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HEALTHCARE FACILITIES MAPPING WITHIN ABUJA MUNICIPAL AREA COUNCIL, FCT – ABUJA

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ABSTRACT

This study analyzes the geospatial distribution of healthcare facilities in some wards within Abuja Municipal Area Council, so as to achieve the following objectives: identifying and mapping healthcare facilities in the study area, assessing the distribution and utilization patterns of healthcare facilities within the study area, creating a Database Management System. A handheld GPS (Garmin GPSMAP 62) was used to acquire coordinates of health facilities. Records of location, ownership and type of health facilities in the study area which constituted attribute

Introduction

In Nigeria, the provision of health care centers is concurrently the responsibility of the three tiers of government. However, because we operate a mixed economy, private providers of medical healthcare services have roles to play in the delivery of healthcare. The role of the federal government is mostly limited to the coordination of the affairs of university teaching hospitals, federal medical centers (tertiary health care) whereas, state governments have the role of managing various general hospitals (secondary health care) within the state. The local government focuses on dispensaries (primary health care) which are regulated by the federal government. (Abbas, Auta, Na'iya, 2012).

GIS (Geographic Information System) is a valuable tool that assists in health research planning, monitoring, as well as evaluating health systems. Hence, GIS can be defined as the science and technology related to the gathering, storage, manipulation, analysis and visualization of georeferenced data. This technology can be linked with health care management and it has the great potential for solving issues that could be very difficult and complex (Zacharias *et al* 2016).

In our world today, digital mapping through GIS has become an indispensable tool with regards to solving environmental-based problems. The methodology adopted for the production of digital maps depends on the level of details that are required, the use to which the map will be put into, as well as the source of the data. Digital mapping operations are very useful in helping organizations achieve significant, analytical as well as operational advantages.

data of the facilities were taken. Probability sampling of individuals was done during the administration of questionnaires and sample size was determined using the Krejcie and Morgan (1970) table. An existing map of the study area was georeferenced and digitized using ArcGIS 10.1 after which the coordinates and all other attribute data obtained were imported into the same software for further analysis. Maps showing health facilities within the Study area were produced, Buffer analysis was performed and the Nearest Neighborhood analysis was also carried out. Other analysis performed were SPSS analysis in which Logistic regression was carried out to help determine the utilization of the facilities, cross tabulation analysis was also performed to further analyze the questionnaires administered to respondents and finally, Detrended Correspondence Analysis (DECORANA or DCA) was performed to observe the relationship that existed in the dataset collected. A total number of 46 healthcare facilities were recorded in the study area of which 8 were Primary Health Care, 4 were Secondary Health Care, and 34 were private healthcare facilities. The buffer analysis of 4km performed showed that the health facilities were clustered and Karu Ward was the only ward well serviced with health facilities. A database containing all information on the health facilities recorded was also created to aid further manipulation, storage and easy retrieval of data via query operations. It is therefore recommended that the government should ensure that facilities provided should be in proportion to the population being served and also assist in training and recruiting more health workers to meet the health needs of the ever-increasing population.

Location intelligence has empowered even non-Geographic Information Systems (GIS) experts in gaining advantages through the use of location in making more insightful everyday decisions. GIS which has the ability to manipulate spatial data, the ability to gather and store, manipulate and analyze, as well as visualize georeferenced data has offered several opportunities in the creation of a realistic perspective of the world and a chance to see the future action (Burrough, 2001).

In the Health sector, health care planning is interestingly a field that depends on spatial data. The location of health facilities, distribution of patients and their characteristics are examples of spatial data that are usually handled during local health planning. Some selected wards under Abuja Municipal Area Council have been selected as case study to show how GIS can be relevant to local health planners and also support their decisions.

The ability to have quick access to health care is a very vital component of an overall health system. This however has a direct impact on the burden of diseases that affect countries all over the world. Measuring accessibility to health care facilities therefore broadens our understanding of the geographical distribution of health systems within and between communities which facilitates the development of health policies based on concrete evidence.

The creation of a database for health care facilities and production of maps which help in the depiction of the spatial distribution and also providing information about location and their physical relationship to each other is the role GIS and computer application plays in the health

sector. GIS however integrates computer hardware, software and geographically referenced data. The purpose for the adoption of GIS in the health sector is the fact that maps provide an added aesthetic dimension to data analysis, which helps in the visualizing of any complex pattern and relationships. The relationships between neighboring areas are explicit in a map which gives room for efficiency in the visualization of spatial patterns.

The use of Geographical Information System (GIS) for the measurement of physical accessibility is well established. In the context of health care planning, the ability of GIS in the identification of the geographical extent of health facility within a catchment area, which corresponds to the area containing the population utilizing this facility, is particularly of immense importance. We are able to use GIS to ascertain the spatial distribution of these health facilities, knowing where each health facility is located, which areas have more health facilities as well as those areas that need more facilities.

Healthcare facilities have a high level of significance and quick access to them is a significant factor that contributes to a healthy population. GIS however offers organizational and analysis tools that aid in responding to the growing demands for healthcare and the limited budgets in meeting such demands. Public health organizations need GIS technology in order to understand population health, community health needs and in order to make relevant decisions.

Several scholars have used GIS to integrate different data and generate relevant information for decision making in health management. Benachi and Yasui (1999) however identified a positive correlation between deprivation of health centres and mortality rate. By the analysis of their data from 2,200 small areas of Spain, they obtained two indices of deprivation and concluded that deprived areas had excess mortality rates estimated at 35,000 deaths. Thus, they called for the intervention of the government in those deprived small areas of the country.

GIS and remote sensing are very suitable for use in the surveillance and control of infectious diseases, particularly for vector borne disease which are often found rural areas. They are also of great relevance in meeting the demand of outbreak investigation as well as response, where location data are required, rapid communication of information and quick mapping of the epidemics dynamics are important.

Statement of Research Problem

In recent times, there has been increase in population which has led to the increase in demand for several basic amenities and infrastructure. The difficulties in controlling the growth of population has made it difficult to provide resources that can meet the increasing needs and demands for essential public services like education, housing and most especially healthcare. Several healthcare centers exist within the study area but it has not been established whether these health facilities are easily accessible, adequately enough, equally distributed and efficiently utilized. This however forms the basis of this research.

One of the problems associated with the spatial distribution of health facilities in Nigeria is the fact that there is bias in their distribution. While some communities have access to health facilities, other people have to travel from their communities to other places to have access to healthcare. However, this increases the risks associated with emergency cases. When health facilities are not easily accessible in cases of accidents, women in labour, and medical conditions that require

immediate attention, it increase the mortality rate. This has been the case of rural areas within our country. Some rural areas however have access to health facilities but they are inadequate. As a result, such facilities cannot meet the healthcare needs and demand in those communities.

The criteria for health care planning for third world countries was specified by World Health Organization, WHO (1997). In order to have adequate and equity of access to health centres, WHO indicated that each service area should cover a catchment area of 4km2 with a population of 60,000 for primary health care. A number of healthcare facilities exist within the study area but it has not been established whether or not these existing facilities are adequate and distributed in the right proportion. In line with WHO (1997), this study therefore aimed using GIS techniques to map the spatial distribution of health care centres within the study area.

Research Questions

1. Is there equity in the distribution of healthcare facilities?
2. Are healthcare facilities easily accessible by everyone within and around these wards?
3. How effectively are such facilities utilized?

Aim and Objectives of the Study

The aim of this research is to map the geospatial distribution, determine the accessibility and utilization of healthcare facilities in Nyanya, Karu, Orozo and Karshi wards of Abuja municipal area council, FCT Abuja, using GIS techniques.

The objectives of this research include the following:

1. To identify and map healthcare facilities in the study area
2. To assess the distribution and utilization patterns of healthcare facilities within the study area
3. To create a Database Management System

Empirical Review

An Overview of Healthcare and Health Services

A very significant indicator of social development is healthcare. In an overall healthcare system, access to the health facility is very important and has an influence on mortality rate and the spread of diseases. Hence, the spatial distribution of health facilities across a country is important to planners. The inequitable distribution of these facilities over space is an issue of concern and however gives rise to the issue of provision and effective utilization of the facilities. Health facilities are highly available in the urban areas and lesser in rural areas. One common factor used to measure an area's prosperity and quality of life is the number and quality of health facility in a country or region (Ijeoma Ayuba, 2016).

Health facilities include all public, private, non-governmental and community-based health facilities defined as a static facility (i.e., having a designated building) in which health services are generally offered. Health posts can be counted as static facilities, although they are generally small with minimal supplies and may need to be disaggregated for interpretation purposes (WHO, 2010).

Furthermore, health facilities can be referred to as the physical structure and supporting equipment established for provision of health services. It usually involves a structure with facilities

for different health service needs, equipment such as cold chain facilities for storage, management and use in the provision of health services to the population (Shrestha, 2010).

Markus and Makanjuola (2011) stated that health policies are usually geared towards the creation of a basic infrastructure as well as sufficient manpower for the effective delivery of health services for a population growing rapidly, putting into consideration primary, secondary and tertiary levels. Many studies have shown that healthcare facilities are available in communities and various district health systems. Therefore, their adequacy is judged based on the availability of healthcare facilities in a particular area of study, the utilization of services provided by the available health facilities and assessing whether or not the coverage goal is achieved. This research is aimed at developing a logical framework that can be used to judge the provision and spatial distribution of these facilities, hence, calling for subsequent intervention and improvements where necessary.

Health facilities as can be understood both qualitatively and quantitatively. This means that the quality of healthcare services and accessibility to health facilities delivery within a country can be judged using the quality of physical, technological and human resources available at a given period. The physical structure of health facilities comprises of the building and other fixed structures which include pipe borne water, good access road, electricity and other facilities within the health care environments, while, the technological aspect has to do with the equipment meant specifically for smooth running and use in the hospital. (Ijeoma, 2016).

Different ways and techniques have been used to measure the accessibility to healthcare facilities, which also depends on the context of application. The need for the provision and equal distribution of health facilities have risen in order to meet set health goals in addition to the Millennium Development Goals. Nigeria being a member state seeks to pursue strategies to complement the effort of African Union in its goals of increasing better health for all, it states that:

- All citizens should have equal access to the services which they are entitled.
- To have a healthy and safe environment.
- Access to health care.
- Maintaining land use policy to avoid inappropriate depletion of community's facility land.

The problem of provision multiple facilities to serve people with healthcare services and healthcare information exists, therefore there is need for the proper distribution of these facilities in order to aid in maximizing accessibility and in turn help the government and other stakeholders save cost through the provision of health facilities that would efficiently be utilized by an entire population and most importantly optimize the delivery of healthcare.

The need for this research arises because data on health facilities and resources available to the health system are very vital in equipping the government, community and other stakeholders in determining the most effective ways of meeting the health-related needs of the population. However, the availability of health services are not enough criteria to serve as indicators that can accurately reflect access to and utilization of services. Take for instance, clients may avoid using local facilities or decide to utilize facilities lying outside their immediate catchment area due to travel logistics, sociocultural preferences and the issues regarding quality which may be actual or perceived. Urban areas however are faced with a peculiar challenge because, even though facilities may be in close proximity, the issues of affordability and acceptability also tend to be more important obstacles to access (WHO, 2010).

