

## Locational Distribution of Health Care Facilities in the Rural Area of Ondo State

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### Authors' contributions

This work was carried out in collaboration between both authors. Author JUU designed the study wrote the protocol but author WB supervised the work. Author JUU performed the statistical analysis. Author JUU managed the analyses of the study. Author JUU wrote the first draft of the manuscript. Author JUU managed the literature searches while author WB edited the manuscript. Both authors read and approved the final manuscript.

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### ABSTRACT

**Aim:** This research is aimed to assess the locational Distribution of health care facilities in the rural area of Ondo state.

**Study Design:** Case study research design.

**Place and Duration of Study:** Three senatorial districts of Ondo state Nigeria and lies within latitude 50 451 and 70521 N and longitude 40 201 and 60 51 E between July 2010 and September 2011.

**Methodology:** This study was conducted within 3 senatorial districts in the study area. The Global Positioning System (GPS) was adopted to take the coordinate of all the existing health care facilities in the area. "Nearest Neighbour Analysis" (NNA) was the inferential statistical used in analyzing the data. This was used in establishing the distribution pattern of health facilities in the study area. Nearest Neighbour Analysis is the method of exploring pattern in the locational data by comparing

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mean distance (Do) of the phenomena in question to the same expected mean distance (De) usually under a random distribution of any phenomenon.

**Results:** The distribution of health care facilities in the area was clustered with the z-score table value for the three senatorial districts (Akure North, Ilaje and Ose) as 18.74, 35.31 and 21.44 respectively. This result does not enjoy adequate randomization thereby having implication for effective planning.

**Conclusion:** Results from the study show that health care facilities in the state were unevenly distributed, hence hampering health development at the grassroots. In the area where population is not evenly distributed, the mean centre of population distribution is calculated as the “demand”, which forms the origin of location. The facility location point is considered as destination points or “supply”. The study suggests proper planning through the location of more and adequately equipped medical facilities in the rural area of Ondo state so as to enhance sustainable health care delivery.

*Keywords: Health care facilities; nearest neighbor analysis; rural area; Ondo state.*

## 1. INTRODUCTION /STATEMENT OF PROBLEMS

Good health is a precondition for socio-political and economic development of any nation. In recognition of this, the fourth National Development plan [1] documented that good health has a direct relationship with happiness, intelligence, political stability and productivity of the citizens of a country [2]. This is predicated on accessibility to health care facilities identified to be one of the major indicators of development and, according to [3], a strong influence of individual's earning capacity. However, the locational pattern of any facility, (Medical facilities inclusive) can determine the level of its utility. From the locational pattern, the spatial distribution of any facility could be determined. [4] Sees spatial structure of a distribution as both the location of each element relative to each other. Since the need for health care varies in space and organization, the physical environment also varies in characteristics from place to place and this invariably has implications for the pattern of demand for health care facilities. The closer a health facility is to the people, the greater its utility and benefits. This can be connected to how they are distributed over the space in both urban and rural areas.

Consequent upon this, the supply of quality healthcare services in isolated rural areas is a challenge in many settings. The quantitative and qualitative shortages plus unequal distribution of health workers at the expense of rural areas characterize sub Saharan countries including Nigeria. In Ondo state for example, explicit consideration has not been given to the need for equity in the planning and distribution of health care facilities over the years. This has led to the

emergence of many regions within the state where both public and private health care facilities are sparsely provided. Often regions with difficult terrain and unplanned and hazardous physical environment are neglected. One major area in Nigeria which has generated much interest nationally and internationally is Ondo state, which is a petroleum-producing part of the Niger delta. While successive governments have invested in the health sector, the result on health care access is not commensurable to its input as mortality is still very high. This owes largely to the unequal distribution of health care facilities within the area particularly in the rural area that accommodates a higher percentage of population [5]. Most researches conducted have for instance, web-based spatial approach to the distribution of health care facilities and the distribution of Information System [6], patronage of health care facility [7] among others, without recourse to the locational distribution of health care facilities. This is the gap the study intends to fill. This study therefore focused on the locational distribution of health care facilities in the rural area of Ondo state.

