



Spatial Analysis of Physical Accessibility to Rural Health Care Facilities in Nigeria: A Review

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ABSTRACT

In the literature of spatial analysis of physical accessibility to rural health care facilities in Nigeria, it seems that growing attention has been given to health care which is a fundamental human right to every citizen to have access to health care services when needed, but cost of living is high, the road network is poor, and many people lack enough to afford expensive healthcare, apart from paying an extra for transport to a long distance health facility. The situation increases the tendency to delay or miss effective health care on a daily basis all over the country; especially in rural areas where infrastructural development is low. This paper seeks to provide a comprehensive literature on spatial analysis of physical accessibility to rural health care facilities in Nigeria so as to show the importance of adequate healthcare facilities in providing sustainable rural development. Healthy population and access to healthcare services are significant factors influencing economic development and prosperity. Thus, accessibility to healthcare facilities has generally been identified as a major indicator of development, and the existing spatial pattern of distribution of healthcare facilities play very prominent role in gauging the level of efficiency or otherwise of the existing level of provision of these facilities within any region. Health planners, over the years, have been focusing on financing healthcare with less consideration of the spatial physical accessibility to facilities. It is glaring that finance alone will not redeem the failing Nigerian health system. Therefore, healthcare planners and researchers must prioritize other dimensions of healthcare access such as spatial physical accessibility which they have ignored over the years

Keywords: Healthcare facility, Rural, Nigeria, Spatial, GIS, Accessibility

Introduction

It is a fundamental human right to have access to health care services when needed. It is desirable for a government to ensure high quality provision and equal and easy access to fundamental health care services to all citizens. Varying spatial distribution of the population, health care facilities and transportation infrastructure in an area often lead to spatial variations in accessibility to health care facilities, which in turn will result in disadvantaged locations and communities having poor spatial accessibility to needed health care facilities. In many health care systems, adequate, equitable and easy access to health care facilities is often considered one of the main objectives (Powell & Exworthy, 2003). To ensure equal and easy access it is essential to ensure that the population, health care facilities and the transportation infrastructure are positioned in a manner that facilitates high spatial accessibility.

In Nigeria, the World Bank (1962) and Second National Development Plan (1974) recognized that a healthy population is an economic asset and acknowledged the need to make health services and facilities available and accessible to the general population. However, Nigeria, (1981) observed that "poor management continues to be a serious handicap in the effective delivery of health services in the country, health facilities are in short supply and the available one are inefficiently utilized". But, effective delivery and management of healthcare services is achieved if there are effective legislations that are fully implemented, timely evaluated and properly reviewed.

The Federal Government of Nigeria adopted a National Health Policy in 1998. The objective of the policy was to provide the population with access to primary, secondary and tertiary healthcare as needed through a functional referral system. It recognizes that the provision of health services is a responsibility of the federal, state and local governments; as well as civil societies and non-governmental organizations. But Nigerian Medical Practitioner, 2004 reported that over seventy percent of the populations living in rural areas and a good number in semi-urban towns in Nigeria have a serious problem of access to quality healthcare. This cannot be unconnected with partial implementation, untimely evaluation and review of the health policies in the country. An important aspect of the health policy that requires timely evaluation and proper review is accessibility to healthcare facilities especially in the rural areas. This is because the location of and accessibility to healthcare facilities in a given geographical area influence their utilization. Also, the nature and extent of health problems as well as the threshold population demanding healthcare services in a given location influence the decision of the government on the type of healthcare services to be provided in the area. In Nigeria, primary healthcare is largely the responsibility of the local governments with the support of the state, while secondary healthcare is the responsibility of the state government, whereas tertiary healthcare is the responsibility of the federal and state governments.

Some concepts that have frequently been used to measure health services remain extremely relevant and are part of the key characteristics. For example, terms such as access, availability, utilization and coverage have often been used interchangeably to reveal whether people are receiving the services they need (Bamford et al., 1999). Access is a broad term with varied dimensions: the comprehensive measurement of access requires a systematic assessment of the physical, economic, and socio-psychological aspects of people's ability to make use of health services. Availability is an aspect of comprehensiveness and refers to the physical presence or delivery of services that meet a minimum standard. Utilization is often defined as the quantity of healthcare services used. Coverage of intervention is defined as the proportion of people who receive a specific intervention or service among those who need it (Bamford et al., 1999). Access to medical services is one of the basic necessities of any human community. It is a major complement to a strong, dynamic and progressive society.

