment good. It is assumed that individuals are both producers and consumers of health with an initial stock of health that depreciate with age but can be increased by investment. The model shows multi-sectoral linkages of demand for health as derived demand and that few people want health care for its own sake, the individual is considered not to be passive consumers of health but active producers that spend time and money on the production of health.

In explaining the model further, Grossman said health has an inter-temporal consumption pattern that depreciates and can be analyzed as a capital good. According to Grossman, our health finance and other activities that enhance good health care are limited due to income and other constraints. We have a huge influence over our health since we can take decision affecting our consumption patterns, our health care utilization and our environment.

Grossman posited that health is demand for two reasons, first as a consumption commodity that gives direct utility and sick days are a source of disutility. Secondly, as an investment commodity which produces health time for household leisure. This shows that an increase in a person stock of knowledge or human capital raises his productivity in the market sector and the non-market or household sector for the production of commodities that enter is a utility function. Grossman while explaining the model highlighted the difference between health and medical care. Medical care is one of the inputs into the production of health which is considered to be the output and also pointing out the difference between health capital and other forms of human capital. The model supporting the traditional demand theory considers that each consumer has a utility or preference function that allows him or her rank alternative combinations of goods and services purchased in the market. Consumers are to select the combination of goods and services that gives them optimal utility subject to their income or resource constraint since spending on goods and services cannot be greater than income.

Health is part of human capital inherited as an initial stock which depreciates with age and can be increased by an investment over time. In addition, personal choice such as diet, exercise, cigarette smoking, and alcohol consumption can affect the length of life and death occurs at the level where the stock of health is low. Therefore efficiency is defined as the amount of health obtained from a given amount of health inputs that include years of formal schooling completed.

### 2.2.4 HEALTH BELIEF MODEL (HBM)

This model that was generally regarded as the start of research in health behavior originated from the work of three psychologists (with phenomenological orientation), Godfrey Hochbaum, Stephen Kegels and Irwin Rosenstock (1952). The model is influenced by the theories of Kurt Lewin. Health belief model focused on a systematic way to explain and predicts preventive health behavior and utilization of health services. HBM attempt to know the factors that are responsible for requesting health care services. The model is used in explaining and predicting preventive health behavior. What motivates an individual to undertake a health behavior is categorized as individual perceptions, modifying behaviour, and the likelihood of action. Individual perceptions are factors that affect the feeling of illness and the individual attachment of importance to health. Health belief model stated that perception of a personal health behavior threat is affected by three factors; general health value (interest and concern about health), specific health beliefs (exposure to a specific health threat) and beliefs about the consequence of the health problem. Once an individual discovers a threat that out weight his/her expected benefits, the person is most likely to take preventive health decisions. HBM, in summary, means that after an individual has perceived a threat to health, he/she modifies his/her action and take a proactive decision for health benefits.

### 2.2.5 NURSING SERVICE DELIVERY THEORY (NSDT)

The foundation of NSDT is the open system theory by Katz and Kaln (1978). This system was adopted to nursing work to explain the work environment. NSDT identifies that care is delivered both in the cluster and on inpatient in a hospital. The care provider transforms inputs in the workplace with good system structure and programme to yield outputs, such inputs include care recipients, staff, material and fiscal resources and information which are transformed in a nursing production function by work done, structure and inbuilt work conditions. The model explained that the outputs generated from inputs include clinical, human resource and organizational outcomes. If such an outcome is positive, it encourages members of the community to continue the usage of the organization’s services. This will lead to staff been retained, more funding is received and accreditation is maintained. Furthermore, ensuring the organizational policies meet performance targets set by controlling bodies to sustain the interaction with the external environment.

According to NSDT, at the point of health care delivery, each nursing production sub-system is expected to interact with another subsystem that exists within the organization. Structures and internal demands of nursing production subsystem and the work conditions help in the type of service received. Longer stay and emergency department overcrowding is an example of negative feedback. In response to this, the theory stated that the solution should include adaptive function, supportive function, and maintenance function. The adaptive function was explained to entails implementing a proposed solution, while supportive and maintenance function means hiring nurse practitioners and formalizing policies to enable the work of nurse practitioners respectively.

Furthermore, according to NSDT, management function will ensure these changes are implemented across subsystem, role and hierarchical boundaries to make sure everybody comply and to monitor performance. The nursing production subsystem also called emergency department will redistribute roles by staff mixing, that is, inputs, service capacity or throughput is increased which will lead to an increase in capacity and satisfaction. In conclusion, NSDT said by considering the role of inputs and throughputs in nursing service delivery, the production subsystem should not work in isolation. In other words, healthcare service delivery is more effective with interdependent with other subsystems and interaction with the external environment. The NSDT, therefore, emphasizes the collaboration of factors to deliver an effective nursing production subsystem.

## 2.3 EMPIRICAL LITERATURE

As a result of the importance of infrastructure to quality health, several scholars have studied the relationship that exists between infrastructure and healthcare outcomes in ECOWAS countries. One of such research is that ofDeon Filmer and Lant Pritchett (1997), they observed that the availability of primary health infrastructure or community health worker has a positive impact on the rural health condition. Variables such as access to hospitals, numbers of doctors, numbers of health centers, and availability of rural health workers are significant determinants of local health status. Zeynep (2000) while evaluating the effect of variations in the volume of health care systems on mortality across 21 OECD countries using Generalized Least squares (GLS) technique of estimation observed that higher number of active physicians are important as a ten

percent increase in numbers of doctors would lead to a six percent decrease in premature mortality in men and six and a half percent in women caused by health disease. More public expenditure on health also shows a lower rate of reduction in premature mortality.

In research carried out by Yusuke (2010), which revealed that GDP per capita and access to enhanced sanitation have statistically significant and favourable effects in decreasing child mortality. In contrast, health system factors which are measured by government health spending, immunization coverage, skilled birth attendants and the number of physician per 1,000 people do not lead to a reduction in child mortality. Imoughele L and Ismaila M (2013) studied the effect of a physician on healthcare. They discovered that there was a direct relationship between population per physician and total government health expenditure in Nigeria as a one percent increase in population per physician lead to 0.021 percent increase in government health expenditure. Fasoranti M. M (2015) observed that literacy rate, the share of health expenditures and consumer price index were also significant factors in government health expenditures. On the other hand, per capita GDP, the total population of age 65 and an above, the total population of age 14 and younger and life expectancy rate were found to be insignificant.

On infrastructure provision, Ademiluyi and Aluko (2009) in their work that examined the infrastructural distribution of healthcare services in Nigeria discovered that the distribution of medical care delivery favours urban settlers at the disadvantage of rural settlers. They further discovered that health care providers love to settle in urban areas mainly because of social amenities like water, electricity, good road, quality education for their children and the prospect of job opportunities for their spouses, thereby denying rural settlers access to quality healthcare. Immunization carried out in Nigeria in 2005 reported a 25% success rate for urban children against 7% for the rest suggesting lopsided distribution of health infrastructure. They recommended that the rural areas where the majority of Nigerians live should equally enjoy better infrastructure for improved access to good and quality healthcare services.

David et al (2008) carried out a study of the effect of healthcare capacity in South African provinces. The result indicated that the density of hospitals was associated with greater government allocations which also result in a higher number of doctors providing healthcare services. Bhargava Alok (2005) findings revealed that government have to be proactive because there are likely to be shortages of medical teaching staff in countries such as Burundi, Eritrea,

Lesotho, Mali, and Niger where enrollment rates in tertiary education were less than 3%, the figures for Botswana and South Africa were 4.7% and 14.6%, respectively. A situation that will affect the numbers of physicians per thousand of the population. Akeem Akinwale (2010) in the study relating to insufficient infrastructure in Nigeria showed that efforts to improve healthcare infrastructure have failed in Nigeria primarily because of negligence and corruption.

