Mapping and Assessment of Healthcare Facilities Using GIS in a Part of Ikorodu Metropolis, Lagos State

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Abstract—The uneven distribution of health care services in Nigeria had been validated the inequalities in the accessibility and the best of fitness care services rendered to citizens. Basic fitness care offerings continue to be a cardinal responsibility of the authorities for the survival of her citizenry. Mostly in the developing country, the accessibility to these health care centres is poorly understood and underserved by the timing populations. there is a need to apprehend the elements that affect or inhibit health care used and what contributed to the use elements in term of distance from residences to the health care amenities and the thickly populace developed round the facilities. This paper focuses on the acceptable evaluation of spatial distribution of health care facilities and proposed for new health centres in some of catchments location that deserves it primarily based on distance and population figures in Ikorodu Local Community Development Area. It was subdivided into Ibesi, Ojuohde, Local Govt, Police Post, Ebute, Ogoloto, Tos Benson, Ita Elewa, Sambo, Alagbala and Eyiita Area with their two land mass for every the catchment area inside the learn about which covered two Ibesi Area, Ojuohde Area, Local Govt, Area, Police Post Area, Ebute Area, Ogoloto Area, Tos Benson Area, Ita Elewa, Sambo Area, Alagbala Area and Eyiita Area covered 128.585 ha, 59.658 ha, 106.793ha, 99.631ha, 140.803ha, 109.485ha, 131.518 ha, 155.051 ha, 89.698 ha and 112.907 ha. Based on buffer coverage and population used and it was revealed and proposed new healthcare centres for Oujohede, Local Govt, Ibesi, part of Eyiita, Sambo, Alagbala and Ogoloto areas maps were produced. The useful geodatabase was created for digital healthcare facility mapping for less difficult replace every time it's necessary.

Index Terms—Assessment, Distribution, Propose, Primary Health Facilities, Catchment Area, Ikorodu.

I. INTRODUCTION

Health is an all-inclusive human right and being centered around social contributed and political concerned around the world. World Health Organization [17] characterizes health as a condition of complete physical, mental and social prosperity and for such perfect expressed could swing to alluring outcomes. For all intents and purposes, most we seen frequently is that human determined to have different health hesitations which had driven the general population to undesirable consistently. Consequently, social insurance foundations are administration arranged foundations that give restorative consideration offices including observational, demonstrative, research and remedial and rehabilitative administrations to general society. Satisfactory and successful appropriation of social insurance offices contributes tremendously to human services administration arrangement and necessities of the general population. In the health segment, much concern has been communicated relating to the example of dispersion of health care offices and dimension of usage. At the end of the day, the dimension of access to social insurance offices is a component of the level of reasonableness in spatial dispersion of the offices. [11] dealt with the disparity in offices circulations which are viewed as double issues of restricted offices and low close to home versatility in the creating social orders. Openness in this setting has spatial subject and connotes the simplicity with which potential social insurance searchers get to the health offices where human services administrations are conveyed. [10] set out on the territorial health related issues and affirmed the presence of disparity in the circulation of medicinal services offices in Nigeria. The national health approach expects to accomplish health for all Nigerians dependent on the national theory of social equity and value as plainly articulated in the second National Development Plan of 1970-1974. These standards of social equity and value and the beliefs of opportunity and opportunity have been asserted in Nigeria's constitution. Along these lines, the national health approach was figured with regards to these national targets and reasoning. To this end, the essential human services are received as the methods for accomplishing the national objective of social equity and value. As characterized in Alma-Ata Declaration of 1978, "essential medicinal services... brings medicinal services as close as conceivable to where individuals live and work [16]. With respect to [8] who had seen that the issue in the human services area is past on the nature of administrations rendered as well as on amplenness of health offices supplier. The nature of administrations rendered is identified with the dimension of labour accessible. Despite the fact that, WHO declared that Nigeria is yet to build up a health labour plan that depicts the classifications and number of work force required considering current status [6], the health labour level in Nigeria appear to be inside worthy standard for the creating nations. Nigeria has surpassed the WHO standard