GIS has been used by various scholars for the integration of different data in order to generate the required information for decision making in health management. Its first application was seen in 1854, when John Snow an anesthesiologist mapped out disease outbreaks in order to gain more insights to their causes. The highest density of cases that occurred in households that used the public pump on Broad Street as their water source were mapped out by Snow. This was the beginning of GIS as Snow began to map the location of outbreaks, roads, water lines as well as property boundaries. When all these features were added to his map it was interesting to find out that common cases of cholera were found along the water line. John snow's Cholera map was what connected GIS and the health sector and also brought about the era of spatial analysis of data. He demonstrated that GIS is a tool for solving problems by the lifesaving discovery he made. (GISGeography, 2018).

Geographical Information System (GIS) inculcated into Health Management Information System (HMIS) could be a very powerful and useful tool in making the delivery of health care more efficient and effective. It includes but not limited to management of database, planning purposes, risk service area mapping, identification of location, etc. One of the reasons why there is a sudden surge of GIS use in healthcare application is due to the fact that health related factors have spatial dependency. GIS application helps capture, store, combine, analyze and display data using Remote Sensing, topographical surveys, urban survey and town planning, geology, hydrology, traffic and transport engineering, land use pattern, rainfall pattern, and drainage. (Ashok, 2015)

GIS has the ability to manipulate geographic data. Its ability to gather, store, manipulate, analyze and visualize georeferenced data has brought several opportunities that aid in creating a realistic perspective of the world and also gives us the chance to envisage the future action. This unique ability provided by GIS has brought many experts the opportunity to distil and integrate large spatial data sets into useful information which therefore offers a new perspective and unique approaches to finding solution to problems. GIS is applicable in virtually every facet of our daily lives, and the data it uses varies. These data that are geographically referenced or spatial in nature can be used in depicting the spatial context of various fields, creating models and predicting future occurrences. (Abubakar Sadiq and Ibrahim Mohammed, 2013).

Environmental health began to interact with geospatial analysis as a result of the advancement in computing. The relevance of this is seen in the ability to view maps, identifying areas where diseases are prevalent, identifying breeding grounds for pests, determining spatial population distribution for health studies, as well as determining the ratio, location and distribution of health facilities.

Geographic Information Systems (GIS) is a science and geospatial technology that can be utilized in the identification and display geographic patterns of diseases, the assessment of environmental exposures, estimation of incidence, prevalence, and survival statistics as well as expose health disparities in order to enhance effective communication with the public, business and political leaders. The management of public health requires information on aspects which includes the number of health facilities that are available and their distribution as well as prevalence of diseases in order to take decisions on either creating additional infrastructure facilities or for taking immediate action to respond to situations. GIS is fast becoming a vital tool in healthcare applications covering database management, planning, risk assessment, service area mapping and location identification (Tahir, 2010).

Geospatial technology has availed the field of public health and epidemiology with a very vital tool for the visualization of disease burden spatially and helping in the analysis of data. This new opportunity GIS provides was once technologically out of reach. Considering Nigeria's huge strides in the field of ICT, an urgent need has arisen for the development of technology assisted strategies that would aid in the planning of a very suitable model which will help to capture data for a wide

variety of patients for the development of an automated cloud based technique for the systematic storage and management of data. The development of a generic model is aimed at facilitating the decision makers in the derivation of strategies from the managed data and the incorporation of the same in the provision of location based health services, allocating funds in order to meet the required needs as well as monitor the progress as an ongoing activity. Praveenkumar *et al* (2014).
Benachi and Yasui (1999) established the fact that there exists a positive correlation between the rate of mortality and deprivation of health centres. From the result of their analysis of 2,200 small areas of Spain, two indices of deprivation were obtained and they concluded that, deprived areas had excess mortality rates estimated at 35,000 deaths. They then called upon the government to intervene in those deprived small areas of the country. Olajuyin et al, (1997) also investigated the effect of location on the utilization of healthcare centres in Irewole local government area of Osun State, Nigeria. For their research they made use of population data, list of health centres and their locations, and the distance between settlements and each health center. The result of their research showed that health centres were not evenly distributed among the settlements and a paramount factor was distance.
Dzikwi and Abbas (2012) also used GIS technique to map the spatial distribution of rabies in Kaduna State. GIS was used in the analysis of record data obtained from the state ministry of agriculture and maps from their archives to track the spread and management of the disease within the state.

Benefits of GIS in Healthcare

Technology has brought about tremendous advancement in the health sector. One of these interesting technologies has to do with addressing geographical links to diseases as well as geographical location of healthcare facilities. Geographic Information System has made it easy to deal with issues pertaining location. The systems deals with sophisticated mapping software that enables users to visually display geographic data. The visual display of these data allows users to see the geographical grouping of demographic data of patients.
Below are some benefits of Geographic Information System in Healthcare.

- **Tracking the Spread of infectious diseases:** The role of GIS goes beyond tracking the occurrence of diseases. One of the most powerful abilities GIS has in healthcare is the ability to track and identify where diseases are most likely to spread next. These kind of data can help health workers prepare in advance for the disease and as well reduce their impact.
- **Identifying health trends:** With the aid of GIS software, healthcare professionals are able to identify trends related to health and also identify healing efforts based on those trends. With the rate of increase of chronic diseases like cancer, cardiovascular diseases, diabetes and the likes, GIS has the ability for the provision of effective methods that can be used in addressing where certain diseases are more likely to occur or where those diseases are prevalent. This helps health workers to be more proactive in the implementation of preventive strategies.
- **Utilization of Personal Tech:** Collecting huge quantity of accurate personal data is expected to reveal so much about personalized healthcare. Personalized healthcare technologies are powerful tools for imputing information into a GIS because of the ability they have to inform statistical studies. It has the potential of uncovering long term geographic trends with regards to demographics of people living in an area. Some devices that can be worn have the capability to collect broad information like the average heart rate, pattern of sleep, exposure to sunlight. When these data are added to a GIS, it could help in determining whether the average heart rate and pattern of sleeping differs over

geographic locations. If such variations exist, the discovery of the reason of such existence could pave way for new realms of research in healthcare.

- **Improvement of services:** GIS technology can be used by community leaders and developers as the work more closely with hospitals in order to address national healthcare needs. GIS can also help in the identification of those neighborhoods that have great need for healthcare facilities. It is a tool that can enhance effective decision making.

The benefits of Geographic Information System to healthcare cannot be over emphasized. It is a powerful tool that can be used to address significant health issues when implemented. Diseases management and improvement of healthcare services can be achieved using GIS. If this technology is adopted by more health professionals, the benefits would continue to increase as well as the connection between hospitals and the communities they are serving.

Materials and Method

Study Area.

Karshi Development area is consists Nyanya, Karu, Orozo and Karshi which are four wards within the Abuja Municipal Area Council (AMAC) one of the six area councils in the Federal Capital Territory. The Municipal Area council is the local government responsible for administration of the city.

Nyanya Ward: Nyanya is a satellite town that borders Abuja and Nassarawa state. This ward shares boundary with Karu ward. It is located along the major route that links Nassarawa state and the Federal Capital. This region is mostly a residential area for the working population in Abuja and is popular for its Nyanya market. Its

The following regions constitute Nyanya Ward:

- Kugbo
- Gbagalape
- Angwa Bawa
- Nyanya Site, Area A – F

Karu Ward: Karu is a satellite town within the Abuja Municipal area council and located between Latitude 9° 0' 39" North and 7° 34' 31" East. It connects Nyanya to Orozo and Karshi wards. The Gbagyis are the predominant tribe in this. However, other inhabitants include Hausa, Tiv, Yoruba Igbos and other tribes which form the minority.

The following regions constitute Karu Ward

- Karu Village
- Karu Site (FHA)
- Jikwoyi

Orozo Ward: Orozo is another town located in the Federal Capital Territory. It is located between 8° 54' 43" North and 7° 34' 22". It is located between Jikwoyi and Karshi

The following regions constitute Orozo Ward

- Ajata
- Anka
- Badna
- Gidan daya
- Gidan Mangoro
- Kpeyegyi
- Kurudu

- Kurudu Gwandara
- Orozo I
- Orozo II

Karshi Ward: Karshi is a satellite town located in the FCT and situated in Abuja municipal area council with its geographical coordinates being 8° 49' 40" North, 7° 33' 0" East. Gwandaras are the predominant tribe in this region and constitute about 85% of the total population. Gbagyi, Gade, Fulani, Hausa, Tiv, Idoma and Yoruba. Farming, blacksmithing and hunting are the predominant occupations of the inhabitants.
The following regions constitute Karshi Ward.

- Karshi West
- Karshi East
- Karshi South

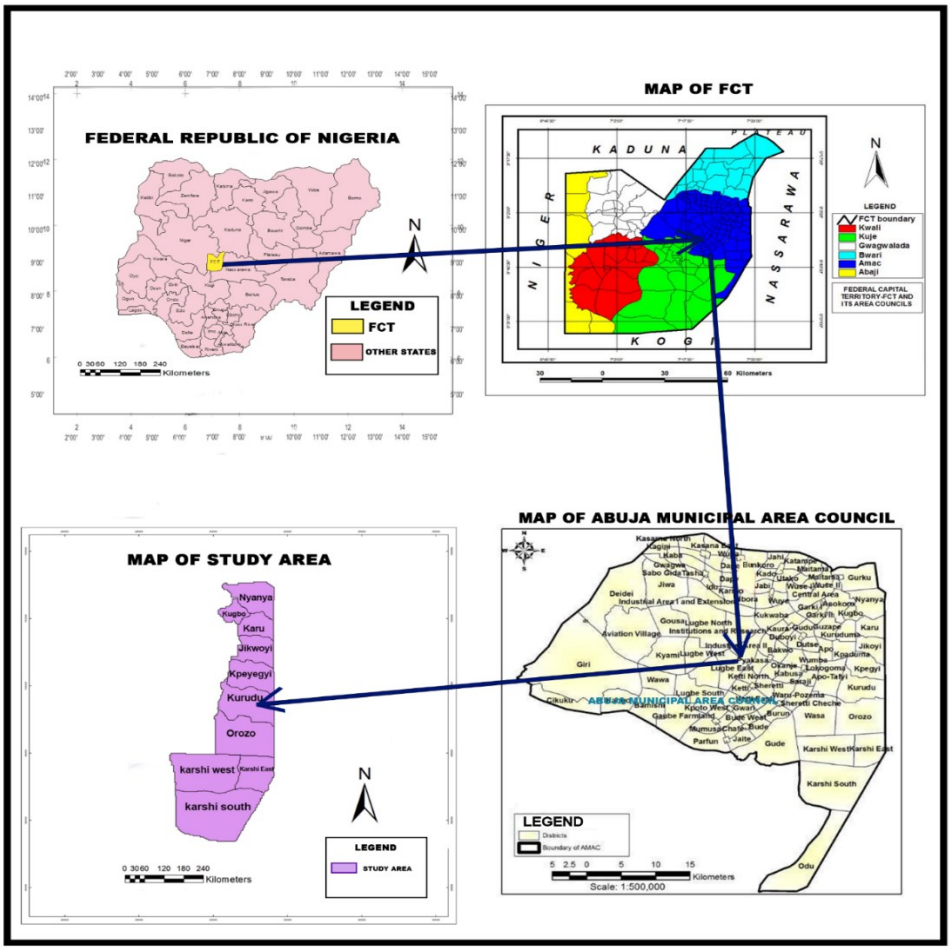

Figure 1: Maps Showing the Study Area

Reconnaissance

Prior to the commencement of any field survey, the area of interest ought to be examined critically by the researcher. This is the first and very vital aspect of any field survey operation, which gives

the researcher an overall picture of the area of interest that would be covered in the course of the data acquisition. This will help in gathering all relevant information that would serve as a guide while collecting data as well as help the researcher decide the best methods to adopt and asses any possible risk that might arise.