### 1.1 Study Area

Ondo State of Nigeria was one of the seven states created on the 3<sup>rd</sup> February, 1976 by the Federal Military Government of Nigeria. (Fig. 1) It was carved out of the old Western State. The state covers a total area of the former Ondo province, created in 1915 with Akure as the provincial headquarters. It lies between latitude 5° 45' and 7°52' N and longitude 4° 20' and 6° 5' E. Its land area is about 15,500 Square kilometers. Edo and Delta States bound Ondo State on the East, on the West by Ogun and

Osun States, on the North by Ekiti and Kogi States and to the South by the Bight of Benin and the Atlantic Ocean (Fig. 1).

Until recently cocoa used to be the major source of wealth for the state but this has been replaced by petroleum which is prospected in Ilaje and Ese Odo local government areas. The population of more than 55% in the rural areas of Ondo State lived below poverty level [8]. This condition of poverty was aggravated due to the poor attention given to the health sector in the state.

Going back to history, in 1979, when the civilian government took over, the number of health facilities was increased – hospitals rose from 18 to 26 in number, maternity centres from 127 to 164, and dispensaries from 153 to 173. By 1985,

there were additional 30 comprehensive health centres, as against 2 in 1979. However, a result of the location quotient analysis indicated increasing disparities in the distribution of both hospitals and lower level health facilities. Apparently, though relative to their population, some LGAs have an excess share of the health facilities while some have shortfall.

## 1.2 Literature Review

Hospital functions such as food in – patient care or bed-related function. However what is called hospitals in most Nigerian cities fall short of all these. Hence health care facilities have been categorized in this research into, small clinics, health centers and major centers based on the facilities and services provided [9].