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for the African area of one specialist for every 10,000 populace [6],[7] and [15] For the creating nations including Nigeria, the specialist/populace proportion of 1:10,000 with mean medical clinic administration scope of 0-16km sweep have been prescribed[6]. In any case, the specialists are mal-conveyed, the greater part of them being in the urban zones while there are networks that have never observed a specialist; others have a proportion of one specialist to 200,000 Population [15] As far as health attendants, there are multiple times a larger number of medical caretakers than specialists. Like the specialists, attendants are additionally mal-appropriated. In any case, numerous country health focuses all through Nigeria are kept an eye on by medical caretakers who give social insurance administrations to the provincial people [6]. From an examination done by the Directorate of Food, Roads and Rural Infrastructure in 1987, Nigeria has around 100,000 towns and self-ruling networks however there are around 10,711 health foundations at the essential human services level including health and maternity focuses, health centres and dispensaries [15]. This implies there is approximately one office for every 10 towns/networks and this makes openness to health administrations exceptionally poor particularly in rustic regions. This had set up the actualities that in medicinal services administrations, patients are not set up to travel more than 5km or a half-hour venture by walking to get social insurance administrations [7]. Moreover, [15] further focused on that for preventive administrations, for example, vaccination and health instruction, the separation individuals need to make a trip to get administrations is substantially less than 5kms or half hour venture. The arrangement of medicinal services focuses in Nigeria is a simultaneous duty of the three levels of government in the nation. Be that as it may, on the grounds that Nigeria works a blended economy, private suppliers of restorative medicinal services have an unmistakable task to carry out in social insurance conveyance. The Federal government's job is for the most part constrained to planning the issues of the college showing emergency clinics, Federal Medical Centres (Tertiary Health Care) while the State Government deals with the different General medical clinics (Secondary Health Care) and the Local Government centres around dispensaries (Primary Health Care) which are managed by the national government. The all out use on social insurance is 4.6% of GDP, while the level of national government consumption on human services is about 1.5%. The sufficient supply and ideal distribution of assets to medicinal services focuses is of incredible significance for health improvement of the residents; be that as it may, access to them should likewise be set up while choosing where to site them. Spatial availability accordingly stays a standout amongst the most essential variables considered in human services contemplates. Such investigations centres around, the examination of physical or potentially basic availability to human services, evaluation of the varieties in the arrangement and use of medicinal services focuses, investigation of the degree of administration territories and distinguishing proof of holes in arrangement, displaying of ideal office areas, examination of issues of value and proficiency in social insurance arrangement, appraisal of social insurance approaches among others and the preferences. Once in a while, these issues are considered in connection to the occurrence of illness and mortality. At the centres of a large portion of these examinations is in this way the issue of area and its job or effect on the arrangement of human services. Human services Facilities Categories in Ikorodu had assumed fundamental jobs because of the inundation of populace in the territory. Medical services offices were subdivided into three classifications, Primary, Secondary and Tertiary social insurance offices. Essential Health care characterizes as a human services framework that gives the main dimension of contact between the populace and social insurance suppliers. Due to its significance in the conveyance of health administrations, the middle, states and neighbourhood levels then a few governments began creating essential medicinal services framework and labour and they trusted that there are the nearest health offices found in the country territories. It gives a road of taking care of health related cases quicker before getting most noticeably awful and exchanged further. Auxiliary Healthcare characterizes as the second level of health framework, in which patients from essential social insurance are alluded to masters in higher medical clinics for treatment. These offices are mostly possessed and constrained by the state governments. They are likewise accepted to have probably the best submits terms of man forces and current hardware in the states. The administrations rendered too are accepted to be among the best in their region. Tertiary Healthcare characterizes as any organization giving health training at a tertiary dimension more often than not inside the state. Tertiary Health care alludes to a third dimension of health framework, in which particular consultative consideration is given ordinarily on referral from essential and optional therapeutic consideration. Particular Intensive Care Units progressed demonstrative help benefits and concentrated restorative staff on the key highlights of tertiary medicinal services. The tertiary medicinal services framework is controlled and overseen by the Federal Government of Nigeria. They are known to have the best experts and hardware in the nation. They are additionally accepted to offer the best administrations inside the area they are being sited at. Most medical clinics in this unit are college instructing emergency clinics while others are authority clinics like the neuropsychiatric clinics and among others.