Reconnaissance usually involves the following tasks:

- Critical examination of the research in order to understand the purpose
- Planning stage
- Choosing the most efficient method for carrying out the task
- Identifying possible limitations and seeking possible means to avert or reduce them.

Field Reconnaissance

Field Reconnaissance involves the actual visitation of the site where data is to be collected. This is done to carry out further investigation about the area and gather all necessary information needed to aid the task. The researcher also familiarizes himself with the area during this process, making it easier to collect data.

Sampling/Training of Research Assistants

During the cause of data collection, all health facilities within the study area would be visited. Spatial and attribute data would be collected. Also, the opinion of individuals with regards to accessibility and utilization of these health facilities would be sampled. This would be done by administering questionnaires, hence the need for sampling.

In order to achieve all these, there would be need to get and train research assistants that would help in the data collection process. The training involves instructions on how the questionnaire is to be completed as well as detail review of the questions contained in the questionnaire. Also, data collection techniques, interviewing techniques, and field procedures were also part of training because vital information regarding this study has to be obtained first hand.

Sample Frame

Four wards in the Abuja municipal area council which consist of about 21 communities were classified as units which serve as the Primary sampling Units. All these communities were visited for sampling of respondents as well as collection of data on health facilities located in the area.

The population covered by this study is defined as the universe of all men and women age 15 and above within the study area.

A probability sample of individuals and households were then selected and all men and women identified in the universe were eligible interviewees.

Based on the Krejcie and Morgan (1970) table, the sample size of the study area is given below:

Table 1: Showing population and Sample size of study area

S/No.	WARD	Population	Sample Size
1	Nyanya	199,481	384
2	Karu	243,041	384
3	Orozo	62,261	382
4	Karshi	42,990	381

Source: Abuja Municipal Area Council (AMAC)

Data Collection

This stage involves the collection of primary and secondary data. All relevant data needed for the achievement of the aim of this research are gathered in this stage.

Two types of data would be collected in this stage of the research.

- **Primary Data:** this includes geographical coordinates of health facilities as well as the attribute data of such facilities. Also, data collected by means of administering questionnaires fall under this category as well as other data collected by means of surveys carried out on the site.
- **Secondary Data:** Data from Archives and all other forms of existing data fall under this category. Existing maps, population data and statistical data needed for tis research also fall under this category.

Results and Discussion

Mapping Identified Healthcare Facilities

Table 1 below shows all the healthcare facilities that were identified in the study area, the names, wards and locations in which those facilities were identified. A total number of forty-six (46) healthcare facilities which consisted government and private owned health centres were captured during the field work for spatial and attribute data collection. All information contained in the table are captured and stored in the data base which has been created for easy retrieval via various queries as well as updating when necessary.

From the records, it can be seen that Nyanya General Hospital is the Hospital with the highest number of bed spaces amounting to a total of 70 beds, followed by Karshi General Hospital which has 57 bed spaces.

Also, the table shows that Karu ward, which comprises of Karu and Jikwoyi has the highest number of health facilities in the whole area, a total of 25 health facilities. Orozo ward has the second highest with a total of 13 health facilities. Nyanya ward however has 5 facilities while Karshi ward has 3 health facilities, making it the ward with the least health facilities.

All these information and more can be retrieved from the database via various forms of query.

Table 1: Distribution of Public and Primary Healthcare Facilities in Karshi Development Area of AMAC.

S/ NO	Name of Facility	Location	Ward	Type Of Facility	Ownership	No. of bed Spaces	No. of patients per day	No. of Doctors	No. of Midwives	No. of Nurses
1	Michael Cross Specialist	Karu site	Karu	Private HC	Private	4	8	2	2	1
2	SOJ Healthcare centre	Karu Site	Karu	Private HC	Private	4	5	1	0	2
3	STEDMED Specialist Medical Centre	Karu site	Karu	Private HC	Private	5	7	2	1	2

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4	Fredrickson Medical Clinic	Karu site	Karu	Private HC	Private	4	10	1	1	3
5	East Vission Eye Clinic	Karu site	Karu	Private HC	Private	1	15	1	0	1
6	Nigeria Customs Medical Centre	Karu site	Karu	Secondary HC	Government	26	88	10	7	25
7	Care Hospital and Fertility Clinic	Karu site	Karu	Private HC	Private	10	10	2	2	2
8	IHOTU Telemedicine Clinic	Karu site	Karu	Private HC	Private	10	12	2	1	2
9	Karu General Hospital	Karu site	Karu	Secondary HC	Government	30	47	13	19	24
10	Primus Intl. Super Specialist Hospital	Karu site	Karu	Private HC	Private	35	40	15	12	15
11	LONA City Care Hospital	Karu site	Karu	Private HC	Private	15	20	2	2	4
12	Karu Primary Health Care	Karu Village	Karu	PHC	Government	5	60	1	1	0
13	Alpha Z Clinic	Karu Village	Karu	Private HC	Private	6	10	1	1	2
14	ECWA Comprehensive Medical Centre	Karu Village	Karu	Private HC	Private	17	20	3	5	5
15	Sister of Nativity Hospital	Jikwoyi	Karu	Private HC	Private	20	60	3	4	15
16	Cornelia Jubilee Hospital	Dagbadna	Karu	Private HC	Private	15	10	2	3	5
17	Success Meternity Clinic	Dagbadna	Karu	Private HC	Private	2	5	0	1	1
18	Rapha Hospital and Meternity	Jikwoyi	Karu	Private HC	Private	4	10	3	1	4
19	LONA City Care Hospital	Jikwoyi	Karu	Private HC	Private	10	12	1	2	3
20	Life Way Clinic and Meternity	Jikwoyi	Karu	Private HC	Private	3	2	0	1	1
21	Jikwoyi Pimary Health Care	Jikwoyi	Karu	PHC	Government	11	70	3	4	6
22	Jikwoyi Medical Centre	Jikwoyi	Karu	Secondary HC	Government	25	100	5	5	12

23	Eagles Vission Eye Clinic	Jikwoyi	Karu	Private HC	Private	0	10	1	0	1
24	WRISBERG Hospital	Jikwoyi	Karu	Private HC	Private	6	10	1	1	2
25	First Hospital and Meternity	Jikwoyi	Karu	Private HC	Private	8	15	2	2	3
26	De Rose of Sharon Hospital and Meternity	Kpeyegyi	Orozo	Private HC	Private	20	50	4	3	10
27	Kpeyegyi Primary Health Care	Kpeyegyi	Orozo	PHC	Government	10	40	1	2	3
28	Our Frontier Hospital and Meternity	Kpeyegyi	Orozo	Private HC	Private	4	10	0	2	1
29	Meye Hospital and Meternity	Kurudu	Orozo	Private HC	Private	8	70	2	1	5
30	Kurudu Primary Health care	Kurudu	Orozo	PHC	Government	10	50	1	1	2
31	Gilgal Hospital LTD	Kurudu	Orozo	Private HC	Private	15	20	3	2	4
32	Comprehensive Primary Health Care	Gidan Mangoro	Orozo	PHC	Government	12	160	3	4	5
33	Mayvour Clinic and Meternity	Angwan Mada	Orozo	Private HC	Private	4	5	0	1	2
34	Medi Crown Health Centre	Gidan Mangoro	Orozo	Private HC	Private	4	8	0	0	3
35	Excell Hospital	Orozo	Orozo	Private HC	Private	6	10	1	0	3
36	Orozo Primary Health Care	Orozo	Orozo	PHC	Government	5	43	0	2	2
37	MLOSH Clinics	Gidan Mangoro	Orozo	Private HC	Private	5	6	2	1	2
38	Cornelian Meternity Rural Clinic	Gidan Mangoro	Orozo	Private HC	Private	6	14	1	0	3
39	Habolu Hospital	Karshi	Karshi	Private HC	Private	8	10	1	1	2
40	Karshi General Hospital	Karshi	Karshi	Secondary HC	Government	57	96	17	53	67
41	Karshi Primary Health Care	Karshi	Karshi	PHC	Government	6	30	0	1	2

42	Nyanya General Hospital	Nyanya	Nyanya	Secondary HC	Government	70	155	21	58	75
43	Access Scan Hospital	Nyanya	Nyanya	Private HC	Private	8	12	1	1	3
44	Bismol Hospital and Maternity	Nyanya	Nyanya	Private HC	Private	15	25	3	3	4
45	Irefa Hospital	Nyanya	Nyanya	Private HC	Private	8	15	1	2	3
46	Saffron Hospital LTD	Nyanya	Nyanya	Private HC	Private	20	30	3	4	7
	TOTAL	-	-	-	-	**577**	**1515**	**142**	**221**	**349**

Source: Author's field work, 2019

The figures below show the mapping and geospatial distribution of healthcare facilities which were identified in the study area. From the map, all the facilities captured and their corresponding locations can be seen in the various communities. The legend on the maps helps in the interpretation of all information contained therein.

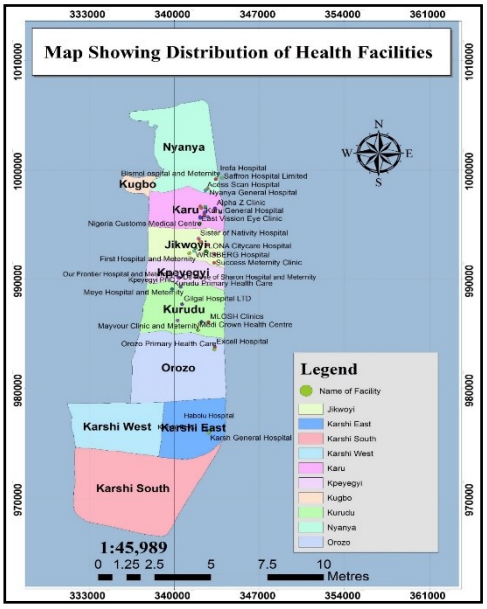


Figure 4: Map Showing Distributions of Health Facilities in Karshi Development Area of Abuja Municipal Area Council.

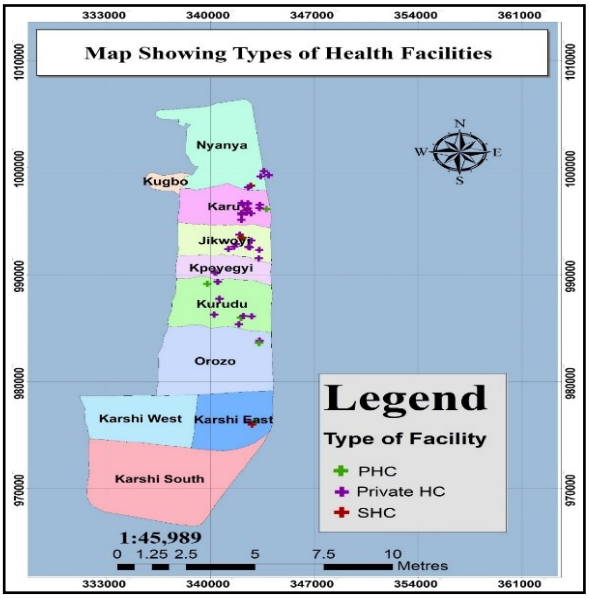


Figure 5: Map Showing Types of Health Facilities in Karshi Development Area of Abuja Municipal Area Council.

Ownership and Location of Health Care facilities.