Thus, the provision of health services should therefore be a shared responsibility between the private and public sectors. The main goal of health service delivery is to provide equitable utilization and access to healthcare services. An important factor in obtaining quality care is physical access to healthcare as lack of spatial access can result in delayed treatment and poor health outcome. Fundamental to addressing the issues of equity and equitable access to healthcare is the issue of geographical distribution (Oliver & Mossialos, 2004). Adequate, equitable and easy access to healthcare facilities by local communities in specified geographical areas is an important issue of human service provision to the individuals living in that area. It is also a challenging issue for both public policy makers and urban planners (Burns & Inglis, 2007; Geertman & Ritsema, 1995; Hewko, 2001; Luo & Wang, 2003).

It is essential to ensure that the population, healthcare facilities and transportation infrastructure are spatially located where accessibility frictions are less to ensure equal and easy access. There are many different conceptualizations of accessibility to healthcare facilities, and many different measures of accessibility have been proposed and used in literature (Hewko, 2001; Talen & Anselin, 1998). Facilitating access is concerned with helping people to command appropriate healthcare resources in order to preserve or improve their health. If services are available and there is an adequate supply of services, then the opportunity to obtain healthcare exists, and a population may 'have access' to services (Hewko, 2001; Talen & Anselin, 1998).

In Nigeria, healthcare provision is a concurrent responsibility of the three tiers of government in the country. However, because Nigeria operates a mixed economy, private healthcare providers also have a visible role to play in healthcare delivery. The federal government's role is mostly limited to coordinating the affairs of the University Teaching Hospitals and Federal Medical Centers while the State government manages the various general hospitals and the local government focuses on dispensaries (Primary Health Care) which are regulated by the federal government through the National Primary Health Care Development Agency (NPHCDA). Varying spatial distribution of the population, healthcare facilities and transportation infrastructure in an area often lead to spatial variations in accessibility to healthcare facilities, which in turn would result in disadvantaged location and communities having poor spatial accessibility to needed healthcare facilities (Ahmad, 2012).

The rural populace in Nigeria has very low access to health facilities when compared with their urban counterparts, yet they constitute about 51.4% of the population (Central Intelligence Agency (CIA), 2015). Rural people in Nigeria encounter a range of service delivery and health problems when they try to access healthcare. Such problems range from drug stock-out to poor infection prevention practices to shortage of health staff and this can lead to unnecessary suffering by patients or in the worst cases, death. Some communities usually lack the means of confronting these challenges, leading to poor access to healthcare services (Health Partners International [HPI], 2014).

The provision of effective rural health care services is necessity for the overall social and economic development of rural communities in particular and nation in general. There are many challenges faced by rural communities concerning health care access which include economic destabilization, shortages of medical personnel; as well as transportation and barriers to care. Location of health care facility influences utilization and also efficiency more when compared with influence of decision to seek and receive care. The most determining factor of the utilization of health care facilities is distance that the patients must travel in order to obtain treatment (Adamu, 2000).

Access to healthcare in Nigeria

Nigeria's position as the most populous nation and strongest economy in Africa is a paradox of its health system; which is 187th out of 191 World Health Organization (WHO) countries (World Health Organization, 2006). With a population of 185 million as of 2016, extreme poverty, poor environmental quality, insurgency and insecurity; the budget for health care is bound to suffer significantly. Therefore, healthcare policies in the country are tailored to suit the limited funds. Even when funds are released, corruption and government bureaucracies perforate the effectiveness of the target intervention. Consequently, the Nigeria Health system has not experienced a significant improvement in the last two decades (Adeboye, 2014).

Nigeria is among the greatest burden bearers of diseases morbidity and mortalities in the world. Malaria, Tuberculosis (TB), Human Immunodeficiency Virus (HIV) and malnutrition which have disappeared or reduced in many countries are still among the active sources of death in the country. Despite the successes achieved in the last decade in many countries, malaria remains a major public health problem in Nigeria with the greatest toll on under-five children and pregnant women (Malaria Elimination Programme, 2015). According to the Nigeria Malaria Indicator Survey of 2015 (Malaria Elimination Programme, 2015), malaria accounts for 60% of outpatient visits and 30% of admissions in the hospitals, it causes up to 11% of maternal mortalities, 25% of infant mortalities and 30% of under-five mortalities. It also records 110 million clinically diagnosed cases and estimated 300,000 malaria-related childhood deaths yearly.

Nigeria is also counted among the 14 high burden countries for TB and HIV, seventh among 30 high TB countries worldwide and second in Africa. According to Kanabus (2018), about 407,000 people in Nigeria get TB every year. The problem is further compounded with the presence of HIV. It is estimated that 63,000 HIV positive cases get TB each year and an estimated 115, 00 HIV negative people die from TB (Kanabus, 2018). Beyond Malaria, TB and HIV; child malnutrition stunts 6 million children and more than half of them severely (UNICEF, 2015). Comparatively, Nigeria's malnutrition rates are higher than those of West Africa and World malnutrition rates. While stunting, underweight and wasting are 37%, 29% and 18% respectively in Nigeria; they are 36%, 23% and 11% in West Africa; and 25%, 15% and 8% in the world (UNICEF, 2015).