The World Health Organization [17] described GIS as an excellent means of analyzing epidemiological data, revealing trends, dependencies and interrelationships that would be more difficult to discover using traditional tabular approach. Site selection and distribution of health care centers are important components of an overall health system which has a direct impact on the burden of diseases that affect many countries in the developing world. The creation of health care centers database and mapping helps in showing the spatial distribution and information about location and their physical relations to each other. The purpose of using GIS in site selection and distribution of health care centers is that maps provides an added dimension to data analysis, which helps in visualizing the complex patterns and relationships. The use of GIS for measurement of physical distribution is well established and...
has been applied in many areas including retail site analysis, transport, emergency services and health care services [5]. [13] Specified criteria for health care planning for third world countries and indicated that each service area should cover a 4km catchment area with a population of 60,000 for primary health care in order to have adequate and equity of access to health centers. [2] and used GIS technique to demonstrate the relationship between distance and patronage of health centers in Ife. He noted that attendance at each health center in Ife region is a function of both type of service available there and the distance from other center providing similar services. [9] analyzed the spatial distribution and efficiency of health centers in the old Bendel (now Edo and Delta) State. He created a data base of all the health centers in Benin and found that there were discrepancies between the population distribution and the distribution of health centers. [4] illustrated the problems and effects of poor location planning in the provision of public facilities in Ogun state, Nigeria. They identified some of the ways in which the Nigerian government has misinterpreted issues of efficiency and equity in the distribution of maternity clinics thus resulting in the proliferation of facilities which did not address the needs of many communities. Similarly, [9] studied the distributive effects of the location of health care facilities in Ibadan, Nigeria in terms of access to them using Scheiders and Symons access opportunity model. His study revealed that areas of high accessibility lie to the North and areas outside the traditional pre-colonial city. Using both regression and correlation analysis, he found that there was no systematic discrimination against low income disadvantaged groups. However, he pointed out that distribution was not equitable and concluded that public policy on health care provision in the country does not adequately address the needs of the people. [12] investigated the effect of location on the utilization of healthcare centers in Irewole local government area of Osun State, Nigeria. They considered the population data and distance of the settlements to each health center. It was revealed that health centers were unevenly distributed among the settlements and that the distances were paramount factors. [3] also carried out extensive GIS mapping and documentation of primary maternal health care centers in Ugheli South and Warri South Local Government Areas of Delta state, Nigeria. This was done to provide geospatial information about the distribution and accessibility of primary health care centers. The distribution was found to be clustered in some areas leaving others underserved. Similar studies by [1] also suggested that poor maternal health care is largely due to or aggravated by poor access to health care facilities. Hence, a variety of methodologies and approaches have been adopted to investigate physical accessibility based on distance and/or time. However, one of the best ways to measure accessibility is to examine the distribution of maternal health care facilities as well as their service areas or coverage. However, there was no consensus /or correlation in the literatures reviewed that explained explicitly in supporting the working distance modelling that the patients allowed to travel or adventure to walk before their ensure their insurers for health engagement. Moreover, in lines with this conclusion aforementioned above, the health centre situated within Ibese, Ojubode, Ogoloto, Eyita sambo and Alagbala are not being found with the requirement prescribed to the insurer in the Nigeria and that made it not function effectively.

II. GEOGRAPHIC LOCATION OF THE STUDY

Ikorodu is a city in north-east Lagos State, Nigeria. There are two local development councils within Ikorodu, viz, Ikorodu North and West Local Development Areas. It is located approximately between latitude 603°7′ to 604°5′N and longitude 30°3′ to 30°5′E with a land area of about 394 km². It is bounded in the east and west by Epe and Somolu Local Government Areas respectively, in the south by the Lagos lagoon, and towards the north by Ogun State. Based on the 2006 census, the population of the study area is put at 535,619. Within Ikorodu there are 57 public primary schools and 12 secondary schools, some of which includes Government College Ikorodu, Government Technical College, Lagos State Civil Service Model College Igboogbo and Ikorodu High School, there are also several private nurseries, primary and secondary schools and one tertiary institution is Caleb University and it locates at the Imota area of the town. Lagos State Polytechnic Ikorodu, a government owned polytechnic is also located in Ikorodu. The total number of health facilities in the state is 26 state hospitals and 150 public health care centres in the state, in addition to privately owned hospitals and clinics. The main water sources public taps, yard well/borehole, and water vendors. Few residents make use of streams and rivers as their drinking water. Predominant land uses in the state are residential, industrial, recreational and fisheries (aquaculture), it lies in the tropical climate. In winter, there is much less rainfall than in summer with the average temperature of 26.90°C. The vegetation pattern is a reflection of the climatic condition of the mangrove forest which is made up of mangrove plants of different species. The climatic condition and vegetation pattern favours agricultural practice. Ikorodu east, Ikorodu west and Ikorodu central Local council development areas are located in an upland area with topography that enhances effective drainage through which several rivers flow into the Lagos lagoon. Commonly, the reported related health problems include: malaria, diarrhoea, cholera, sexually transmitted diseases (STDs), asthma, hypertension, skin infections, typhoid and paratyphoid fevers and tuberculosis due in proper disposal of wastes [7].
III. MATERIALS AND METHODS