Records from the research reveals that the private sector own 73.9% of healthcare facilities within the study area, which makes it the major player in healthcare delivery. The Government however owned 26.1% of the facilities. Also, the result revealed that Karu ward has the highest number of

healthcare facilities with a total of 25 healthcare center making 54% of the healthcare facilities in the entire study area.
No tertiary healthcare facility was found in any of the wards. Table 5 below shows the results in detail.

Table 2: Ownership and location of healthcare facilities.

Ward	Primary HC		Secondary HC		Tertiary HC		Private HC		TOTAL	
	No.	%	No.	%	No.	%	No.	%	No.	%
Nyanya	-	-	1	25	-	-	4	11.7	**5**	**10.3**
Karu	3	37.5	2	50	-	-	20	58.3	**25**	**54.3**
Orozo	4	50	-	-	-	-	9	26.7	**13**	**28.2**
Karshi	1	12.5	1	25	-	-	1	2.9	**3**	**6.5**
TOTAL	**8**	**100**	**4**	**100**	-	-	**34**	**100**	**46**	**100**

Source: Field work

Assessment of Distribution and Utilization of Healthcare Facilities in The Study Area.
Distribution of Healthcare Facilities by Sector
The distribution of health facilities and services by sector as shown in the table 6 depicts that the private sector owns 73.9% of the facilities, and has more bed spaces amounting to 53.7%. However, the government sector has more staffing compared to the private sector. 52.8% of the doctors were owned by the Government sector while 47.2% of belonged to the private sector. Also, 63.8% of the nurses were in the government sector while 36.2% were in the private sector. 71.1% of the midwives were in the government sector while the remaining 28.9% were in the private sector.

Table 3: Distribution of Health Facilities by Sector

Sector	Hospital/Clinics	%	Hospital Beds	%	Doctors	%	Nurses	%	Midwives	%
Government	12	26.1	267	46.3	75	52.8	223	63.8	157	71.1
Private	34	73.9	310	53.7	67	47.2	126	36.2	64	28.9
Total	46	100	577	100	142	100	349	100	221	100

Source: Field work, 2019

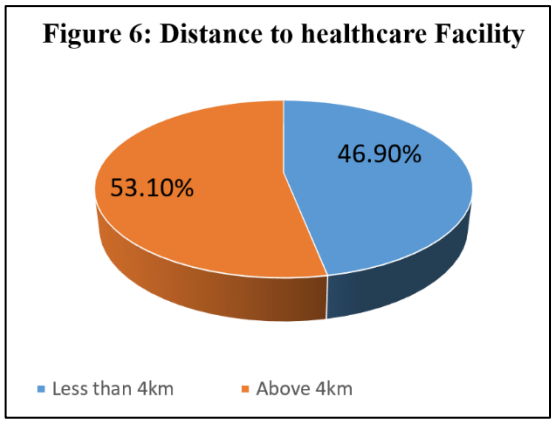
Based on the analysis of the results above, it is seen that the private sector plays a very important role in healthcare delivery. In line with its main objective, the National Health Policy Initiative

(NHPI) has continued to encourage the expansion of the private sector and has also promoted their participation in the delivery of healthcare services.

Population Access to Health Care and Equity in Distribution

Access to services is given by the convergence of demand and supply. A simple way to characterize accessibility is by indicators of closeness of facilities to a given residential place. Figure 66 shows the accessibility of healthcare in by the entire population in the study area. 46.9% of the population reside less than 4km away from health facilities while 53.1% of the population resided more than 4km away from health facilities. This indicates that 53.1% of the population cover above 4km to access primary, secondary or private health facility.

From the above results, it shows that there is no equity in the distribution of healthcare facilities across the study area. A higher percentage of the population do not have health facilities within 4km radius which is the WHO standard, hence they cover more distance in order to access healthcare.



Service Areas of Health Facilities

Although patients in Karshi development area of AMAC and its environs are at liberty to visit any facility of their choice, proximity has a way of influencing the utilization of health facilities closer to patients. Though other factors like variety of service provision, availability of manpower, efficiency and efficacy of treatment received exist, the issue with distance cannot be ignored. For this reason, Buffer analysis of 4 kilometers radius have been done in order to show the service area coverage of the health facilities in the study area.

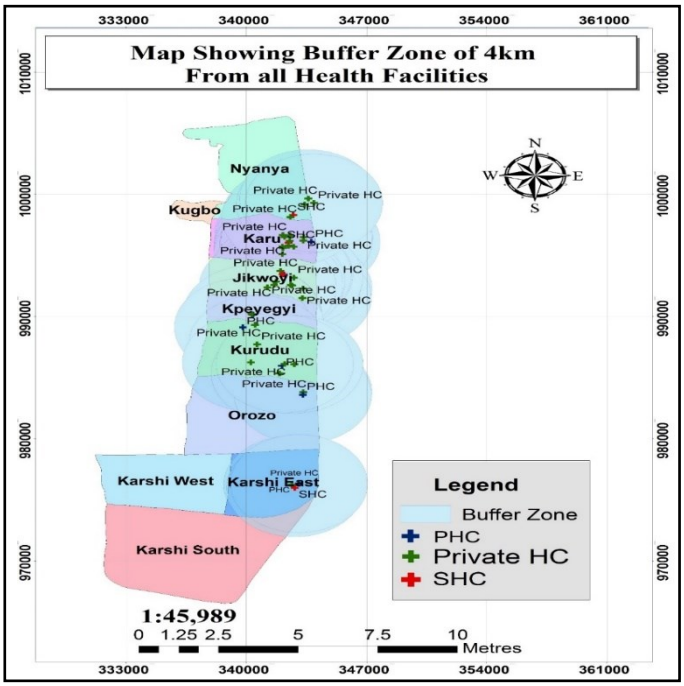
Buffer Analysis

This is one of the GIS operations that is done to automatically build buffer zones with specified width or distance around points, lines, or region geometric objects. One of the WHO standard for the citing of health facilities is that the facilities should cover a radius of 4km. beyond the 4km radius, another facility should be citied to ensure equity in distribution and easy accessibility. The specified buffer distance used for the analysis was 4km and the aim was to determine the circle band (service area) of the health facilities and areas that are not properly and efficiently served in terms of special accessibility.

The result showed that Karu ward was all covered and health facilities were easily accessible from all angles within the ward. Orozo ward was mostly covered though there were still some areas not within the catchment area of the health facilities in the ward. However, Nyanya and Karshi wards had larger areas that were not within close range to the existing health facilities. Figure 7 below shows the catchment area that all the health facilities cover.

As shown on the map only all parts of Karu ward is fully served. It is also evident that there is buffer zone overlap. However, most parts of Karshi ward and Nyanya ward are not served by the Facilities

Figure 7: Showing buffer zone



Nearest Neighbor Analysis

Having done the buffer analysis, it is good to further by subjecting the data to Nearest Neighbor Analysis in order to see the pattern of spacing of the various health facilities. The spatial pattern of health facilities has to do with the way facilities are arranged in a geographical space. Series of factors could affect the pattern of arrangement of these facilities. This could be the ease with which the facilities are accessed from the nearby settlements, access roads, barriers to transportation such as the presence of water bodies, rugged terrains and forested regions.

Figure 8: Result of Near Neighbor Analysis

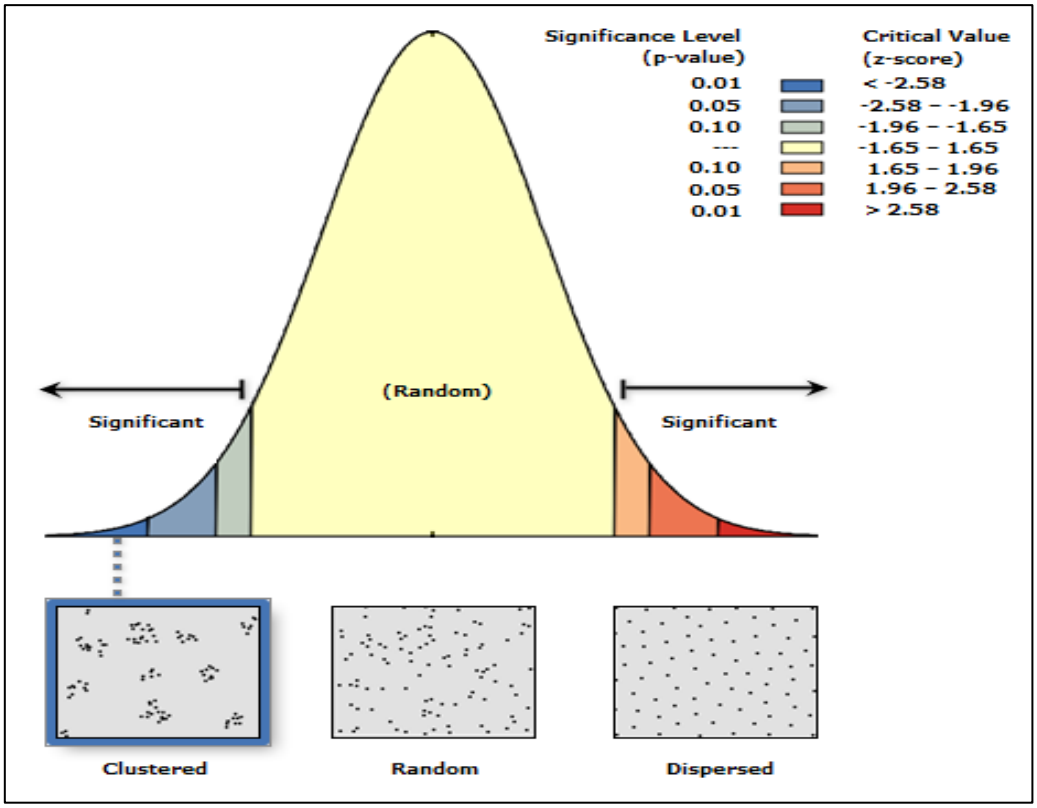


Table 4: Average Nearest Neighbor Summary

Observed Mean Distance:	**361.985828 Meters**
Expected Mean Distance:	694.215809 Meters
Nearest Neighbor Ratio:	0.521431
Z-score:	-6.20946
P-value:	0
Dataset Information	
Input Feature Class:	HOSPITALS
Distance Method:	EUCLIDEAN
Study Area:	88676148

Source: Researcher's Data Analysis.

The result of nearest neighbor analysis performed to analyze the spatial pattern of the health facilities in Karshi Development Area, revealed that the facilities were clustered. This could probably be because the facilities were located among settlements and residence of the given population which also appeared to be clustered.

Utilization of Healthcare Facilities in The Study Area

The utilization of healthcare facilities is one of the objectives of this research. Based on the records collected, several analyses have been performed as can be seen below.

Population Per Hospital Bed

This would be determined by the number of people in an area served by the available hospital beds in that area.

Bed workload per 1,000 would be computed with the given formula:

$$\frac{Number\ of\ Beds}{Population\ of\ area\ served} X1000$$

Bed workload for Karu Ward

$$\frac{278}{243{,}041} X1{,}000 = 1.14$$

This Indicates that approximately, I hospital bed serves a given 1,000 people in Karu ward.

Bed Workload for Nyanya Ward

$$\frac{121}{199{,}481} X1{,}000 = 0.61$$

This result indicates that for every given 1000 population, a single bed is not enough to serve them.

Bed Workload for Orozo Ward

$$\frac{109}{62{,}261} X1{,}000 = 1.75$$

This result shows that approximately 2 beds serve a given 1000 population.