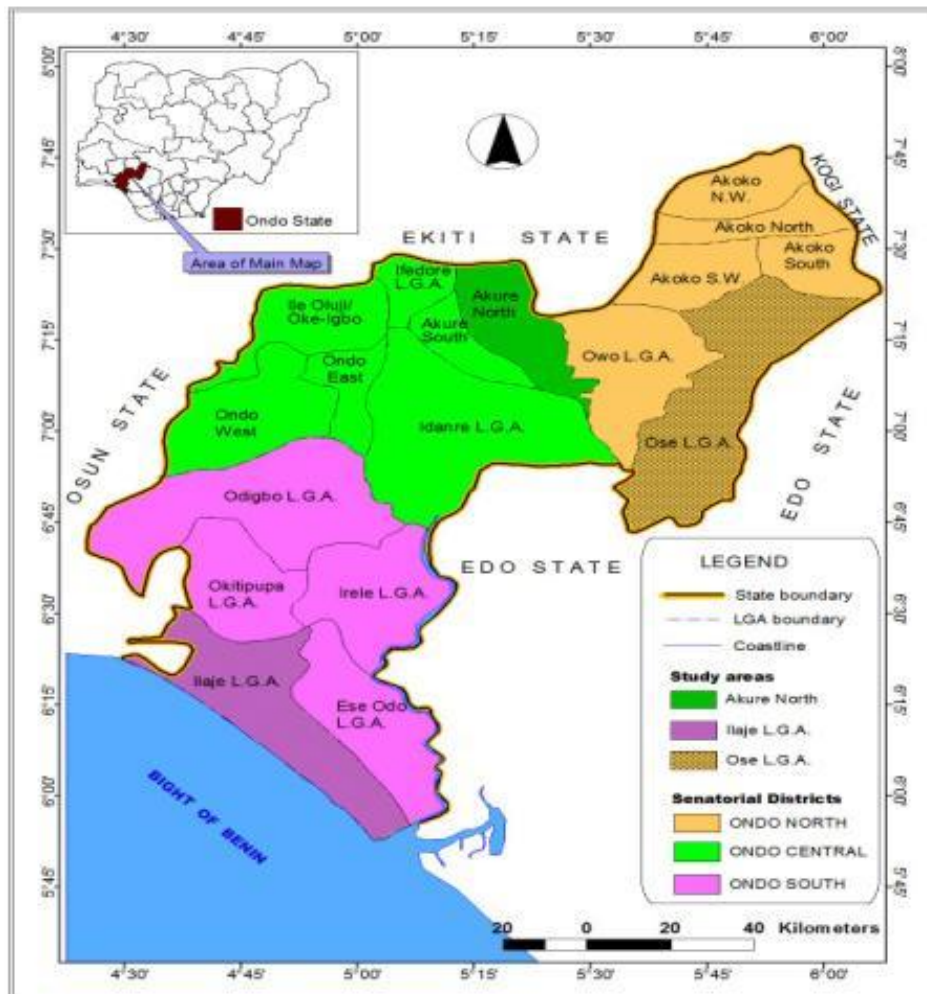


Fig. 1. Ondo State and selected local government areas of the study

Source: Ministry of Lands and Survey, Ondo State, 2006

'Closing the gap in indigenous health status' and 'improving distribution and equitable access to services' have been identified as national priorities [10]. Improving access to acceptable, adequately resourced, sustainable models of PHC in rural and particularly remote areas, where health outcomes are worse and there is a high proportion of indigenous residents, will redress the gap in health outcomes in a country that otherwise ranks well internationally in terms of its health system and life expectancy.

On location of medical facilities, numerous factors of public facilities have been given [11] observed that in recent times, the issues of access, equity and efficiency criteria that consider the distributional aspect of public facilities have been receiving attention. [12] shares the same idea when he asserted that accessibility questions had assumed greater importance among researchers and policy makers in recent years. implying that, location on a transport network is an important determinant of the availability of public facilities (medical services inclusive).

Looking at the geo spatial distribution of primary health care, [13] using Germain GPS to capture the Co-ordinates of the health centres with the aid of Arc Map 9.3 (ESRI) GIS software applied multivariate technique to show that the nearest neighbour value for Warri South Local Government, Nigeria, was clustered in pattern of distribution while Ughelli South LGA showed randomised distribution rather than clustered pattern.

[14] studied the location distribution of rural medical services for effective development in Ekiti State, Nigeria and found out a high incidence of morbidity and mortality resulting from the prevalence of preventable and infectious diseases due to unevenly distribution of facilities in the area.

[6] in their web-based spatial approach to the distribution of health care facilities observed that the distribution of Information System in Nigeria showed that stakeholders were able to visualize the distribution of tertiary hospitals in Nigeria, and make useful inferential decisions with ease. Similarly, [15] undertook a mapping of the spatial distribution of post primary schools in Yola North Local Government Area of Adamawa State, Nigeria using nearest neighbor analysis and discovered that random distribution pattern existed in the location of the schools.

[16], observed in his study of overview of infrastructural distribution of healthcare services in Nigeria and discovered that the distribution of medical care delivery in Nigeria has favoured the urban population at the expense of the rural. Also, in terms of infrastructural distribution of healthcare, the rural areas (mainly the majority) in Nigeria are being neglected to satisfy the urban areas, where the educated, the rich and government functionaries reside.

Furthermore, [3], conducted a study on the assessment of spatial distribution of health centers in Ilo-Ilo, Nigeria and discovered that an output of 0.99228, an indication of weak randomness, because it exceeds the Z-score table value of -0.723417 which is indicative of insignificant accessibility and submitted that the scenario is a microcosm of state of health facility distribution in typical Nigerian cities where health facility distributions do not adhere to any particular pattern or criteria.

[17], observed in his study on health care financing in Ethiopia: an implications on access to essential medicines that Revenue retention by health facilities, systematizing the fee waiver system, standardizing exemption services, outsourcing of nonclinical services, user fee setting and revision, initiation of compulsory health insurance among others in Ethiopia. Although limited, the evidence shows that there is increased health care utilization, access to medicines, and quality of services as a result of the reforms.