Methodology refers as the phases by phases approach undertaken by one to achieve the stated objectives in this paper. The X, Y locational position of the healthcare centers, health records and Local Area Development Authority (LCDA) with their addresses was obtained from the Lagos state ministry of health. These coordinates points were plotted on the ArcGIS 10.3 Version and which aids to justify their position on the ground and within the study area. The administrative map, satellite imageries and population data were referred as the secondary input. Administrative map was sourced from the Lagos state surveyor general’s office and it was use to depict the extent of the study area. One meter’s resolution satellite imagery was acquired and georeferenced. The roads, river and towns were extracted from the image and Population data was obtained from the National Population Commission, Lagos state office and it was use to analyze the patronages. [14] criteria for selection of proposed sites for health care centers were adhered to:

A. Proximity and Accessibility being recommended by [14] for the criteria for sitting new health center that it must not be more than 5km from residential areas and the distance must not more than 20m from the major road.

B. Population Size must be overestimated from 500 to 5000 people that should have access to at least 1 health center.

IV. ANALYSES AND RESULTS

Findings an alternative or permanent remedy into healthcare delivery system in Nigeria becomes critical problems. Produce a locational map in digital format it enhances health preparedness, facilitate the management and maintenance of health records of any kind because data keeping is of best interest of any sectors to drive improvement as a serving entity. GIS possesses capability of handling the geometric which consists of spatial and non-spatial problems and these make it absolutely function different from other computer based information system. This had created an avenue of linking spatial and non-spatial within the study area. Figure 2 shows subdivision of the extent of the study area into the eleven catchments area which are inclusive Ibese, ojubode, local Govt area, Tos benson area, Ebute Area, Sambo area, Ita elewa and Alagbata, Ogoloto, Eyita and Alagbata. It also revealed the numbers of existing healthcare facility that was pioneered by Government and that shown that there was no much on the ground that could cater enough for the total population collated in 1999 census as of 535,619. If the trend of its growth ought to be analyzed by the rate of 3.2% yearly and up to dates. This becomes a rational problem to the facility because more pressure would be surely exerted on them.

A. Population Distribution

The population figures for lbese, ojubode, local Govt, Tos benson, Ebute, Sambo, Ita elewa and Alagbata, Ogoloto, Eyita and Alagbata area were stated categorically in 1991 census where every locality is counted per head in the population. The data was linked to the geometric data from the imagery and forming a geospatial database which is known as the heartbeat of GIS. This has shown its capability by display catchment area population in gender sensitive by using multiple bar charts displaying in Figure 3 and also helps to display their population where Local Govt, Ojubode and Ita-Elewa area possessed the largest populations of 34567, 31789 and 30099 respectively while Ebute area recorded the list population figure of 3467. The highest and lowest population ranges between 34567 and 3467 per catchment area in the study.

B. Testing of Database

This is done to determine whether the relationship
between phenomena and their attributes are capable of being retrieved from the database created. The phenomena tests were the locational position of the health centres, Bio data of the staff and population figure of people servicing the facilities in the study. This operation has capability of searching and retrieving information from the geographic features found within the area is considered. Single criterion searching was engaging to recover spatial data from the database where Catchment area population was chosen without other features in the investigation zone and is more than or equal to even thousands population in the catchment. The Syntax = Select* From Catchment Where: Catchment_population = >7000 and this displays the qualities in the Figure 4, where Tos benson, Sambo,Ita eleta, Alagbata, Ibese, Ojubode, Local Govt, Ogoloto and Police post area were chosen from the database. They are strong exceptional populated due to growing yearly than the other catchment zones involved. The land mass for each catchment area within the study included Ibese Area, Ojubode Area, Local Govt. Area, Police Post Area, Ebute Area, Ogoloto Area, Tos Benson Area, Ita Elewa, Sambo Area, Alagbala Area and Eyita Area covered 128.585 ha, 59.658 ha, 106.793ha, 99.631ha, 140.803ha, 109.485ha, 131.518 ha, 111.625ha, 155.051 ha, 89.698 ha and 112.907 ha. Figure 5 shows the selected the catchments area that found within the study area and at the same time having more than or equal to seven thousand populations. In figure 6, it shows that areas like Tos - benson, Sambo,Ita eleta, Alagbata, Ibese, Ojubode, Local Govt, Ogoloto and Police post area met with the criteria in figure 4. It produces a light green map which capturing exactly nine catchment areas and which left three catchment area in the study. It connects Ibese, ojubode, local Govt area, Tos benson area, Ebute Area, Sambo area, Ita elewa, Ogoloto, Eyita and Alagbata Area.