Bed Workload for Karshi Ward

$$\frac{\mathbf{71}}{\mathbf{42990}}\boldsymbol{X1,000} = \mathbf{1.65}$$

This result however reveals that approximately 2 beds serves a given 1000 population.\

Population Per physician

This is the number of people in an area, usually an administrative unit, for each physician located there.

The ratio of health workers in the study area is computed with the formula below:

$$\frac{Number\ of\ Health\ Workers}{Population\ of\ given\ area}X10{,}000$$

Population per physician in Nyanya ward

$$\frac{189}{199{,}481}X10,000 = 9.47$$

This result however reveals that there are approximately 9 health workers per 10,000 people

Population per physician in Karu Ward

$$\frac{299}{243{,}041}X10{,}000 = 1.19$$

This result reveals that in Karu ward, the population per physician is approximately 1 health worker per 10,000 people.

Population per physician in Orozo Ward

$$\frac{82}{62{,}261}X10{,}000 = 13.17$$

This result reveals that there are approximately 13 health workers per 10,000 population

Population per Physician in Karshi Ward

$$\frac{143}{42{,}990}X10{,}000 = 33.26$$

This result reveals that there are approximately 33 health worker per 10,000 population. Hence, based on the analysis of results from the 4 wards, Karshi ward has a better Physician-Patient ration than the rest of the wards.

Results of Cross Tabulation Analysis of Questionnaires.

From the administered questionnaires administered in each ward under the Karshi Development Area of Abuja Municipal Area Council. The table shows the results of analysis of questionnaires administered to respondents in the various wards. For distance covered to access health care, it is seen that 56.6% of the population in Nyanya ward cover less than 4km, 41.1% of the population covered less than 4km in Karu ward while majority covered above 4km to access healthcare. In Orozo ward, 64.9% (majority) covered more than 4km to access healthcare while in Karshi ward. 45.5% covered above 4km to access healthcare. Most of the respondents however, indicated that the healthcare services they received was good.

Also, it can also be seen that non-communicable diseases, unintentional injuries and accidents, accounted for the highest causes of visits to health facilities in all the wards. Majority of the respondents also indicated that the cost of healthcare was high.

Table 5: Crosstab Analysis

Variable		Nyanya Ward	Karu Ward	Orozo Ward	Karshi Ward
Gender	Female	165 (43.7%)	202 (53.7%)	158 (42.4%)	270 (71.4%)
	Male	213 (56.3%)	173 (46.3%)	215 (57.6%)	108 (28.6%)
Marital Status	Married	235 (62.2%)	215 (57.6%)	204 (54.7%)	338 (89.4%)
	Unmarried	143 (37.8%)	158 (42.4%)	169 (45.3%)	40 (10.6%)
Family Size	Less Than 5	145 (38.4%)	158 (42.1%)	157 (42.1%)	109 (28.8%)
	More than 5	233 (66.6%)	217 (57.9%)	216 (57.9%)	269 (71.2%)
Type of Education	Formal	316 (83.6%)	312 (83.2%)	319 (85.5%)	369 (97.6%)
	Informal	62 (16.4%)	63 (16.8%)	54 (14.5%)	9 (2.4%)
Educational	Pri./Sec.	182 (48.1%)	152 (40.5%)	91 (24.4%)	37 (9.8%)

Level	Tertiary	196 (51.9%)	223 (59.5%)	282 (75.6%)	341 (90.2%)
Employment Status	Unemployed	256 (67.7%)	208 (55.5%)	205 (55.0%)	50 (13.2%)
	Employed	122 (32.3%)	167 (44.5%)	168 (45.0%)	328 (86.8%)
Monthly Income	Low	159 (42.1%)	87 (23.2%)	70 (18.8%)	21 (5.6%)
	Medium/High	219 (57.9%)	288 (76.8%)	303 (81.2%)	357 (94.4%)
Standard of Living	Low	164 (43.4)	236 (63.3%)	181 (48.5%)	258 (68.3%)
	Medium/High	214 (56.6%)	137 (36.7%)	192 (51.5%)	120 (31.7%)
Visit to Health Facility	Yes	235 (62.2%)	261 (69.6%)	355 (95.2%)	236 (62.4%)
	No	143 (37.8%)	114 (30.4%)	18 (4.8%)	142 (37.6%)
Type of Illness	Communicable disease	123 (32.5%)	90 (24.0%)	54 (14.5%)	115 (30.4%)
	Non-Communicable, unintentional injuries/Accidents	225 (67.5%)	285 (76.0%)	319 (85.5%)	263 (69.6%)
Quality of Care	Good	280 (74.1%)	273 (72.8%)	325 (87.1%)	292 (77.2%)
	Poor	98 (25.9%)	102 (27.2%)	12.7 (12.9%)	86 (22.8%)
Severity of Illness	Severe	247 (65.3%)	239 (63.7%)	259 (69.4%)	102 (27.0%)
	Not Severe	131 (34.7%)	136 (36.3%)	114 (30.6%)	276 (73.0%)

Cost of Care	High	263 (69.6%)	253 (67.5%)	281 (75.5%)	253 (67.1%)
	Low	115 (30.4%)	122 (32.5%)	91 (24.5%)	124 (32.9%)
Distance Covered	Less than 4km	214 (56.6%)	154 (41.1%)	131 (35.1%)	206 (54.5%)
	More than 4km	164 (43.4%)	221 (58.9%)	242 (64.9%)	172 (45.5%)
Type of Facility	Primary H.C.F	144 (38.1%)	202 (53.9%)	162 (43.4%)	123 (32.5%)
	Secondary/Tertiary H.C.F	234 (61.9%)	173 (46.1%)	211 (56.6%)	225 (67.5%)

Source: Field work.

Detrended Correspondence Analysis (DECORANA or DCA)

The records of healthcare facilities collected which contained revealing the number of bed spaces, number of patients per day, number of doctors, number of nurses and number of midwives are represented in a two-dimensional DCA plot. The DCA shows the variations and relationship between the data sets. The points closer to each other on the graph possess similar behavior and are closer in relationship compared to those that are farther away. The closer the points are, the closer the relationship that exists between them.

Figure 9: showing row points for patients per day

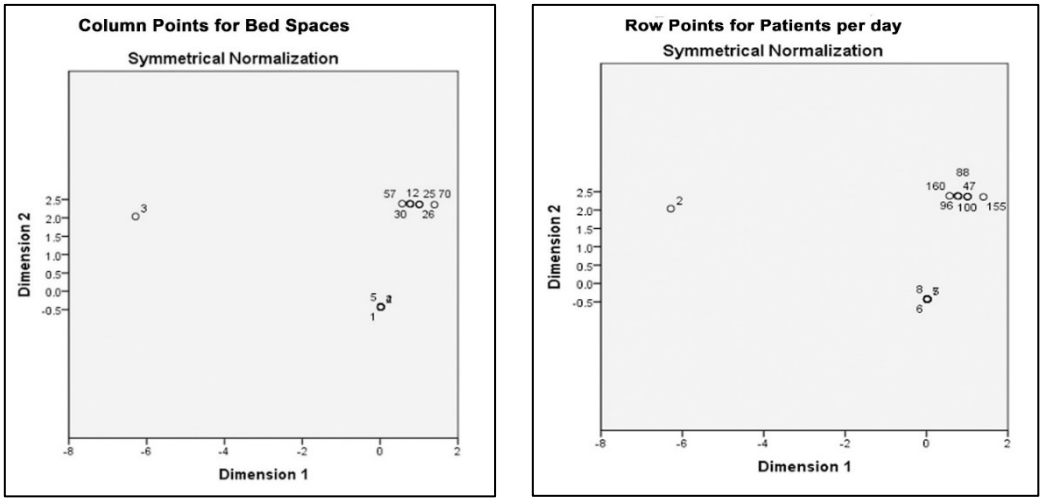


Figure 10: showing Column points for Bed Spaces

Figure 8 above shows that there is a closer relationship which exists between facilities with higher patients per day which ranges between 47 and 160 than there is with facilities with 3 to 8 patients per day or less. Also Figure 9 shows that those facilities with 12 to 70 bed spaces appear closer to each other, hence having similar behavior and relationship. Those with lower bed spaces appear farther showing there is no close relationship. This has several implications like in terms of expansion of the capacity of the facility to accommodate more patients.

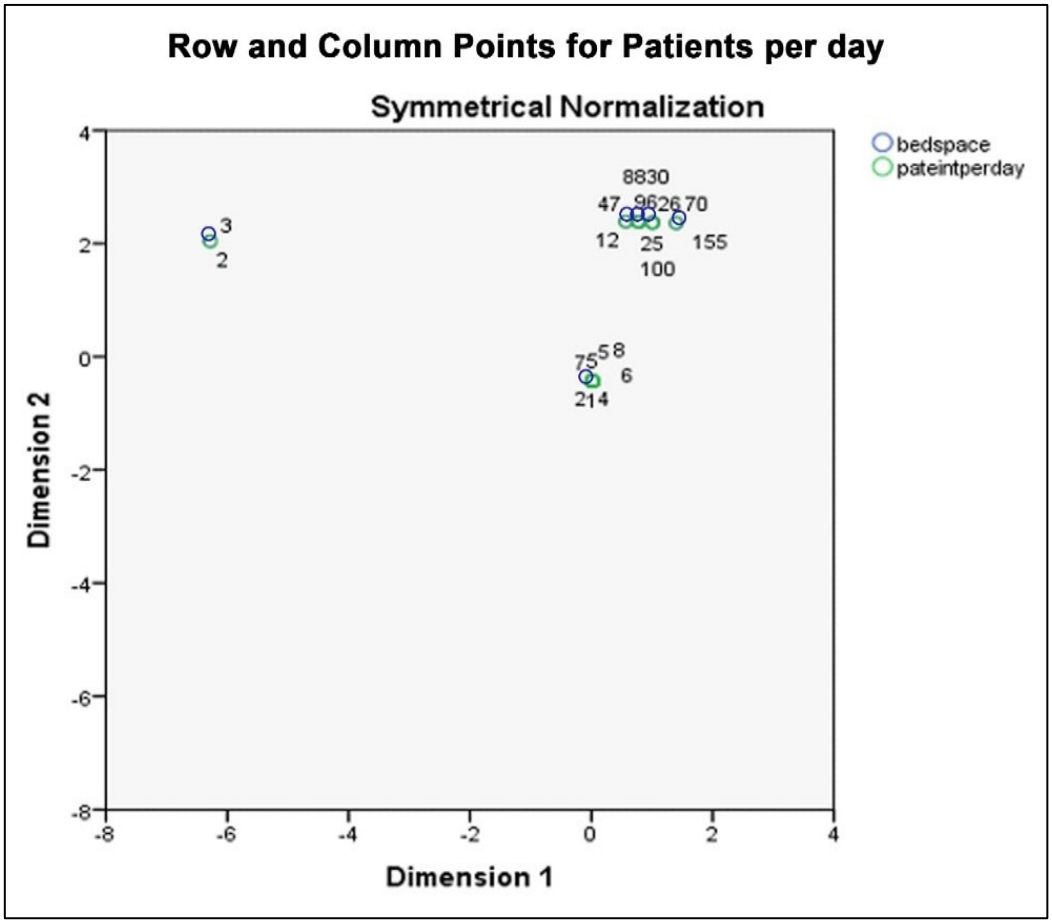


Figure 11: DCA of Patients per day by Number of Bed Spaces

The graph above reveals that there is a relationship between the number of bed spaces and number of patients per day. It can be seen that the facilities with higher number of bed spaces has a relationship with higher number of patients per day. Hence, the more the bed spaces, the more the patients; the lesser the bed spaces, the lower the patients that can be accommodated. Also, the graph also reveals a distant relationship between facilities with lower bed spaces and facilities with higher bed spaces.