## 2. MATERIALS AND METHODOLOGY

The study was conducted within randomly selected 11 settlements across the three senatorial districts of Ondo state. Data for the study were collected from primary sources. The study utilized Global Positioning System (GPS) to take the coordinates of health care facilities as they were located across the state. Inferential statistics (Nearest Neighbour Analysis) (NNA) was used to analyze the data to optimize the use of facilities required to be provided with the aid of ArcView GIS in the study area (it enables the users to dynamically analyse and update the information linked to those locations spatially). Although other methods like point distribution, quadrant analysis do exist, however, this method takes into cognizance the area extent as well as the distance separating feature of interest. The method is increasingly being used in the analysis of point pattern because of its simplicity [18]. In

addition, there are numerous application software within which the NNA can be operated especially when data points is large. NNA is the method of exploring pattern in the locational data by comparing mean distance (Do) of the phenomena in question to the same expected mean distance (De) usually under a random distribution.

## 2.1 Concept of Nearest Neighbour Analysis

The concept can be applied to phenomena, which assumed to be distributed in an isotropic or uniform surface or phenomena that are strongly clustered. The Nearest Neighbour Analysis (NNA) is based on a straight line measurement of distance separating a phenomenon and the nearest neighbour space. The concept was originally developed by plant ecologists Clark and Evans, in 1954 who were interested in the distribution of various developed plants species over the earth surface [18]. The method indicates the degree to which any observed distribution deviates from what may be expected, if the distributions of points are random. Phenomena are said to be randomly distributed if they satisfy the following conditions:

- (a) Any part in the area has the same chance of occurring in any sub-area like any other point.
- (b) Any sub area of specified size has the same chance of receiving a point as any sub-area of that size.
- (c) The placement on the location of each point is not influenced by any other point.

Therefore, Nearest Neighbour Analysis by definition produces a figure (expressed as  $R_n$ ) which measures the extent to which a particular pattern is clustered (nucleated), random or regular (uniform).

The formular for the Nearest Neighbour Analysis is expressed as;

$$R_n = 2\bar{d}\sqrt{n/a}$$

Where

- $R_n$  = description of distribution  
 $\bar{D}$  = the mean distance between the nearest neighbors (km)  
 $A$  = area under study (metre)  
 $N$  = total number of points.

Furthermore,  $R_n$  (the nearest neighbour index) measures the extent to which the pattern is clustered, random or regular.

When Clustered:  $R_n = 0$  i.e. All the dots are close to the same point.

Random:  $R_n = 1.0$  There is no pattern.

Regular:  $R_n = 2.15$  There is a perfectly uniform pattern where each dot is equidistant from its neighbours.

Nearest Neighbour Analysis (NNA) has been applied into a spatial dimension by scholars. For example, [18] applied the model to the spatial distribution of secondary school in Egba Division of Ogun State, where he discovered that the spatial distribution of secondary schools in the area were more than random being clustered or uniform. The concept is limited by not being able to asses the socioeconomic attributes of the facilities users but relevant in terms of the degree to which any observed distribution deviates from what may be expected, if the distributions of points are random. In this study, it is being applied to assess the locational distribution of health care facilities in the rural area of Ondo state.

## 2.2 Existing Situation in the Study Area

Tables 1 and 2 present the locational attributes with respect to minimum and maximum distance of the existing healthcare facilities in the study area.

Out of 14 facilities captured within the study area, eight (57.14 %) were found to be publicly own while the remaining six (72.9%) were private cutting across the three senatorial districts in the state. In all, five (35.7%) facilities were located in each of the south and central and four (28.6%) in the north senatorial district respectively. It will seem to be evenly distributed across the area.