Renee et al (2012) used data from Service Provision Assessments and Demography and Health Surveys of five countries in Sub-Saharan African. Their result discovered that of the hospitals surveyed, there was none of them had sufficient infrastructure to follow minimum standards that are essential for emergency and surgical care as recommended by the World Health Organization. This suggests that increased attention should be given to infrastructure to increase access to healthcare in the region.

Yaqub, Ojapinwa, and Yusuff (2010) in order to study the impact of governance on public health expenditure and health outcomes in Nigeria used ordinary least squares and two-stage least squares in their research study with data spanning from 1980 to 2008. They observed that public health expenditure and unemployment affect access to health. Governance variable proxy by the corruption perception index has a negative impact on infant mortality and under-five mortalities as a result of corruption. Aduralere (2015) also while analyzing the determinants of public health expenditure in Nigeria posited that unemployment rate, tuberculosis, and population are major determinants of health expenditure. Other factors such as sickle-cell anemia, gross domestic product per capita and human immune deficiency virus are discovered to be insignificant. Matthew et al (2015) in their work also agreed with Yaqub, Ojapinwa, and Yusuff (2010) and Aduralere (2015) on the role of government spending on health. They employed Johansen Co-integration and the Vector Error Correction Model (VECM) econometric technique to determine the long-run link between government spending on health and health outcomes in Nigeria. Their findings showed that public spending on health has a significant relationship with health outcomes in Nigeria. They, therefore, recommended that the public should be informed about the effect of environmental factors such as carbon dioxide emissions on individuals' health and it was also recommended that there should be an increase in health sector spending to increase infrastructure.

Eneji, Juliana and Onabe (2013) in their findings discovered that improved government spending on health is important to improving economic growth because a healthy workforce will increase working time and earnings. Their regression result showed that health expenditure and health status explain about 53 percent changes in national productivity. They recommended that since health status has an effect on labour force participation, challenges such as coverage, affordability, inequality, quality, and sustainability of healthcare services should be reviewed to increase income with a high life expectancy rate. To find out if there is causation between economic growth and health, Babatunde (2010) proxy health by life expectancy showed that one extra year increase in the average years of schooling causes a 0.876% increase in life expectancy. Okezie et al (2016) discovered that a percentage change in government recurrent expenditure on health will lead to 0.01 percent reduction in health output. This unusual result may be due to corruption and poor governance in Nigeria. This study is in line with Lloyd (2013) whose research showed that an increase in health care spending in Nigeria did not translate to improved health or improved health infrastructure. Numerous evidence has shown that corruption, bad governance, the poor institution have continued to affect the health sector in developing countries compared to developed countries. But contrary to what Okezie el al (2016) and Lloyd (2013) asserted, Blinder (2002) discovered that political stability will increase total health output by 0.02 percent which is in line with our a priori expectation. Just like Blinder, Igbinedion (2016) studied the effect of public health expenditures on maternal mortality rate. The result shows that increase private and public health expenditures reduces the maternal mortality rate in Nigeria. And in addition, poverty was found to have a significant effect on maternal mortality rates in Nigeria.

Huge out-of-pocket payment is another factor that reduces access to healthcare. Riman and Akpan (2012) adopted the stratified sampling technique to demonstrate how high levels of infant mortality and morbidity came about as a result of huge out-of-pocket payment and inequality in income distribution in Nigeria. High out-of-pocket payment can push people to seek alternative means to stay healthy. Isaac B. Oluwatayo (2016) through primary data discovered that most of the respondents relied on local doctors, spiritualists, and patent medicine stores for health care.

Kareem el al (2017), Omitogun (2014), Abu Nurudeen, Abdullahi Usman (2010) and Yusuke (2010) showed the relationship between economic components and healthcare service delivery in Nigeria. Kareem el al (2017) pointed out that a positive relationship between GDP and health expenditure with a unit increase in health expenditure increasing GDP by 0.0046%.Omitogun (2014) analysis shows that unemployment and political instability have a negative relationship with gross total health expenditure of the government and are also not significant. Real gross domestic product and health expenditure share in total government expenditure are positively related to total health expenditure and are significant at one percent and five percent level of significance respectively. Furthermore, Abu Nurudeen, Abdullahi Usman (2010) discuss that increasing government expenditure on health results in an increase in economic growth. They among others suggest that the government should raise its expenditure in the development of the health sector and healthcare infrastructure since it enhances productivity and economic growth.

Robert et al (2003) sought to establish the challenges and opportunities of the public health workforce in Sub-Saharan Africa. The result showed that more resources are needed to contribute to the development of infrastructure, human capital, and management processes because a sturdier public health workforce will be better equipped to relate the effectiveness of health interventions and to ensure that the new resources coming into the health segment lead to the improvement of the health of all populations.

Bockerman and Ilmakunnas (2007) observed a correlation between unemployment and health in Finland over the period 1996–2001 using difference-in-difference model and matching methods. Their result showed that the health status of those that are not employed is lower compared to those who are gainfully employed. More importantly, the overall population average revealed that the health condition of the unemployed worsened the more over the year. This is not unexpected as it will be more evident in a country without comprehensive health insurance for its citizens.

Kaibung'aMavole and Okuku (2017) found a link between infrastructure and healthcare service delivery in Baringo County, Kenya. The study concludes that road networks, power coverage, healthcare facilities, and water and telecommunication, positively affect healthcare service delivery. Novignon et al (2012) carried out a panel data report covering forty-four Sub-Saharan

African countries using fixed and random effects panel data regression model to estimate the effects of health care expenditure on health outcome. They discovered that a one percent increase in health expenditure reduced the infant mortality rate by three infants per 1000 live births. They further suggested that due to the lack of adequate infrastructure in Sub Sahara Africa, increasing medical care spending will lead to a significant improvement in service delivery. Allocating funds to the health sector may not yield an expected result if such funds are not effectively and efficiently utilized in improving service delivery.

Kim and Shannon (2013) tested data between 1973 and 2000 using a mixed-effect model from data collected from seventeen Organization for Economic Cooperation and Development countries. The findings showed that government health expenditure was well utilized. There was a negative relationship between government expenditure on health and infant mortality rate. The study also reveals that a positive relationship exists between government spending on health and life expectancy at birth. This showed that more government spending on health infrastructure is good for the overall wellbeing of the citizen especially where good governance and institution are entrenched.

Rajkumar and Swaroop (2007) examined the effect of public health spending on the mortality of children under five. The study showed that increasing health spending by one percentage has no significant effect on reducing under-5 mortality in countries with weak governance compared to countries with good governance where government medical spending has a positive effect on the under-5 mortality rate. A study of the relationship between health status and public health spending in Ghana from 2001 to 2010 by Azinin, Sackey, and Keyeke (2013) using the ordinary least squares estimation technique found that public health expenditure has an insignificant impact on death of children under five years in Ghana. This is in alignment with the study of Deluna and Peralta (2014). Deluna and Peralta analyzed public health expenditures, income and health outcomes in the Philippines from 1981 to 2010. They used the Granger causality test and Vector Auto-Regressive (VAR) estimation technique and they observed that past healthcare spending has no positive impact on under-five mortality rates.

Cevik and Tasar (2013) studied the impact of public spending on health care and outcome in 131 countries using the ordinary least square (OLS) technique. The research work discovered that a 10% increase in government health expenditure on infrastructure leads to a 20% decrease in

infant and child mortality rate while income per capita has no significant impact on reducing both under five and infant mortality.