Figure 7 describes the Multiple Criteria situations, where two or more conditions are used to query from the functional geodatabase created and this bases on the criteria set upon in the study. This multiple criteria condition was employed to retrieve the required information from the database which uses select by location. It implies that select feature from one or more target layers based on their location in relation to the features in the source layer. The Syntax Select method: Select features from Target layers “hospital” & major Road is the Source layer from the model selected and where both features spatial selection method for target layers are within a distance of the source layers features of twenty meters apart. Specifically, more than one field is used from the table in order to achieve this result. The select by location model revealed some of the hospitals fallen within the distance of 20m from the major road set and they are Hopewell Hospital, General Hospital, LPHC Ita Elewa, Newgate Hospital, EOCC Primary Health Centers, Ikorodu Clinic and Eyita Health Centres. Figure 8 shows the hospitals position relatively to their locate of Hospitals being found on the distance of within 20m away from major road. Figure 9 shows the Locate map for the Hospital on the distance of within 20m away from major road.
Buffer zone uses a spatial function to create task around a given phenomenon. It also helps to give an insight or demarcate areas affected or unaffected by spatial activities which often show the extent of coverage of a feature. The buffer zone of 1000m walking distance was created around each health center based upon the Perrya & Gesler (2000) criteria. It revealed and determined the catchment areas that have better coverage for users to assess health care facility and they are inclusive the Tos benson, Ebute, Sambo, Ita eleta and alagbata area in figure 10. In Ibece, ojubode, local Govt area, but Tos benson area, Ebute Area, Sambo area, Ita elewa and Alagbata, Ogoloto, Eyita and Alagbata Area have been in population geometrically over the years though they possessed at least one health center to their domains but due to increase in their population they deserved additional health center. In Figure 14 and 15, where the population is more than or equal and less than 7000. The Ebute and Eyita area do not have a particular health center that are serving them and choose to depend on neighbouring health center to care for their predicament it was showed clearly in Figure 15.
the part of Ogoloto, Eyita sambo and Alagbala have known as Area being denied by distance of 1000m walking distance to hospital before they could assess the healthcare facility. Overlay operations were used and it showed all possible propose new health center within the study area based on distance of 1000 by 1000m by using fishnet tool to configure the areas that were underserved and this indicated the exact geolocation met for the new health center in terms of distance and as it was showed colour yellow for the description of new health center propose site. Also Population Size was another criterion sited and the condition was that area/catchment with a population of 500 to 5000 people stand out to possess at least one health center. It shows that despite the population size was exceeded 500 to 5000 yet there was health center sited in their domain because areas such as Ibese, ojubode, local Govt area, but Tos benson area, Ebute Area, Sambo area, Ita elewa and Alagbata, Ogoloto, Eyita and Alagbata Area have been recorded geometrically population over the years. Though they possessed at least one health center to their domains but due to increasing numbers in term in population they deserved additional health center. And where the population is less than 7000 is Ebute and Eyita area yet do not have a particular health center that are serving them and they choose to depend on neighbouring health center to care for their predicament.

VI. CONCLUSION

It is concluded that the geodatabase created was tested and analyses performed base on the criteria set for the study at hand. It showed the number of health centers facility in the study area by using GIS techniques of handling the pre and post analyses. As per keeping records, it aids in preparedness for requirement to place on ground before the issues are discussed towards the objectives. Adequate analysis can be made through queries thereby enhancing decision making by residents of Ikorodu and policy makers. The database allows for easy access, storage and retrieval information at will and to effectiveness identifies area posed to under-utilized which had not been making it well defines the maximum output being expected.

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