Figure 12: showing Column points for Doctors

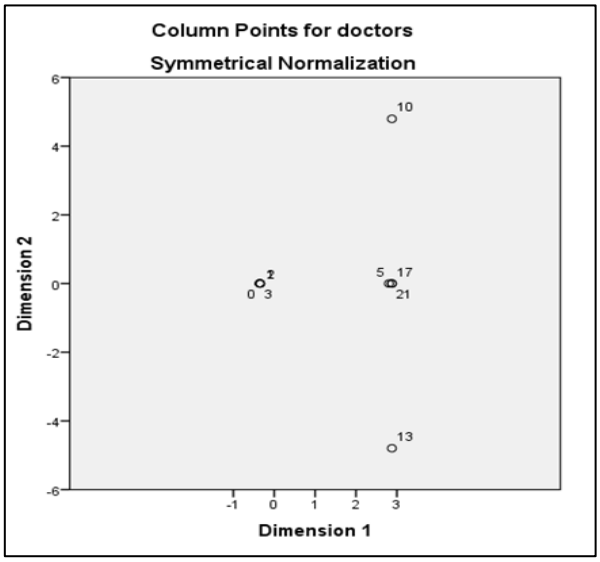
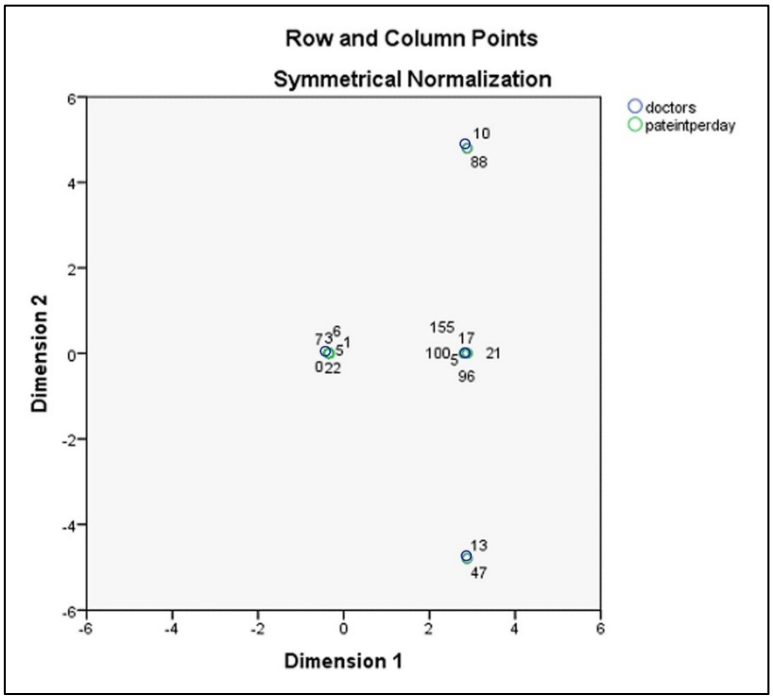


Figure 9 above shows the two-dimensional DCA for number of doctors. The relationship between numbers of doctors can be seen. Points closer to each other on the graph have close relationship.

Figure 13: Showing row and Column points for number of doctors by number patients per day.



The figure above shows that there is a relationship between facilities with more number of doctors as they appear close to each other. It also proves that those facilities with more doctors attract more patients as seen on the graph. This is however due to the fact that there would be enough

doctors on ground to attend to the healthcare needs patients. Also, there would be patients fewer patients in facilities with fewer doctors as a result of insufficient workforce.

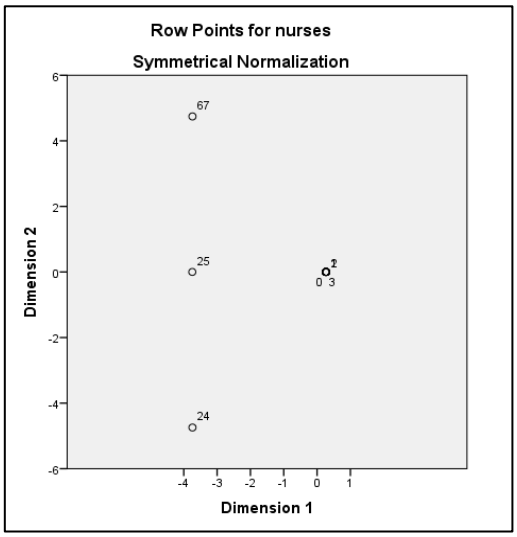


Figure 14: Showing row points for Nurses

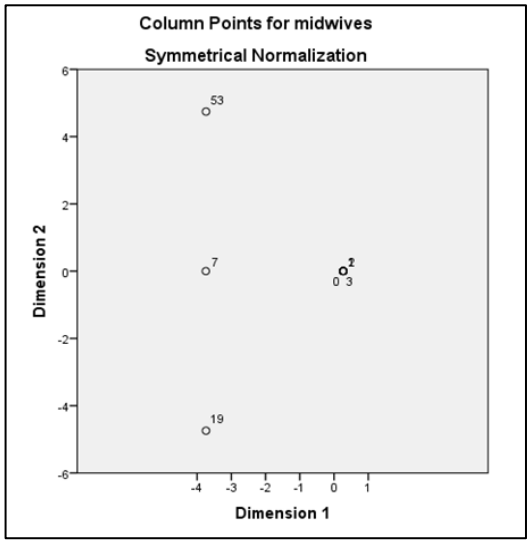


Figure 15: Showing Column points for Midwives

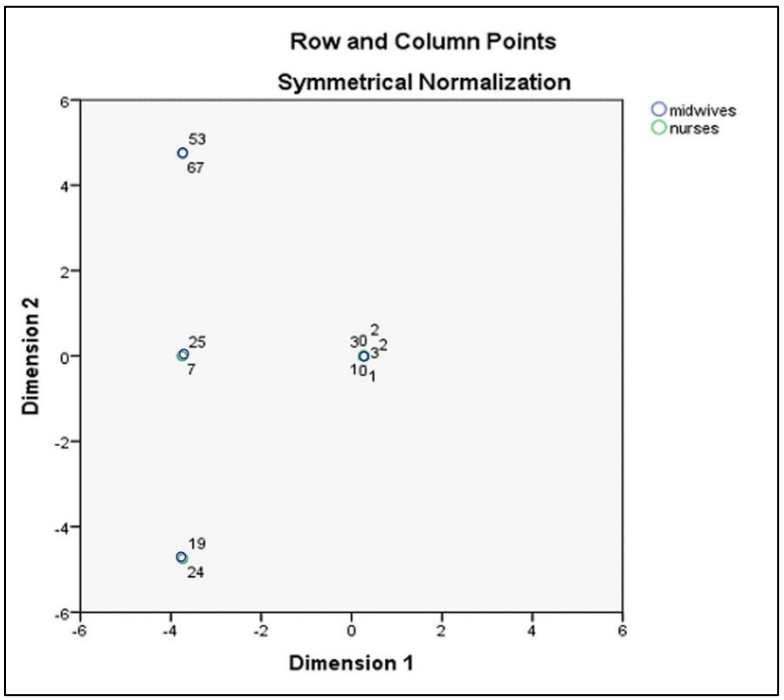


Figure 16: Showing Column points for Nurses and Midwives

Result of Multivariate Analysis

Table 9: Showing result of Multivariate analysis.

Explanatory Variables	B	S.E	Wald	df	Sig	Exp (B)
Characteristics of the subject						
Age 15 and Above	-0.491	0.757	0.42	1	0.517	0.612
Gender Male	-0.189	0.132	2.054	1	0.152	0.828
Gender Female	0.144	0.796	3.559	1	0.927	0.781
Family Size (< or = 5)	0.71	0.999	3.982	1	0.05	0.894
Family Size (> 5)	-0.009	0.137	0.004	1	0.949	0.991
Secondary Education	0.666	0.185	12.976	1	0	1.946
Higher Education	0.951	0.146	19.938	1	0	1.918
Marital Status (Married)	0.118	0.137	0.746	1	0.388	1.125
Marital status (Unmarried)	-0.311	0.151	0.495	1	0.349	0.788
Employment (Employed)	-0.77	0.134	32.959	1	0	0.463
Employment (Unemployed)	0.101	0.925	0.115	1	0.053	0.107
Low Standard of Living	0.415	0.137	9.173	1	0.002	1.514
High Standard of Living	0.689	0.231	9.055	1	0.405	1.011
Family Low Income	0.045	0.249	0.033	1	0.856	1.046
Family High Income	0.351	0.12	8.592	1	0.003	1.42
Visit to health Facility	-0.4	0.155	6.618	1	0.01	0.671
Characteristics of Disorder						
Type of Illness Group II	0.083	0.151	0.302	1	0.583	1.086
Type of Illness Group III	0.125	2.811	8.114	1	0.112	0.469
Severity of Illness	-0.204	0.137	2.209	1	0.137	0.816
Characteristics of Service						
Low Quality Care	-0.112	0.325	0.709	1	0.528	0.723
High quality Care	0.402	0.151	0.11	1	0.008	1.495
Low Cost	-0.311	0.146	0.302	1	0.511	0.714
High Cost	0.112	0.142	0.618	1	0.432	1.118
Short distance to healthcare	0.118	0.132	0.802	1	0.37	1.125
Long Distance to healthcare	-0.045	0.249	0.033	1	0.856	1.046
Primary Health Care Facility	0.131	0.132	0.051	1	0.391	1.167
Secondary/tertiary healthcare Facility	-0.034	0.132	0.067	1	0.796	0.967
Constant	0.806	0.805	1.003	1	0.317	2.238

Source: Author's Field work

Characteristics of the Subject.

Table 8 above shows result of multivariate analysis. There are three types of explanatory variable as shown in the conceptual framework in figure 3. The coefficient of the age group is negative (-0.491). This tells that the effect of age group in the utilization of healthcare services is negative. The log odds or logit of p decreases by 0.491 and the final column of the table displays odds ratios, interpretations of which are straightforward. The odds ratios of the age group is 0.612.

Looking at the gender of respondents, the result revealed that males are less likely to seek healthcare from a modern health facility as compared with females. The chances of utilization is higher with females (0.144) than it is with males (-0.189).

The odds ratio of family size tells that the chances of utilization of health facilities by small families (< or = 5) is higher (0.710), while larger families (> 5) with negative value (-0.009) has lesser chance of utilizing health facilities. Regarding education, odds ratio shows that those with higher level of education were associated with greater utilization of healthcare from any modern source than those with secondary and primary education. Knowledge therefore seems to be a very relevant

factor when it comes to explaining patterns of utilization. This may imply that the more educated visit to health facilities are for preventive services as well as curative reasons. On the other hand, education could be serving a proxy for income. This might imply that those with higher levels of education have a higher income and as a result also have a higher probability of modern healthcare utilization because they can afford it.

Short distance travel to receive healthcare also contribute to the probability of utilizing a care. Respondents whose houses were within less than 4kms range to healthcare facilities are more likely to visit the facilities to seek medical attention. The coefficient of long-distance travel to receive healthcare negative (-0.045). This tells that the effect of long distances towards utilization of modern healthcare services is negative.