In other to evaluate the quality of governance, public health spending and health status in sub-Saharan Africa, Makete, and O'Hare (2015) opined that public spending on health has a statistically significant impact in improving health outcomes. Public spending on health leads to a reduction in under-five mortality between 9-11 percent while it also raises life expectancy by three percent. However, the impact of public spending on under-five mortality and life expectancy in a country with good governance and quality institution is more commendable. It leads to a reduction in under-five mortality between 17- 19 percent and a rise in life expectancy by 6 percent. Their findings were in consonance with Rajkumar and Swaroop (2007). In the research that examined the effect of public health expenditure on infant and under 5 mortalities, it was discovered that reduction in the level of corruption improves the health status of infant, under-five children, and life expectancy. Therefore, the eradication of corruption in the health system is necessary to ensure that public spending is used for the purposes they are budgeted for.

Basu, Soylu, and Barenberg (2015) used ordinary least square(OLS) and two-stage least square (2SLS) with unbalanced panel data set of 31 Indian states spanning 1983 to 34 and 2011 to 2012 to analyze how public health expenditure affect infant mortality rate. Their result showed that public health care spending is important in reducing the infant mortality rate in India. An increase in public health expenditure by 1% of GDP was discovered to reduce infant mortality by 8 death per 1000 live birth and they also find out that female literacy and urbanization have a negative effect on infant mortality rate.Filmer and Pritchett (1999) while examining the impact of public spending on infant mortality observed that about ninety-five percent of cross-national variation in infant mortality can be explained by a country's per capita income. Additionally, public spending on health has relatively little impact on infant mortality and independent variation in public spending explains less than one-tenth of one percent of the observed differences in mortality across countries.

Findings by Cole and Neumayer (2012) showed that a one percent rise in malaria incidence will shrink total factor productivity between 0.58% and 0.75% while lack of access to safe water will reduce total factor productivity by 1.06%, confirming a priori expectation. According to Berger and Messer (2013), an increase in public share of health expenditures is associated with increases

in mortality rates. This means tobacco use, alcohol use, fat consumption, female labour force participation, and education levels are significantly related to overall mortality rates. The work of Cole and Neumayer (2012) andMark C. Berger and Jodi Messer (2013) stress the impact of healthcare on productivity and to a large extent the economy.

Evidence has also revealed the impact of good health care on a child's survival and education. Paul Schultz (1999) postulates that good health through healthcare infrastructure has a positive impact on the learning ability of children which leads to the improved educational outcome; school completion rate, higher means of years, schooling, achievement, increases the efficiency of human capital formation by individuals and households.Abbas, Faisal, and Hiemenz (2011) carried out a study aimed at examining the presence of a long-run association between public health care expenditures and the other variable. Urbanization and unemployment have a negative effect on health care expenditures. The work shows that it is costly to provide health care to residents of remote rural areas of Pakistan.

Sami Chaabouni and ChokriAbednnadher (2010) in the study of the determinants of health expenditures in Tunisia. Their results of the bounds test show that there is a stable long-run relationship between per capita health expenditure, GDP, population aging, medical density, and environmental quality. The results in the short and long run, which indicate that health care is a necessity rather than a luxury in Tunisia, confirm the a priori notion that health care behavior changes with the level of the economic development. Some previous studies found health care to be a luxury good.

The input of health workers is also necessary to ensure efficient service delivery in the health sector. In their findings, Deon Filmer, Jeffrey Hammer and Lant Pritchett (1997) observed that the availability of primary health infrastructure or community health worker hasa positive impact on the rural health condition. Other variables such as access to hospitals, numbers of doctors, numbers of health centers, and availability of rural health workers are a significant determinant of local health status. Zeynep (2001) while evaluating the effect of variations in the volume of health care systems on mortality across 21 OECD countries using Generalized Least squares (GLS) technique of estimation observed that higher number of active physician is important as 10 percent increase in numbers of doctors would lead to 6 percent decrease in premature mortality in men and 6½ percent in women caused by health disease. More public expenditure on health also shows a lower rate of reduction in premature mortality.

## 2.4 LIMITATIONS OF PREVIOUS STUDIES AND VALUE ADDED

Empirical studies as regards to how healthcare outcomes will improve drastically have yielded less effort in ECOWAS countries. Part of the challenges was as a result of scanty research work as regard how infrastructure affects health in the region. The bulk of studiesreviewed on health outcome did not focus on ECOWAS countries, and most of them concentrated on how expenditure and governance affect healthcare in Africa and Sub-Saharan Africa (SSA) as a whole.The outcomes of these studies, as shown above, reveals that domestic government health expenditure, governance, and physicians are important factors in determining health status in Africa and SSA, but the impact of infrastructure on healthcare outcomes in ECOWAS (the bloc where one of her countries have the worst maternal mortality rates in the world) is yet to be proven.

On this premise, the current study is expected to throw more light on how healthcare infrastructure affects health outcomes in ECOWAS countries. This current research will also examine how other factors other than healthcare infrastructure influence health outcomes in ECOWAS countries.

# CHAPTER THREE

# METHODOLOGY

## 3.1 THEORETICAL FRAMEWORK

The theoretical framework to be adopted by this work is the AvedisDonabedian Model (1966) developed to study structure, process, and outcome. According to the model, the framework for quality of care is based on three categories which are Structure, Process, and Outcome. Structure (infrastructure) is the means through which services are carried out, while Process is the service supplied through the available healthcare structure. Output refers to the effects or impact of healthcare on the health condition of patients and the population. Going by the objectives of the study, we seek to investigate the relationship between healthcare outcomes (infant mortality rate and under-five mortality) and healthcare infrastructure available for treatment with intervening variables such as density of physician, numbers of nurses and midwiferies, source of drinking water, birth assisted by skilled health personnel, out-of-pocket expenditure, mobile cellular service, basic sanitation services, hospital beds and hospital centers.

In evaluating the effect of healthcare infrastructure on healthcare outcomes in ECOWAS countries, the study shall employ a panel model. Panel data regression differs from time-series and cross-sectional regression models. Panel data is the movement over time of cross-sectional units.

The functional form of the model is as presented below:

$$Y_{it} = a + \beta X_{it} + u_{it} \quad - - - - - - \quad (1)$$

$i = 1 \ldots n, \quad t = 1 \ldots t$

Where

Yit = Outcome Variable

$\beta$ = Vector of parameters

Xit = Vector of explanatory variables

$\mu$it = error term

The t subscript represents the time-series dimension and i subscript denote the cross-section dimension. Healthcare outcome is expected to improve with the available healthcare infrastructure. AvedisDonabedian's theory will, therefore, serve as the bedrock on which the model for this work will be established.

### 3.2 MODEL SPECIFICATION

AvedisDonabedian Model (1966) forms the building block for the modeling structure of this work. The models for this work were structured in a way to show how public healthcare infrastructure affect health outcome in ECOWAS countries. Following the work ofImoughele el al (2013), Omitogun, Olawunmi (2014) and Eneji el al (2013). The following models will be specified for the objectives of the study.

**MODEL 1**

The model will examine the effect of healthcare personnel on infant mortality rate per 1,000 live birthsin ECOWAS countries. Based on the synthesis empirical works of some authors like Yaqub, Ojapinwa and Yusuff (2010), Eneji, Juliana and Onabe (2013) and Okezie, Emeh and Njoku (2016) methodological approach, the functional form of the model for effect of public healthcare workers on healthcare outcome in ECOWAS countries can therefore be stated as:

IMR= f (PHY, NM, BRT,) - - - - - - - (2)

IMR represents infant mortality rate per 1,000 live births.The infant mortality rate is the number of infants dying before reaching one year of age, per 1,000 live births in a given year.