Table 2 shows the mean distance as the distance separating all the identified health facilities within the identified LGA, while the standard deviation refers to the deviation of the average distance from the mean value. The minimum and maximum values refer to the lowest and the highest distance between facilities in each of the LGA. Therefore, Okeluse Maternity centre had the lowest average distance among the health facilities in Ose LGA, the Basic Health Centre at Iju had the lowest average distance among all the health facilities in the Akure North

LGA, while Comprehensive Health Centre at Igbokoda had the lowest average distance in the Ilaje LGA. Health facilities with the lowest standard deviation and the highest minimum distance in each Local government area are the most isolated of the facilities.

### 3. DISCUSSION OF RESULTS

The result on Table 3 and the contents of Fig. 2 show that the distribution of health care facilities in the area was clustered. This implies a high level of inequity in the facilities' distribution. It also had an important implication for facility planning and management. The inequity implied

that Igbokoda (Ilaje) and Iju (Akure) enjoyed closer proximity to the location of medical facilities while other settlements were at farther proximities away from the facilities. Settlements like Iju and Igbokoda enjoyed better the available medical services than any other settlements in the study area. In the area where population is not evenly distributed, the mean centre of population distribution is calculated as the "demand", which forms the origin of location. The facility location point is considered as destination points or "supply". The travel time can then be estimated as the shortest time through the road networks between the pair of population and the healthcare facility locations [19].

**Table 1. 34 the locational attributes of health care facilities in the study area**

No	Facilities and location	Meters	Latitude	Longitude
1	Basic Health Centre, Imeri	259.08	7.306598	5.922424
2	Cottage Hospital, Okeluse	67.056	6.779354	5.581548
3	Maternity, Okeluse	56.6928	6.780160	5.590589
4	Adelabu Hospital	359.9688	7.397167	5.255449
5	Health Post, Adeyemi, Clinic	364.8456	7.395809	5.286872
6	Basic Health Centre, Iju	381.3048	7.390201	5.260523
7	Ife Olu Medical Clinic, Iju	362.4072	7.383625	5.261992
8	General Hospital, Iju	375.2088	7.381767	5.257480
9	Health Post, Iju	375.5136	7.395179	5.262792
10	Comprehensive Health Centre, Igbokoda	4.572	6.355288	4.803869
11	Ayemafuge Hospital, Igbokoda	5.4864	6.356658	4.803256
12	General Hospital, Igbokoda	8.8392	6.365655	4.791225
13	Ebenezer Medical Clinic, Igbokoda	6.092	6.352513	4.807623
14	Basic health centre, Oberawoye	6.4008	6.138854	4.789241