Marital status was also seen to play a role in the utilization of health care services. Those who are married with positive odds (0.118) have greater chances of healthcare utilization than those who are single, divorced widowed or separated (with negative odds -0.311) in terms of employment, the sign of the coefficient in employment showed that those who were working are less likely to utilize healthcare from any modern source than those who are unemployed. (Odds for the employed is negative: -0.770)

In terms of standard of living, the odds revealed that those with higher standard of living were most likely to use a modern healthcare facility than those who have a low standard of living. Also, with respect to income, those with medium and high income have more chances of utilizing a health facility than low income earners. This finding demonstrates the importance of income in the determination of the health status of an individual.

Characteristics of the Disorder

The result of analysis reveals that infectious diseases are more likely to be treated in modern healthcare facilities than other diseases. As compared to high severity, cases with low severity reduced the chances of utilization of health care while high severity increases chances of utilization.

Characteristics of Services

Odds ratio of utilization of primary, secondary/tertiary healthcare shows that utilization of primary health care was more as compared to secondary/tertiary health care. Odd of utilization also increases when the quality of healthcare is high. This shows that the quality of healthcare provided determines whether or not modern health care facilities would be utilized. A look at the coefficient of cost reveals that utilization decreased when cost of healthcare was low. While high cost which had positive odds revealed higher utilization. This might imply that the respondents associate quality of care with the cost and hence when cost is low, there is less utilization.

In conclusion, having observed the utilization of health care by respondents, it is clear that the three factors in our model of figure 3 have a way of affecting how healthcare is utilized. And the results as revealed and explained has policy implications/prescriptions.

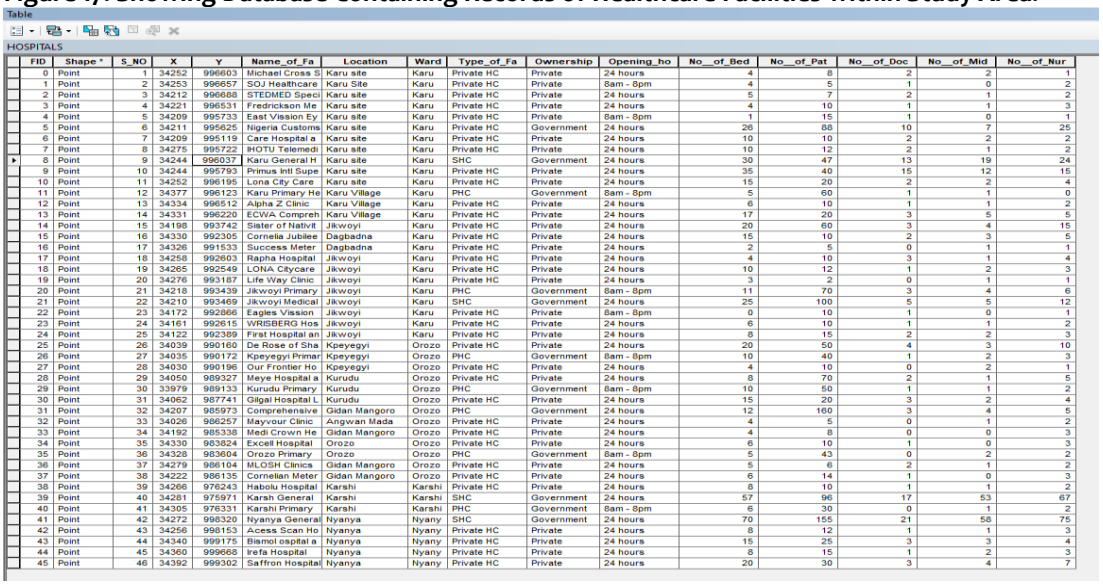
Database Management System (DBMS)

A database management system is a software package that is designed for the definition, manipulation, retrieval and management of data in a database. Generally, a DBMS manipulates the data itself, the format of the data, filed names, the record structure as well as the file structure. Also, it defines the rules to validate and manipulate these data.

All the data (spatial and attribute) of health care facilities collected during the course of this research have been stored in a database which can be manipulated and retrieved in ArcGIS. The

ArcGIS 10.3 can be used to perform various query operations to retrieve information about the healthcare facilities which have been stored up in the Database.
The Figures below show screenshots of the database in ArcMap 10.3 software.

Figure 17: Showing Database Containing Records of Healthcare Facilities within Study Area.



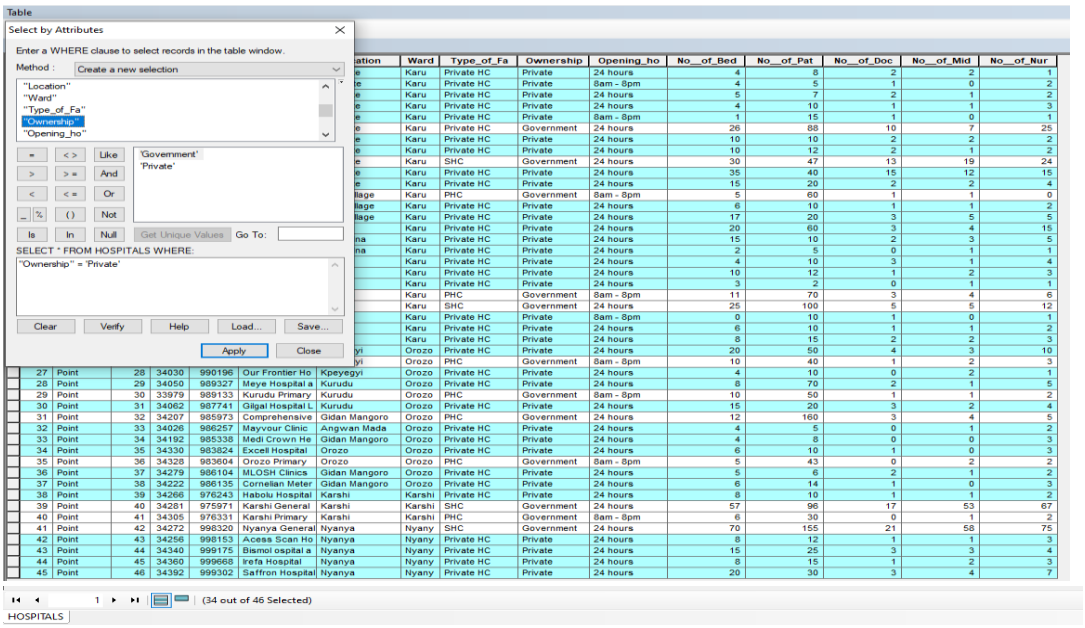
Table

HOSPITALS

FID	Shape *	S_NO	X	Y	Name_of_Fa	Location	Ward	Type_of_Fa	Ownership	Opening_ho	No__of_Bed	No__of_Pat	No__of_Doc	No__of_Mid	No__of_Nur
0	Point	1	34252	996603	Michael Cross S	Karu site	Karu	Private HC	Private	24 hours	4	8	2	2	1
1	Point	2	34253	996657	SOJ Healthcare	Karu Site	Karu	Private HC	Private	8am - 8pm	4	5	1	0	2
2	Point	3	34212	996688	STEDMED Speci	Karu site	Karu	Private HC	Private	24 hours	5	7	2	1	2
3	Point	4	34221	996531	Fredrickson Me	Karu site	Karu	Private HC	Private	24 hours	4	10	1	1	3
4	Point	5	34209	995733	East Vision Ey	Karu site	Karu	Private HC	Private	8am - 8pm	1	15	1	0	1
5	Point	6	34211	995625	Nigeria Customs	Karu site	Karu	Private HC	Government	24 hours	26	88	10	7	25
6	Point	7	34209	995119	Care Hospital a	Karu site	Karu	Private HC	Private	24 hours	10	10	2	2	2
7	Point	8	34275	995722	IHOTU Telemedi	Karu site	Karu	Private HC	Private	24 hours	10	12	2	1	2
8	Point	9	34244	996037	Karu General H	Karu site	Karu	SHC	Government	24 hours	30	47	13	19	24
9	Point	10	34244	995793	Primus Intl Supe	Karu site	Karu	Private HC	Private	24 hours	35	40	15	12	15
10	Point	11	34252	996195	Lona City Care	Karu site	Karu	Private HC	Private	24 hours	15	20	2	2	4
11	Point	12	34377	996123	Karu Primary He	Karu Village	Karu	PHC	Government	8am - 8pm	5	60	1	1	0
12	Point	13	34334	996512	Alpha Z Clinic	Karu Village	Karu	Private HC	Private	24 hours	6	10	1	1	2
13	Point	14	34331	996220	ECWA Compreh	Karu Village	Karu	Private HC	Private	24 hours	17	20	3	5	5
14	Point	15	34198	993742	Sister of Nativit	Jikwoyi	Karu	Private HC	Private	24 hours	20	60	3	4	15
15	Point	16	34330	992305	Cornelia Jubilee	Dagbadna	Karu	Private HC	Private	24 hours	15	10	2	3	5
16	Point	17	34326	991533	Success Meter	Dagbadna	Karu	Private HC	Private	24 hours	2	5	0	1	1
17	Point	18	34258	992603	Rapha Hospital	Jikwoyi	Karu	Private HC	Private	24 hours	4	10	3	1	4
18	Point	19	34265	992549	LONA Citycare	Jikwoyi	Karu	Private HC	Private	24 hours	10	12	1	2	3
19	Point	20	34276	993187	Life Way Clinic	Jikwoyi	Karu	Private HC	Private	24 hours	3	2	0	1	1
20	Point	21	34218	993439	Jikwoyi Primary	Jikwoyi	Karu	PHC	Government	8am - 8pm	11	70	3	4	6
21	Point	22	34210	993469	Jikwoyi Medical	Jikwoyi	Karu	SHC	Government	24 hours	25	100	5	5	12
22	Point	23	34172	992866	Eagles Vision	Jikwoyi	Karu	Private HC	Private	8am - 8pm	0	10	1	0	1
23	Point	24	34161	992615	WRIGHTBERG Hos	Jikwoyi	Karu	Private HC	Private	24 hours	6	10	1	1	2
24	Point	25	34122	992389	First Hospital an	Jikwoyi	Karu	Private HC	Private	24 hours	8	15	2	2	3
25	Point	26	34039	990160	De Rose of Sha	Kpeyegyi	Orozo	Private HC	Private	24 hours	20	50	4	3	10
26	Point	27	34035	990172	Kpeyegyi Primar	Kpeyegyi	Orozo	PHC	Government	8am - 8pm	10	40	1	2	3
27	Point	28	34030	990196	Our Frontier Ho	Kpeyegyi	Orozo	Private HC	Private	24 hours	4	10	0	2	1
28	Point	29	34050	989327	Meye Hospital a	Kurudu	Orozo	Private HC	Private	24 hours	8	70	2	1	5
29	Point	30	33979	989133	Kurudu Primary	Kurudu	Orozo	PHC	Government	8am - 8pm	10	50	1	1	2
30	Point	31	34062	987741	Gilgal Hospital L	Kurudu	Orozo	Private HC	Private	24 hours	15	20	3	2	4
31	Point	32	34207	985973	Comprehensive	Gidan Mangoro	Orozo	PHC	Government	24 hours	12	160	3	4	5
32	Point	33	34026	986257	Mayvour Clinic	Angwan Mada	Orozo	Private HC	Private	24 hours	4	5	0	1	2
33	Point	34	34192	985338	Medi Crown He	Gidan Mangoro	Orozo	Private HC	Private	24 hours	4	8	0	0	3
34	Point	35	34330	983824	Excell Hospital	Orozo	Orozo	Private HC	Private	24 hours	6	10	1	0	3
35	Point	36	34328	983604	Orozo Primary	Orozo	Orozo	PHC	Government	8am - 8pm	5	43	0	2	2
36	Point	37	34279	986104	MLOSH Clinics	Gidan Mangoro	Orozo	Private HC	Private	24 hours	5	6	2	1	2
37	Point	38	34222	986135	Cornelian Meter	Gidan Mangoro	Orozo	Private HC	Private	24 hours	6	14	1	0	3
38	Point	39	34266	976243	Habolu Hospital	Karshi	Karshi	Private HC	Private	24 hours	8	10	1	1	2
39	Point	40	34281	975971	Karshi General	Karshi	Karshi	SHC	Government	24 hours	57	96	17	53	67
40	Point	41	34305	976331	Karshi Primary	Karshi	Karshi	PHC	Government	8am - 8pm	6	30	1	0	2
41	Point	42	34272	998320	Nyanya General	Nyanya	Nyany	SHC	Government	24 hours	70	155	21	58	75
42	Point	43	34256	998153	Acess Scan Ho	Nyanya	Nyany	Private HC	Private	24 hours	8	12	1	1	3
43	Point	44	34340	999175	Bismol ospital a	Nyanya	Nyany	Private HC	Private	24 hours	15	25	3	3	4
44	Point	45	34360	999668	Irefa Hospital	Nyanya	Nyany	Private HC	Private	24 hours	8	15	1	2	3
45	Point	46	34392	999302	Saffron Hospital	Nyanya	Nyany	Private HC	Private	24 hours	20	30	3	4	7

From the above figure, the records of healthcare facilities collected on site are stored up in the Database Management System. All information here can easily be retrieved, manipulated, further processed and printed as well.