PHY stands for a density of physicians per 1,000 population. Physician combines medical doctors and specialist medical practitioners who provide healthcare services.

NM representsthe density of Nurses and Midwifery per 1,000 population. Nurses are health workers that play a critical role in health promotion, disease prevention and delivering primary and community care.

BRT represents birth assisted by skilled health personnel in percentage. These are the percentage of deliveries assisted by a qualified healthcare practitioner.

The relationship between public healthcare infant mortality rate and density of healthcare personnel shall be estimated using the random effect regression models as specified below:

$IMR_{it} = \beta_1 + \beta_2 Phy_{it} + \beta_3 NM_{it} + \beta_4 BRT_{it} + wit$ - - - - (3)

Where: $wit = \varepsilon i + \mu it$

Wit is a composite error term.

**MODEL 2**

The model is used to examine the effect of health facilities on health outcomes. Access to health facilities is expected to reduce the infant mortality rate in ECOWAS countries. The functional form of the model is, therefore:

U5M= f (HB, HC, IMM) - - - - - - (4)

Where:

U5M stands for under-five mortality rate per 1000 population.The under-five mortality rate is the probability per 1,000 that a newborn baby will die before reaching age five, if subject to age-specific mortality rates of the specified year.

HB stands for hospital beds per 1,000 people. Hospital beds include inpatient beds available in public, private, general, and specialized hospitals and rehabilitation centers.

HC denotes hospital centers per 1,000 people. Hospital center is a place where is a place where people can get treated when they are ill.

IMM stands for Immunization (% of children ages 12-23 months). Child immunization, DPT, measures the percentage of children ages 12-23 months who received DPT vaccinations before 12 months. A child is considered adequately immunized against diphtheria, pertussis (or whooping cough), and tetanus (DPT) after receiving three doses of vaccine.

The relationship between health centers and health outcome shall be estimated using the fixed effect regression models as specified below:

$U5Mit = \beta_1 HBit + +\beta_2 HCit + \beta_3 IMMit + \alpha i + \mu_{it}$ - - - - - (5)

$\alpha_i$is the individual country fixed effect, $\mu_{it}$ is the error term, i denotes country cross-sectional index and t is the time index.

**MODEL 3**

The model will examine the effect of basic amenitieson the under-five mortality rate per 1,000 live births. The functional form of the model for the effect of basic amenities on healthcare outcome in ECOWAS countries can, therefore, be stated as:

U5M = f (IDW, BSS, MCS, OOP, GHE, EXH) - - - - - (6)

Where:

U5M stands for an under-five mortality rate per 1000 population.The under-five mortality rate is the probability per 1,000 that a newborn baby will die before reaching age five, if subject to age-specific mortality rates of the specified year.

IDW represents Improved Drinking Water Source, %. Improved water source refers to the percentage of the population using an improved drinking water source.

BSS denotes Basic Sanitation Service, %. It is the percentage of the population that uses improved sanitation systems for a clean environment to prevent transmission of disease.

MCS stands forMobile cellular subscriptions (per 100 people). Mobile cellular telephone subscriptions are subscriptions to a public mobile telephone service using cellular technology.

OOP means Out-of-pocket Expenditure per capita, $. Out-of-pocket payments (OOPs) are defined as direct payments made by individuals to health care providers at the time of service use.

GHE denotes Domestic general government health expenditure per capita, $. It is the expenditure on health from domestic sources per capita.

EXH representsExternal health expenditure per capita, $. External sources are composed of direct foreign transfers and foreign transfers distributed by the government encompassing all financial inflows into the national health system from outside the country.

The relationship between health centers and health outcome shall be estimated using the fixed effect regression models as specified below:

$$U5M_{it} = \beta_1 IDW_{it} + \beta_2 BSS_{it} + \beta_3 MCS_{it} + \beta_4 OOP_{it} + \beta_5 GHE_{it} + \beta_6 EXH_{it} + \varepsilon i + \mu_{it} \quad -(7)$$

$\varepsilon_i$ is the individual country fixed effect, $\mu_{it}$ is the error term, i denotes country cross-sectional index and t is the time index.

### 3.3 MODEL JUSTIFICATION

Panel data is often regarded as the best and efficient form of estimation technique in handling econometric data, most especially those that involve cross-sectional analysis (Gujarati, 2010).

In a situation where the individual effect $u_i$is nonzero, heterogeneity may influence the model. Hence, the OLS estimator is no longer the best unbiased linear estimator (BLUE). Then panel data models provide a way to deal with these problems. Panel data analysis has become a popular analytical because it allows for the inclusion of data across a large sample of N individuals (households, firms, government/countries, etc), and across time T (say, daily, monthly, quarterly and yearly). The panel dataset comprises a matrix of time series for each individual unit or cross-sectional member in a data and offers different estimation method. Cross-sectional data is data of N observation of individuals at the same point in time. But it should be noted that some cross-sectional data exist over time so that such data form a series and a number of cross-section samples taken at a different point in time.

### 3.4 PRE-ESTIMATION TESTS

#### 3.4.1 Descriptive Statistics

In every empirical research, the first step that we should take into consideration is the description of the basic variables used in each analysis in order to give an overall view of every researcher for the variables used. The descriptive statistics would be used to understand the nature of each data used in the model. The descriptive statistic also helps us to know the distributive nature of these data over time, which can be obtained through their averages (Gujarati, 2010).

## 3.5 ESTIMATION PROCEDURE

This study will employ a fixed effect and random effect model. The fixed-effects model controls for all time-invariant differences between the individuals, so the estimated coefficients of the fixed-effects models cannot be biased because of omitted time-invariant characteristic (like culture, religion, gender, race and so on). In the random-effects model, unlike the fixed effects model, the variation across entities is assumed to be random and uncorrelated with the predictor or independent variables included in the model.

## 3.6 DIAGNOSTICS TESTS

This section of the methodology outlines the various test to be conducted in order to ascertain the reliability of results obtained from the estimations.

### 3.6.1 F-test for Fixed Effects

In a regression analysis, the null hypothesis posits that all dummy parameters except the dropped one are all zero, $H_0$: $\mu_1 = \ldots = \mu_{n-1} = 0$. The alternative hypothesis stated that at least one dummy parameter is not zero. This hypothesis tested by an F-test is based on the loss of goodness-of-fit. If the null hypothesis is rejected (at least one group/time-specific intercept uiis not zero), we may conclude that there is a significant fixed effect or a significant increase in goodness-of-fit in the fixed effect model; therefore, the fixed-effect model is better than the pooled OLS.

### 3.6.2 Breusch-Pagan LM Test for Random Effects

Breusch and Pagan's Lagrange multiplier (LM) test examines if the individual (or time) specific variance components are zero. If the null hypothesis is rejected, we can conclude that there is a significant random effect in the panel data and that the random effect model is better for heterogeneity than the pooled OLS. However, if the null hypothesis is not rejected, the pooled OLS is preferred; otherwise, the random effect model is better.

### 3.6.3 The Hausman Test

According to Dimitrious and Stephen (2007), the Hausman test was formulated in assisting choice-making between the fixed effect estimator and the random effect estimator. Hausman (1978) adopt a simple test based on the notion or idea that under the assumption of no

correlation, both OLS and GLS are consistent, but is inefficient, while under the alternative hypothesis, OLS is consistency, but GLS is not. More specifically, Hausman assumed that there are two estimators $\beta 0$and$\beta 1$ of the parameters of $\beta$and he added two hypothesis testing procedures. Under the null hypothesis ($H0$), both estimators are consistent but $\beta 0$ is inefficient, and under the alternative hypothesis, ($H1$), $\beta 0$ is consistent, but$\beta 1$ is consistent.