Source; Authors' field work, 2010

**Table 2. Conversion of locational attributes into the minimum and maximum distance**

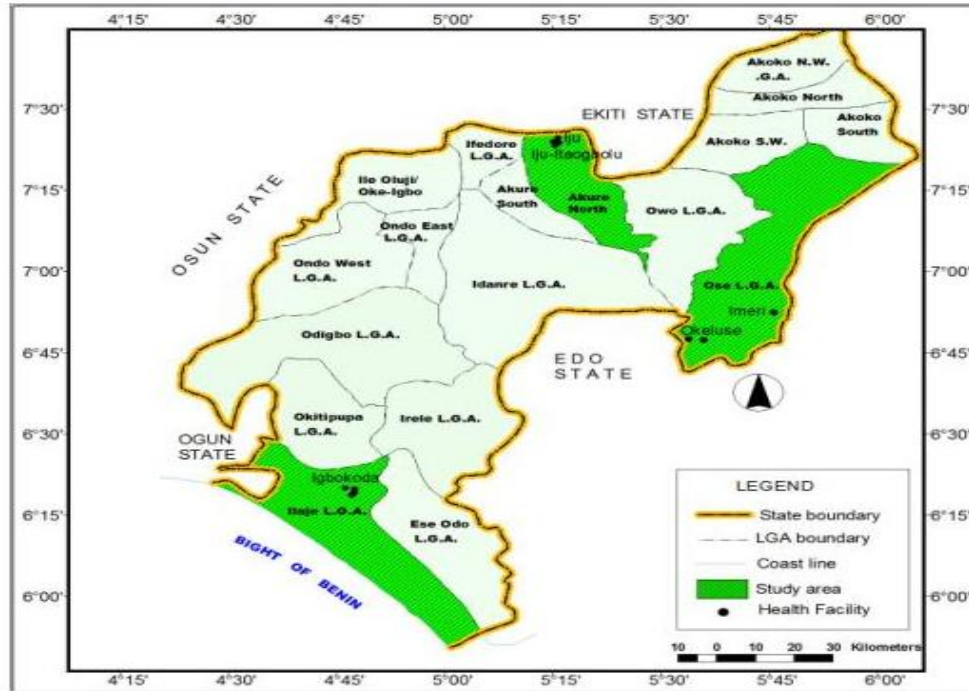
Name of facilities	LGA	Mean	Std dev	Minimum	Maximum
Basic Health Centre, Imeri	Ose	69107.08	306.10	68800.98	69413.17
Cottage Hospital, Okeluse	Ose	35208.26	34204.91	1003.35	69413.17
Maternity, Okeluse	Ose	34902.16	33898.82	1003.35	68800.98
Adelabu Hospital	Akure North	1728.80	941.88	839.81	3471.78
Health Post, Adeyemi, Clinic	Akure North	3152.08	341.66	2658.92	3596.81
Basic Health Centre, Iju	Akure North	1253.44	871.61	604.75	2973.85
Ife Olu Medical Clinic, Iju	Akure North	1457.18	893.29	538.77	3059.01
General Hospital, Iju	Akure North	1687.82	1044.93	538.77	3596.81
Health Post, Iju	Akure North	1395.77	718.78	604.75	2658.92
Comprehensive Health Centre, Igbokoda	Ilaje	6618.6	10044.49	165.95	23983.89
Ayemafuge Hospital, Igbokoda	Ilaje	6655.96	10103.32	165.95	24130.56
General Hospital, Igbokoda	Ilaje	7717.53	10025.15	1661.46	25076.36
Ebenezer Medical Clinic, Igbokoda	Ilaje	6804.0	9786.32	516.30	23709.8
Basic health centre, Oberawoye	Ilaje	24225.16	514.13	23709.8	25076.36

Source: Author's fieldwork, 2010

**Table 3. The result of NNA in the distribution of health care facilities**

LGA	Observed mean distance	Expected mean distance	Nearest neighbour index (Rn)	Z-score	P-value
Akure North LGA	964.29	5313.201935	0.181490	3.835575	0.000125
Ose LGA	23602.557493	11317.418476	2.085507	3.596866	0.000322
Ilaje LGA	5243.893350	8502.433193	0.616752	1.639441	0.101122

Source: Author's fieldwork, 2010



**Fig. 2. Distribution of health facilities in the study area**

Sources; Ministry of Lands and Survey Ondo State (2010) and Authors' fieldwork 2010

By inference, the health care delivery in Iju and Igbokoda were consequently more open to effective planning. On a general note, the results indicated that planning and management was lopsided in the study area. [13], therefore, rightly observed that minimal provision of free hospital services at widely separated locations had effect on transferring the real cost of health care to patients through additional transport cost. This invariably affects the income, expenditure and other household demands.

#### 4. CONCLUSION AND RECOMMENDATION

The study concluded that health care facilities were clustered in distribution in the study area. Since the facility location point is considered as destination points or "supply", it is, therefore,

necessary to include in the distribution plan, facility closer to the people within shortest possible distance. This can be enhanced through the use of GIS as a planning tool in the health care policy.

#### 5. LIMITATION OF THE STUDY

The study was faced with a number of limitation which include financial as well as the instrument such as remote sensing that could be used to take the points far away in the Riverine area of the state.

#### ETHICAL ISSUE

The study was authorised by Ondo state government under the auspices of Ondo state ministry of finance Research and Budgeting.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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