Figure 18: Showing query operation to retrieve all private Healthcare facilities within the Study Area



Table

Select by Attributes

Enter a WHERE clause to select records in the table window.

Method : Create a new selection

"Location"
"Ward"
"Type_of_Fa"
"Ownership"
"Opening_ho"

= <> Like 'Government' 'Private'
> >= And
< <= Or
_ % ( ) Not
Is In Null Get Unique Values Go To:

SELECT * FROM HOSPITALS WHERE:

"Ownership" = 'Private'

Clear Verify Help Load... Save...
Apply Close

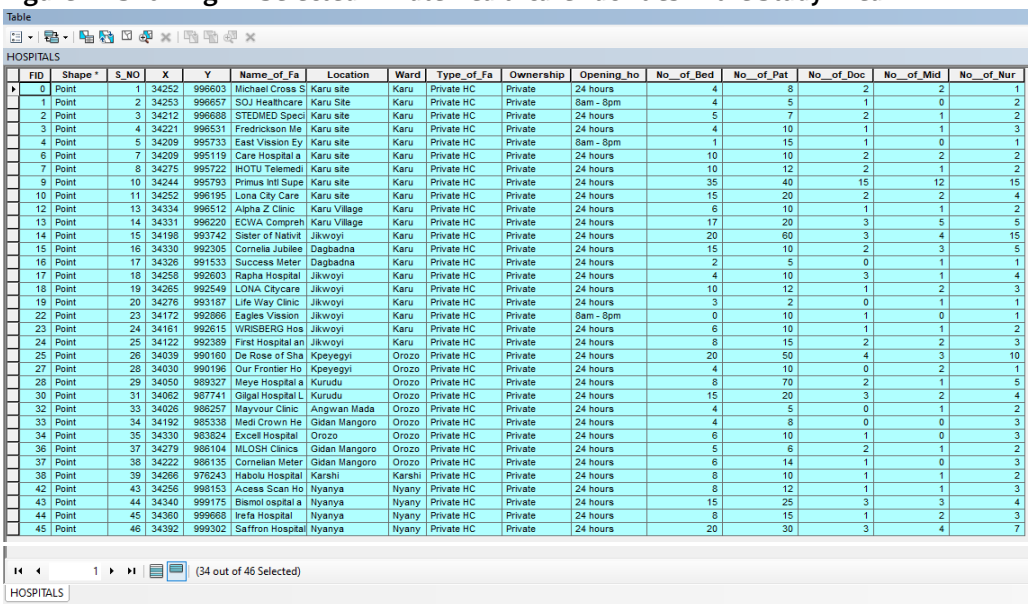
(34 out of 46 Selected)

HOSPITALS

TIJSSRA E-ISSN 3027-2467 P-ISSN 3027-0065

From the above figure, the highlighted (Blue) columns are the healthcare facilities selected based on the query performed to retrieve private healthcare facilities located within the study area. The ones in white are the unselected government healthcare facilities. However, the view can be switched to show only the desired/selected outcome of the query as shown in the figure below.

Figure 18: Showing All Selected Private Healthcare Facilities in the Study Area



Table

HOSPITALS

FID	Shape *	S_NO	X	Y	Name_of_Fa	Location	Ward	Type_of_Fa	Ownership	Opening_ho	No__of_Bed	No__of_Pat	No__of_Doc	No__of_Mid	No__of_Nur
0	Point	1	34252	996603	Michael Cross S	Karu site	Karu	Private HC	Private	24 hours	4	8	2	2	1
1	Point	2	34253	996657	SOJ Healthcare	Karu Site	Karu	Private HC	Private	8am - 8pm	4	5	1	0	2
2	Point	3	34212	996688	STEDMED Speci	Karu site	Karu	Private HC	Private	24 hours	5	7	2	1	2
3	Point	4	34221	996531	Fredrickson Me	Karu site	Karu	Private HC	Private	24 hours	4	10	1	1	3
4	Point	5	34209	995733	East Vission Ey	Karu site	Karu	Private HC	Private	8am - 8pm	1	15	1	0	1
6	Point	7	34209	995119	Care Hospital a	Karu site	Karu	Private HC	Private	24 hours	10	10	2	2	2
7	Point	8	34275	995722	IHOTU Telemedi	Karu site	Karu	Private HC	Private	24 hours	10	12	2	1	2
9	Point	10	34244	995793	Primus Intl Supe	Karu site	Karu	Private HC	Private	24 hours	35	40	15	12	15
10	Point	11	34252	996195	Lona City Care	Karu site	Karu	Private HC	Private	24 hours	15	20	2	2	4
12	Point	13	34334	996512	Alpha Z Clinic	Karu Village	Karu	Private HC	Private	24 hours	6	10	1	1	2
13	Point	14	34331	996220	ECWA Compreh	Karu Village	Karu	Private HC	Private	24 hours	17	20	3	5	5
14	Point	15	34198	993742	Sister of Nativit	Jikwoyi	Karu	Private HC	Private	24 hours	20	60	3	4	15
15	Point	16	34330	992305	Cornelia Jubilee	Dagbadna	Karu	Private HC	Private	24 hours	15	10	2	3	5
16	Point	17	34326	991533	Success Meter	Dagbadna	Karu	Private HC	Private	24 hours	2	5	0	1	1
17	Point	18	34258	992603	Rapha Hospital	Jikwoyi	Karu	Private HC	Private	24 hours	4	10	3	1	4
18	Point	19	34265	992549	LONA Citycare	Jikwoyi	Karu	Private HC	Private	24 hours	10	12	1	2	3
19	Point	20	34276	993187	Life Way Clinic	Jikwoyi	Karu	Private HC	Private	24 hours	3	2	0	1	1
22	Point	23	34172	992866	Eagles Vission	Jikwoyi	Karu	Private HC	Private	8am - 8pm	0	10	1	0	1
23	Point	24	34161	992615	WRISBERG Hos	Jikwoyi	Karu	Private HC	Private	24 hours	6	10	1	1	2
24	Point	25	34122	992389	First Hospital an	Jikwoyi	Karu	Private HC	Private	24 hours	8	15	2	2	3
25	Point	26	34039	990160	De Rose of Sha	Kpeyegyi	Orozo	Private HC	Private	24 hours	20	50	4	3	10
27	Point	28	34030	990196	Our Frontier Ho	Kpeyegyi	Orozo	Private HC	Private	24 hours	4	10	0	2	1
28	Point	29	34050	989327	Meye Hospital a	Kurudu	Orozo	Private HC	Private	24 hours	8	70	2	1	5
30	Point	31	34062	987741	Gilgal Hospital L	Kurudu	Orozo	Private HC	Private	24 hours	15	20	3	2	4
32	Point	33	34026	986257	Mayvour Clinic	Angwan Mada	Orozo	Private HC	Private	24 hours	4	5	0	1	2
33	Point	34	34192	985338	Medi Crown He	Gidan Mangoro	Orozo	Private HC	Private	24 hours	4	8	0	0	3
34	Point	35	34330	983824	Excell Hospital	Orozo	Orozo	Private HC	Private	24 hours	6	10	1	0	3
36	Point	37	34279	986104	MLOSH Clinics	Gidan Mangoro	Orozo	Private HC	Private	24 hours	5	6	2	1	2
37	Point	38	34222	986135	Cornelian Meter	Gidan Mangoro	Orozo	Private HC	Private	24 hours	6	14	1	0	3
38	Point	39	34266	976243	Habolu Hospital	Karshi	Karshi	Private HC	Private	24 hours	8	10	1	1	2
42	Point	43	34256	998153	Acess Scan Ho	Nyanya	Nyany	Private HC	Private	24 hours	8	12	1	1	3
43	Point	44	34340	999175	Bismol ospital a	Nyanya	Nyany	Private HC	Private	24 hours	15	25	3	3	4
44	Point	45	34360	999668	Irefa Hospital	Nyanya	Nyany	Private HC	Private	24 hours	8	15	1	2	3
45	Point	46	34392	999302	Saffron Hospital	Nyanya	Nyany	Private HC	Private	24 hours	20	30	3	4	7

(34 out of 46 Selected)

HOSPITALS

The figure above shows all selected 34 private healthcare facilities within the study area.

Conclusion and Recommendations

The mapping of access to health services and their distrubution led to the discovery of geographic inequalities and to point out the wards that are in need. Decision and policy makers are to correct these inequalities in access to health care services and make every effort to optimize the use of scarce resources in order to improve healthcare delivery. One of the way to do this is to channel interventions to those areas identified on the maps produced and where impact would be greatly felt. However, it wouldn't be enough to merely identify needed locations; consideration should also be given to the size of the population in relation to the statistics provided by this research, which will be of benefit.

Identifying health care needs is one of the important tasks which health care authorities frequently do. Health planners keep analyzing the challenges that occur on health care demands. These challenges require quick response from health authorities, in order to keep matching healthcare facilities supply with the relevant demand. This is a task which needs huge set of data including health facilities location, catchment areas, and population statistics.

This research used GIS to identify, map out and pinpoint the areas in need and the various results, maps and statistics provided would be useful in helping health planners make decisions regarding increasing hospital capacities.

Recommendations

1. Health planners and policy makers should ensure that the health facilities provided and manpower should be in proportion to the population of the areas served so as to prevent the overworking of facilities and to cater for the increasing needs of the increasing population.
2. The government, NGOs and other bodies can assist in training more health workers which would later on be absorbed into the system. This will help increase the number of health workers to meet up with the increasing demand for healthcare.
3. There should be proper distribution of health facilities in order to ensure equity in access.
4. At least one tertiary health facility should be cited within the study area which has a total population of 547,773. The capacity of the existing government facilities should be expanded to measure up with the population in the area.
5. The private sector which also plays key roles in delivery of healthcare services should be encouraged to participate more in provision of healthcare and be given relevant assistance to expand so as to measure up with the rising demand for healthcare as a result of increasing population.

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