### 3.6.4 Heteroscedasticity Test

OLS estimator assumes that the regression disturbances are homoscedastic with the samvariance Across time and individuals. This may not be true for panel data analysis. The present of heteroscedasticity will make the standard errors bias. We should compute robust standard error correcting for the possible presence of heteroscedasticity. When the error process is homoscedastic within cross-sectional units, but its variance differs across units we have so-called GroupWise heteroscedasticity.

### 3.6.5 Test for Serial Correlation

Serial correlation tests apply to macro panels with long time series mostly over 20 years. This is not a problem in microdata with few numbers of years. Serial correlation causes the standard errors of the coefficient to be smaller than their actual values and also over-estimates the R-squared. The null hypothesis here states that there is no serial correlation. We reject this hypothesis if the probability value estimated is less than five percent.

### 3.6.6 Testing for Cross-Sectional Dependence

According to Baltagi (2008), cross-sectional dependence is a problem in macro panels with long time series (over 20-30 years). Pasaran CD test is used to test whether the residuals are correlated across entities. Cross-sectional dependence can lead to bias in test results. The null hypothesis is that residuals are not correlated. The test is applicable only to the fixed effect model alone.

### 3.6 Source of Data and Statistical Package

Panel data from 1990 to 2017 was used in this empirical analysis. The data were obtained from the 15 ECOWAS countries from the World Bank database (2017) and Factsheet of Health Statistics (2018) jointly released the World Health Organization and African Health Observatory.

Data for the density of physician, nurses and midwifery, a skilled health worker at the delivery hospital bed and hospital centers was extracted from Factsheet of Health Statistics (2018), others came from World Development Indicator (2017). The fifteen ECOWAS countries covered are Nigeria, Ghana, Senegal, Mali, Benin, Niger, Cote D'Ivoire, Gambia, Guinea, Guinea Bissau, Burkina Faso, Sierra Leone, Carbo Verde, Togo, and Liberia. Statistical packages such as Stata 11 and Microsoft Excel will be used in the analysis.

# CHAPTER FOUR

# PRESENTATION AND INTERPRETATION OF RESULTS

## 4.1 INTRODUCTION

The central focus of this chapter is on the presentation of the research findings. It gives the summary values of the regression analysis on which the objectives and hypothesis stated in chapter one shall be evaluated. This chapter also validates the theory/hypothesis based on the West African case, and to examine its usefulness. The regression results shall also be statistical and econometrically tested as stated in chapter three.

## 4.2 DESCRIPTIVE STATISTICS

**Table 4.2: Descriptive statistics table of the variables used in the model**

| Variable | | Mean | Std. Dev. | Minimum | Maximum | Observation |
|---|---|---|---|---|---|---|
| U5M | overall | 137.5605 | 60.210 | 17.4 | 326.5 | N = 420 |
| | between | | 43.697 | 35.828 | 201.467 | n = 15 |
| | within | | 42.881 | 29.192 | 271.192 | T = 28 |
| IMR | overall | 82.07524 | 31.783 | 17 | 175 | N = 420 |
| | between | | 24.497 | 28.97143 | 126.939 | n = 15 |
| | within | | 21.183 | 28.60381 | 147.703 | T = 28 |
| GHE | overall | 14.07194 | 21.176 | 1.175 | 108.946 | N = 255 |
| | between | | 20.032 | 2.633 | 83.562 | n = 15 |
| | within | | 7.311 | -25.259 | 40.390 | T = 17 |
| EXH | overall | 17.6255 | 15.876 | 1.737 | 143.537 | N = 255 |
| | between | | 8.239 | 5.398 | 36.573 | n = 15 |
| | within | | 13.727 | -14.939 | 124.589 | T = 17 |
| MCS | overall | 27.19393 | 37.118 | 0 | 141.199 | N = 416 |
| | between | | 8.591 | 11.677 | 42.003 | n = 15 |
| | within | | 36.171 | -14.809 | 132.665 | T = 27 |
| IMM | overall | 65.46429 | 24.592 | 0 | 99 | N = 420 |
| | between | | 16.577 | 40.107 | 92.142 | n = 15 |
| | within | | 18.646 | 10.607 | 110.25 | T = 28 |
| PHY | overall | 1.2779 | 1.743 | 0.016 | 7.694 | N = 170 |
| | between | | 1.088 | 0.184 | 3.485 | n = 15 |
| | within | | 1.407 | -2.036 | 5.486 | T = 11 |

| Variable | | Mean | Std. Dev. | Minimum | Maximum | Observation |
|---|---|---|---|---|---|---|
| BSS | overall | 23.46328 | 14.465 | 5.986 | 65.206 | N = 240 |
| | between | | 14.500 | 9.337 | 52.970 | n = 15 |
| | within | | 3.491 | 7.981 | 35.700 | T = 16 |
| IDW | overall | 62.33984 | 11.519 | 37.998 | 86.459 | N = 240 |
| | between | | 11.029 | 41.819 | 81.833 | n = 15 |
| | within | | 4.321 | 49.728 | 74.772 | T = 16 |
| OOP | overall | 57.43728 | 43.782 | 11.723 | 222.148 | N = 255 |
| | between | | 41.036 | 17.283 | 150.334 | n = 15 |
| | within | | 18.412 | -29.401 | 134.681 | T = 17 |
| BRT | overall | 50.63856 | 17.676 | 14.9 | 98.7 | N = 153 |
| | between | | 14.230 | 23.711 | 83.95 | n = 15 |
| | within | | 10.114 | 20.688 | 80.938 | T = 10 |
| HC | overall | 6.581579 | 6.809 | 0 | 28.47 | N = 382 |
| | between | | 6.808 | 0 | 26.369 | n = 15 |
| | within | | 0.737 | 4.411 | 9.519 | T = 25 |
| HB | overall | 14.27435 | 14.569 | .12 | 94 | N = 407 |
| | between | | 12.565 | .439 | 49.053 | n = 15 |
| | within | | 8.105 | -13.779 | 59.220 | T = 27 |
| NM | overall | 7.023016 | 4.194 | 1.007 | 16.292 | N 152 |
| | between | | 3.158 | 2.228 | 14.286 | n = 15 |
| | within | | 2.584 | 2.060 | 15.860 | T = 10 |

This work employsan unbalance panel analysis. The summary statistics of the variables will first be examined. Infant mortality and the under-five mortality rate havea mean value of 82 per 1,000 live births and 138 death per 1000 population. The impressive rating of Carbo Verde is not coincidental. The country recorded the least value in infant mortality (15 per 1,000 live birth) and under-five mortality (17 per 1,000 population). This impressive health outcome corresponds with the availability of a physician (7.69 per1000 population). In addition, ninety-nine percent of pregnant women in the country received medical attention during delivery. Carbo Verde has the maximum percentage of the population with improved drinking water and sanitation service, 86 and 65 percent correspondingly. The highest healthcare spending in the ECOWAS region ($108 per capita) was also recorded in Carbo Verde in 2013.

In the year 2000, Niger Republic has the lowest percentage of her population using improved drinking water sources and basic sanitation services. Niger has more infant death of 327 per 1,000 population than any other country in the bloc. Liberia, on the other hand, recorded the highest number of under-five mortality of 175 per 1,000 live births. Liberia documented the least density of physicians, nurses, and midwifery. This is evidence of how the availability of health facilities affect health outcomes.

## 4.3PRESENTATION AND INTERPRETATION OF REGRESSION RESULTS

### 4.3.1 Model 1: Effect of health personnel on health outcome

**Table 4.3.1: Health Personnel and health outcome (infant mortality)**

| Infant mortality | Coefficient | Std. Dev. | Z | Prob. |
|---|---|---|---|---|
| Constant | 145.584 | 16.302 | 8.93 | 0.000** |
| Physician | -7.021 | 2.770 | -2.53 | 0.011* |
| Nurses & midwives | -0.425 | 1.309 | -0.33 | 0.745 |
| Birth Attendant | -1.008 | 0.275 | -3.66 | 0.000** |
| LM test | 0.0058** | | | |
| Hausman | 0.4146 | | | |
| $R^2$ | 0.5687 | | | |
| Wald | 0.0000** | | | |

Source: Authors computation. Note: Statistical significance: *<.05, **<.01

The resulted econometrics model is:

IMR= 145.58- 7.021 PHY - 0.425 NM -1.008 BRT

The LMtest shows that random effects regression is preferred to the pooled OLS and the Hausman test indicated that the random effect model is a more appropriate model to the fixed-effect model. The econometrics result reveals that the density of physician and skilled health workers present at birth exact negative and a significant influence on infant mortality. The result shows that the density of physicians reduces infant mortality by 7.02 percentage point per 1,000 people average, while the presence of skilled birth attendants at birth reduces infant mortality by 0.426 percentage point. Although, the density of nurses and midwiferies negatively impacted infant mortality, it has an insignificant effect on infant mortality in ECOWAS countries. This finding was in consonance with the research work of Deon Filmer&Lant Pritchett (2016), and Zeynep (2000)

### 4.3.2 Model 2: Effect of health facilities on health outcome

**Table 4.3.2: Health facilities and health outcome (Under-five mortality)**

| Under-five mortality | Coefficient | Drisc/Kraay Std. Err. | t | Prob. |
|---|---|---|---|---|
| Constant | 296.832 | 22.072 | 13.45 | 0.000** |
| Hospital bed | -0.792 | 0.129 | -6.12 | 0.000** |
| Hospital center | -8.064 | 2.915 | -2.77 | 0.010* |
| immunization | -1.440 | 0.196 | -7.34 | 0.000** |
| F-test | 0.0000** | | | |
| Effect test | 0.0000** | | | |
| Hausman | 0.0004** | | | |
| $R^2$ (within) | 0.5688 | | | |
| Wooldridge | 0.0000** | | | |
| Pesaran test | 0.0000** | | | |
| Wald | 0.0000** | | | |

Source: Authors computation Note: Statistical significance: *<.05, **<.01

The resulted econometrics model is:

U5M= 296.832 - 0.792 HB - 8.064 HC - 1.440 IMM

The F-test result shows that the fixed effect is better than pooled OLS and the Hausman test shows that the fixed effect is a more suitable test to the random-effect model. The Wooldridge test shows the presence of serial correlation while the Wald test indicated that there is heteroscedasticity. This justifies the adoption of the Fixed Effect Model with Driscoll and Kraay'sstandard errors. Driscoll and Kraay'sstandard errorsis a nonparametric covariance matrix estimatorwith heteroscedasticityand autocorrelation consistent standarderrors that are robust for use with both balanced and unbalanced panels.

The econometrics result shows that hospital beds, hospital centers, and immunization have a negative and significant effect on the under-five mortality rate. A percent increase in hospital beds reduces the under-five mortality rate by 0.792 percent per 1,000 people. Likewise, a percent increase in hospital centers reduces the under-five mortality rate by 8.064 percent. Likewise a percentage point increase in immunization decline under-five mortality by 1.440 percentile point in ECOWAS countries.

### 4.3.3 Model 3: Effect of basic amenities on health outcome

**Table 4.3.3: Basic Amenities and health outcome (Under-five mortality)**

| Variable | Coefficient | Drisc/Kraay Std. Err. | t | Prob. |
|---|---|---|---|---|
| Constant | 368.516 | 18.483 | 19.94 | 0.000** |
| Basic sanitation | -1.230 | 0.262 | -4.69 | 0.000** |
| Mobile cellular | -0.180 | 0.051 | -3.52 | 0.003** |
| Drinkable water | -3.508 | 0.295 | -11.88 | 0.000** |
| External Expenditure | -0.142 | 0.063 | -2.25 | 0.040* |
| Out-of-pocket | -0.112 | 0.035 | -3.14 | 0.007** |
| Govt. Expenditure | 0.856 | 0.185 | 4.62 | 0.000** |
| F-test | 0.0000** | | | |
| Effect test | 0.0000** | | | |
| Hausman | 0.0000** | | | |
| within R-squared | 0.7900 | | | |
| Wooldridge | 0.0000** | | | |
| Pesaran test | 0.0000** | | | |
| Wald | 0.0000** | | | |

Source: Authors computation Note: Statistical significance: *<.05, **<.01

The resulted econometrics model is:

U5M= 368.516 - 1.230 BSS - 0.180 MCS - 3.508 IDW -0.142 EXH -0.112 OOP + 0.856 GHE

The F-test result shows that the fixed effect is better than pooled OLS and the Hausman test shows that the Fixed Effect Model is a fit test compare to the random-effect model. The Wooldridge test shows the existence of serial correlation while the Wald test indicated that there is heteroscedasticity. This justifies the adoption of the Fixed Effect Model with Driscoll and Kraay's standard errors. Driscoll and Kraaystandard errorsis a nonparametric covariance matrix estimatorwith heteroscedasticityand autocorrelation consistent standarderrors that are robust for use with both balanced and unbalanced panels.

The econometrics result shows that all the covariatesare significant and they negatively affect the under-five mortality rate as expected with the exception of government expenditure that is abnormally positive. A one percent increase in basic sanitation service and improved drinkable water reduce under-five mortality by 1.230 and 3.508 percentage points per 1,000 people. Out-of-pocket payment negatively and significantly affects under-five mortality. A dollar increase in out-of-pocket expenditure per capita reduces the under-five mortality rate by 0.112 percent. A

percent increase in mobile telephone subscriptions per 1,000 people also declines under-five mortality by 0.1800 percentage points. We also saw that adollar increase in external health resources reduces under-five mortality by 0.142 percentage points in ECOWAS countries. A percentage increase in government expenditure per dollar was seen to increase under-five mortality by 0.856 per 1,000 people. This unexpected result may be due to corruption and bad governance in the ECOWAS region.

### 4.4 Evaluations of Research Hypothesis and Policy Implications

The results above can now be adopted to access the validity of the research hypothesis, as well as to examine the policy consequences of each hypothesis. The first hypothesis in this work stated that health personnel has no significant effect on access to healthcare outcome in ECOWAS Countries. This hypothesis can be rejected because of the result obtained from table 4.3.1 above. This result shows that the increase in health care personnel such as physicians and skilled birth attendants lead to a reduction of infant mortality rate per 1,000 population in ECOWAS countries.

The implication of this finding is that improved access to healthcare personnel would lead to better health outcomes in ECOWAS countries. But more needed to be done on the density of nurses and midwives so that many women will have access to healthcare workers before, during and after delivery.

The second hypothesis posed in this work is that health facilities have no significant impact on access to healthcare outcomes in ECOWAS Countries. Given the result obtained in table 4.3.2, we reject this hypothesis and conclude that healthcare facilities have an effect on health outcomes in ECOWAS countries. Lastly, the third hypothesis showed that other amenities affect healthcare outcomes. The result leads us to reject this hypothesis and conclude that health care amenities havean effect on healthcare outcomes. The implication of the result is that it is only healthcare infrastructure that affectsthe outcome. Provision of other factors such as basic sanitary service and improved drinkable water have a significant effect on health outcomes.

# CHAPTER FIVE

# SUMMARY OF FINDINGS, POLICY RECOMMENDATIONS, AND CONCLUSION

## 5.1 SUMMARY OF FINDINGS

This research work focused on healthcare infrastructure on health outcomes in ECOWAS countries.The study employs a panel analysis of the 15 countries in the region. The countries are Nigeria, Ghana, Senegal, Mali, Benin, Niger, Cote D'Ivoire, Gambia, Guinea, Guinea Bissau, Burkina Faso, Sierra Leone, Carbo Verde, Togo, and Liberia. The data also spanned from 1990 to 2017. In other to achieve the above target, the study set up three objectives which could serve as a guide. The specific objectives include the assessment of healthcare personnel on health outcomes, the impact of healthcare facilities on health outcomes, as well as the effect of other factors affecting health outcomes. Random effect estimator was used for the first objective and discovered that health workers are vital in the provision of healthcare services. Independent variables such as the density of physicians and skilled birth attendants were discovered to lead to a reduction in infant mortality. We employed a fixed effect estimator for the second objective which focused on health facilities and health outcomes. To evaluate this, we regress the under-five mortality rate per 1,000 people on hospital centers, hospital beds, and immunization. The result indicated that all our variables are significant in the reduction of under-five mortality rate. Likewise, we estimate the third objective with the fixed-effect model. We regress the under-five mortality rate on independent variables such as basic sanitary services, mobile cellular subscription, improved drinkable water, external health expenditure, out-of-pocket payment, and domestic government health expenditure. Except for domestic government health expenditure that was positive, all other variables are significantly lead to a reduction in under-five mortality in the ECOWAS region. Healthcare infrastructure is therefore central to the enhancement of health outcomes in ECOWAS countries.

## 5.2 POLICY RECOMMENDATION

After observing the relationship that exists between healthcare infrastructure and health outcomes, we will recommend the ensuing policies to stimulate sustainable improvement in

healthcare infrastructure and service delivery so that mortalities wound reduce drastically in ECOWAS countries.

1. Since the study found that an increased density of health workers would reduce mortality. The study, therefore, recommends improvement in the working conditions of health workers. In addition, the remuneration of healthcare workers should be adjusted to what is obtainable outside the country to discourage brain drain. Also, there should be access to better technology, massive rehabilitation of hospitals through the provision of pipe bone water, electricity and good road networks which will put an end to the recurring brain drain in the health sector.
2. Despite the fact that user-fee or out-of-pocket expenditure has continued to reduce the under-five mortality rate in ECOWAS countries, the government should reduce user-fees by ensuring that the poor majority have access to health. Government across ECOWAS countries should strive to introduce measures that would encourage access to healthcare services such as healthcare insurance, free healthcare services, and enlightenment of the public on the need to use healthcare centers for effective healthcare service and improved outcomes.
3. To increase the effectiveness of healthcare infrastructure on access to healthcare, the government should set aside a special fund to provide technological equipment, massive rehabilitation of hospitals, and provision of pipe-borne water, electricity and good road networks within health centers. This will put a drastic end to medical tourism, a trend common among the affluent of society. An improved healthcare infrastructure would improve service delivery. A better healthcare system will mean more patronage of hospital centers. In the long run, this will reduce the request for foreign exchange and thereby reduce pressure on foreign currency in the region.
4. The study also recommends that laws should be enacted to increase the budget allocated to human capital development, as this is capable of causing a positive impact on economic growth.
5. Finally, the study recommends that ECOWAS should be more assertive with member state when it borders on issues relating to the health of her citizens. As the economy cannot prosper with an ailing population. This will turn ECOWAS countries to health care destination among other African countries.

## 5.3 CONCLUSION

This study examines the effect of healthcare infrastructure on access to health outcomes in ECOWAS countries with data from all member states. The countries used in the study include Nigeria, Ghana, Senegal, Mali, Benin, Niger, Cote D'Ivoire, Gambia, Guinea, Guinea Bissau, Burkina Faso, Sierra Leone, Carbo Verde, Togo, and Liberia. Fixed and random effects estimation technique was applied in the data analysis. Pre-estimation and post estimation tests were also carried out to ascertain the nature of the data and to examine the robustness of the regression result. The result indicated that physicians and skilled birth attendants havea significant effect on health outcomes. The result likewise shows that more health facilities and other amenities are also important determinants of health outcomes among member states. From the holistic study of previous literature and analysis obtained from this current study, the study concludes that the result presented in this study are meaningful for policymaking.

In the course of the study, we encounter some limitations which we believe future studies can improve on. The limitations spanned from the fact that the countries being studied lacked robust data needed for the analysis. Some vital variables that are important are not available to the researcher. Another drawback faced in this study was that of incomplete data. Some countries do not have complete data and this may affect the conclusion of the research. Also, the lack of information about the target population of people that receives healthcare services also posed some limitations to this current study. To crown it all, the researcher was unable to use primary data due to inadequate finance and time. Owning to these constraints, the researcher acknowledges any inadequacies or anomalies that were encountered in the work.

Based on the limitations encountered and some current gaps uncovered in this study, other researchers could as well explore the following areas for a better understanding of the effect of healthcare infrastructure on access to healthcare service delivery in ECOWAS countries. They are as follows:

1. The Impact of healthcare on productivity in developing countries
2. Brain drain, healthcare and human development in West African countries.
3. The Impact of medical tourism on economic development in West African countries.

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# Appendix

```
  ___  ____  ____  ____  ____ (R)
 /__    /   ____/   /   ____/
___/   /   /___/   /   /___/   11.0   Copyright 1984-2009
  Statistics/Data Analysis             StataCorp
                                       4905 Lakeway Drive
     MP - Parallel Edition             College Station, Texas 77845 USA
                                       800-STATA-PC        http://www.stata.com
                                       979-696-4600        stata@stata.com
                                       979-696-4601 (fax)

Single-user 4-core Stata license expires 31 Dec 9999:
       Serial number:  71606281563
         Licensed to:  Oluwafemi
                       Devine

Notes:
      1.  (/m# option or -set memory-) 50.00 MB allocated to data
      2.  (/v# option or -set maxvar-) 5000 maximum variables

. edit

. *(20 variables, 420 observations pasted into data editor)

. encode country, gen (c)

. drop country

. rename c country

. move country year

. egen c_id=group(country)

. move c_id year

. xtset country year
       panel variable:  country (strongly balanced)
        time variable:  year, 1990 to 2017
                delta:  1 unit

.
```

## LM test for Random Effect

## Model 1

```
. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        imr[country,t] = Xb + u[country] + e[country,t]

        Estimated results:
                         |       Var     sd = sqrt(Var)
                ---------+-----------------------------
                     imr |   1775.362       42.13505
                       e |   495.7397       22.26521
                       u |   248.5458       15.76534

        Test:   Var(u) = 0
                             chi2(1) =     7.60
                          Prob > chi2 =     0.0058
```

## HAUSMAN TEST

## MODEL1

```
. hausman fe re

                 ---- Coefficients ----
                 (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
                  fe           re         Difference          S.E.
-------------------------------------------------------------------------------
         phy    -4.952651   -7.021297        2.068646        2.105439
          nm     .3907254   -.4256902        .8164157        1.065808
         brt    -1.592259   -1.008544       -.5837149        .4276498
-------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =          2.85
                Prob>chi2 =        0.4146
```

## MODEL 2

```
. hausman fe re

                 ---- Coefficients ----
                 (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
                  fe           re         Difference          S.E.
-------------------------------------------------------------------------------
          hb    -.7922991   -.9192638        .1269647         .036475
          hc    -8.064584   -1.064874       -6.99971         1.77204
         imm    -1.440109   -1.490791        .0506825        .0009491
-------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =         18.30
                Prob>chi2 =        0.0004
                (V_b-V_B is not positive definite)
```

## MODEL 3

```
. hausman fe re

                 ---- Coefficients ----
                 (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
                  fe           re         Difference          S.E.
-------------------------------------------------------------------------------
         bss    -.3004187   -.1314851       -.1689336        .1390232
         idw      -3.9312   -3.604959       -.3262411        .1415462
         oop     -.086705    -.068682        -.018023         .013061
         mcs    -.1268094   -.1730918        .0462824        .0179032
-------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =         11.05
                Prob>chi2 =        0.0260
                (V_b-V_B is not positive definite)
```

# MODEL ESTIMATION

## Model 1

```
. xtreg imr  phy nm brt, re

Random-effects GLS regression                   Number of obs      =        35
Group variable: country                         Number of groups   =        15

R-sq:  within  = 0.3932                         Obs per group: min =         1
       between = 0.5524                                        avg =       2.3
       overall = 0.5687                                        max =         5

Random effects u_i ~ Gaussian                   Wald chi2(3)       =     28.83
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000
```

| imr | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| phy | -7.021297 | 2.770769 | -2.53 | 0.011 | -12.4519 | -1.590689 |
| nm | -.4256902 | 1.309337 | -0.33 | 0.745 | -2.991944 | 2.140564 |
| brt | -1.008544 | .275333 | -3.66 | 0.000 | -1.548187 | -.4689015 |
| _cons | 145.5841 | 16.30267 | 8.93 | 0.000 | 113.6315 | 177.5367 |
| sigma_u | 15.765336 | | | | | |
| sigma_e | 22.265213 | | | | | |
| rho | .33393881 | (fraction of variance due to u_i) | | | | |

## Model 2

```
. xtreg  u5m hb  hc imm, fe

Fixed-effects (within) regression               Number of obs      =       375
Group variable: country                         Number of groups   =        15

R-sq:  within  = 0.5688                         Obs per group: min =         9
       between = 0.3745                                        avg =      25.0
       overall = 0.3342                                        max =        28

                                                F(3,357)           =    157.00
corr(u_i, Xb)  = -0.7618                        Prob > F           =    0.0000
```

| u5m | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| hb | -.7922991 | .1657308 | -4.78 | 0.000 | -1.11823 | -.4663678 |
| hc | -8.064584 | 1.970627 | -4.09 | 0.000 | -11.94008 | -4.189087 |
| imm | -1.440109 | .0799849 | -18.00 | 0.000 | -1.59741 | -1.282808 |
| _cons | 296.8324 | 12.97953 | 22.87 | 0.000 | 271.3065 | 322.3584 |
| sigma_u | 61.309859 | | | | | |
| sigma_e | 26.373551 | | | | | |
| rho | .84385005 | (fraction of variance due to u_i) | | | | |

```
F test that all u_i=0:     F(14, 357) =    17.18             Prob > F = 0.0000
```

```
. xtscc u5m hb hc imm, fe

Regression with Driscoll-Kraay standard errors  Number of obs      =       375
Method: Fixed-effects regression                Number of groups   =        15
Group variable (i): country                     F(  3,    27)      =     41.12
maximum lag: 3                                  Prob > F           =    0.0000
                                                within R-squared   =    0.5688
```

| u5m | Coef. | Drisc/Kraay Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| hb | -.7922991 | .12945 | -6.12 | 0.000 | -1.057909 | -.5266896 |
| hc | -8.064584 | 2.915257 | -2.77 | 0.010 | -14.0462 | -2.082971 |
| imm | -1.440109 | .196251 | -7.34 | 0.000 | -1.842783 | -1.037435 |
| _cons | 296.8324 | 22.07243 | 13.45 | 0.000 | 251.5435 | 342.1213 |

# Model 3

```
. xtreg u5m  bss mcs idw exh oop  ghe   , fe

Fixed-effects (within) regression               Number of obs      =       239
Group variable: country                         Number of groups   =        15

R-sq:  within  = 0.7900                         Obs per group: min =        15
       between = 0.3616                                        avg =      15.9
       overall = 0.4453                                        max =        16

                                                F(6,218)           =    136.71
corr(u_i, Xb)  = -0.5603                        Prob > F           =    0.0000

------------------------------------------------------------------------------
         u5m |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         bss |  -1.230867   .3151881    -3.91   0.000    -1.852073   -.6096607
         mcs |  -.1800117   .0484154    -3.72   0.000    -.2754339   -.0845895
         idw |  -3.508164    .341142   -10.28   0.000    -4.180523   -2.835806
         exh |  -.1428725    .079814    -1.79   0.075    -.3001784    .0144334
         oop |  -.1122883    .046992    -2.39   0.018    -.2049051   -.0196715
         ghe |   .8567859   .1448418     5.92   0.000     .5713164    1.142255
       _cons |   368.5161   19.54842    18.85   0.000      329.988    407.0442
-------------+----------------------------------------------------------------
     sigma_u |  38.767251
     sigma_e |  12.132457
         rho |   .9107952   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(14, 218) =    48.96             Prob > F = 0.0000


. xtscc u5m  bss mcs idw exh oop  ghe   , fe

Regression with Driscoll-Kraay standard errors   Number of obs     =       239
Method: Fixed-effects regression                 Number of groups  =        15
Group variable (i): country                      F(  6,    15)     =    331.97
maximum lag: 2                                   Prob > F          =    0.0000
                                                 within R-squared  =    0.7900

------------------------------------------------------------------------------
             |               Drisc/Kraay
         u5m |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         bss |  -1.230867   .2625754    -4.69   0.000    -1.790533   -.6712003
         mcs |  -.1800117   .0512118    -3.52   0.003     -.289167   -.0708564
         idw |  -3.508164   .2952341   -11.88   0.000    -4.137441   -2.878888
         exh |  -.1428725   .0636113    -2.25   0.040    -.2784567   -.0072883
         oop |  -.1122883   .0357913    -3.14   0.007    -.1885756   -.0360009
         ghe |   .8567859   .1854003     4.62   0.000     .4616145    1.251957
       _cons |   368.5161   18.48384    19.94   0.000     329.1188    407.9135
------------------------------------------------------------------------------
```

## Diagnostic Test

# Test for heteroscedasticity

# Model 2

```
. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

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

chi2 (15)  =    2343.66
Prob>chi2 =      0.0000
```

## Model 3

```
. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

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

chi2 (15)  =    8993.66
Prob>chi2 =      0.0000
```

# SERIAL CORRELATION TEST

## Model 2

```
. xtserial  u5m hb hc imm

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,      13) =    193.748
           Prob > F =      0.0000
```

## Model 3

```
. xtserial  u5m  bss idw oop mcs

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,      14) =     24.710
           Prob > F =      0.0002
```

# Cross-sectional dependence Test

## Model 2

```
. xtcsd, pesaran abs

Pesaran's test of cross sectional independence =     7.839, Pr = 0.0000
Average absolute value of the off-diagonal elements =     0.498
```

## Model 3

```
. xtcsd, pesaran abs

Pesaran's test of cross sectional independence =     3.820, Pr = 0.0001
Average absolute value of the off-diagonal elements =     0.675
```