Access

Access can be described as the 'degree of fit' between users and a service. The 'degree of fit' might be influenced by the availability, accessibility, accommodation, affordability and acceptability of a service (Penchansky & Thomas, 1981). Furthermore, access is linked with the demographic, socio-economic and cultural characteristics of the population, locations of the health care facilities and of the transportation network. In other words, access is patterned both spatially and socially (Field et al., 2004). Spatially, the more resources that are provided into an area for use the greater the likelihood that people will use those resources and live in that surroundings. Access to an existing resource or facility (e.g. a hospital or a road network) is generally understood as the capacity of an individual to obtain a service when it is needed. Over the last four decades, scholars focusing on access issue

generally agree that 'access' is not a well-defined term (Penchansky & Thomas, 1981).

The literature also suggests the term 'access' cannot be understood on its own but rather, it must be differentiated from other closely related terms, which are often used interchangeably with the term access, including accessibility, availability, affordability, barrier, right of entry, right to use, mobility, and level of permission (Bagheri et al., 2005). Penchansky & Thomas (1981) distinguished two aspects of access, spatial and socio-economic, and described the spatial aspect of access in terms of availability, accessibility and accommodation and the socio-economic aspect of access in terms of affordability and acceptability.

Access is quite a complex term to define and it becomes more complex when the measure of access is not simply the presence of a health care facility, as the presence of service does not ensure the utilization of these facilities in relation to need and health care services users and service provider professionals evaluate "need" differently (Donabedian, 1972). Penchansky & Thomas (1981) observed that access is most frequently viewed as a concept that somehow relates to the consumers' ability or willingness to use health care services, and therefore should consider the personal, financial and organizational barriers to health care service utilization. In contrast, Mooney (1983) argued that access is a question of supply; whereas the utilization is a function of both supply and demand. Equity of access is purely a supply side consideration, in the sense that equal services are made available to patients who have equal health concern.

Accessibility

According to Vickerman (1974) accessibility is a combination of two elements: locations on a surface relative to suitable destinations, and the characteristics of transportation networks linking points on that surface. Accessibility defined as such is similar to the notion of access, as it has a number of spatial and temporal properties that constraint an individual's ability/capacity/preference to access specific destinations (Witten & Exeter, 2003). Accessibility can be defined in terms of mobility, which includes a number of spatial and associated non-spatial attributes and their temporal constraints, on individuals or groups. Accessibility can be measured by (Euclidean, Manhattan or network) distance, by travel (driving, public transport or walking) time or travel cost. Accessibility can be described as travel impedance (travel distance or travel time) between patient location and health care service points (Guagliardo, 2004). Guagliardo (2004) argues that accessibility and availability are not similar terms and that accessibility may depend on availability of the services. With regards to health care service utilization, accessibility is generally influenced by the spatial structures of health care service supply and demand, neither of which is distributed uniformly in space (Wang, 2011).

The Nigerian healthcare system

A health system is the network of organizations, institutions and resources that deliver health services to the public. In Nigeria, two forms of health care services are recognized; modern and traditional healthcare (NPC, 2008). The modern health service includes all forms of organized healthcare that originated from Europe and colonial era, and the traditional healthcare is delivered by herbalists and spiritualists. The three key players in the Nigerian modern healthcare systems are; government (public), private sector and charity (Amaghionyeodiwe, 2008). The public healthcare system has a three-tier structure (i.e. primary, secondary and tertiary) which was fashioned after the three arms of government (i.e. federal, state and local government). The entry point of the health system is the primary healthcare (Amaghionyeodiwe, 2008), which is managed by the local council, though sometimes supported by the state, federal and charity organizations (NPC, 2008). Most primary healthcare centers deliver only preventive and curative care to out-patients.

Secondary care is provided in General Hospitals which are situated in most local government administrative headquarters and managed by the state governments. General hospitals deliver inpatient and out-patient services, supervises and provide referral services for primary health centers. Tertiary healthcare is delivered by the teaching and specialist hospitals, which are mostly managed by the federal government. The teaching and specialist hospitals provide highly specialized services for orthopedic, psychiatric, ophthalmic and infectious diseases. Although this structure is laid out, there are overlaps of functions due to fuzzy health policies, facility bypass and self-referrals by patients (Figure 1 below). The relationships among these three levels of care are shown in Figure 1 below.

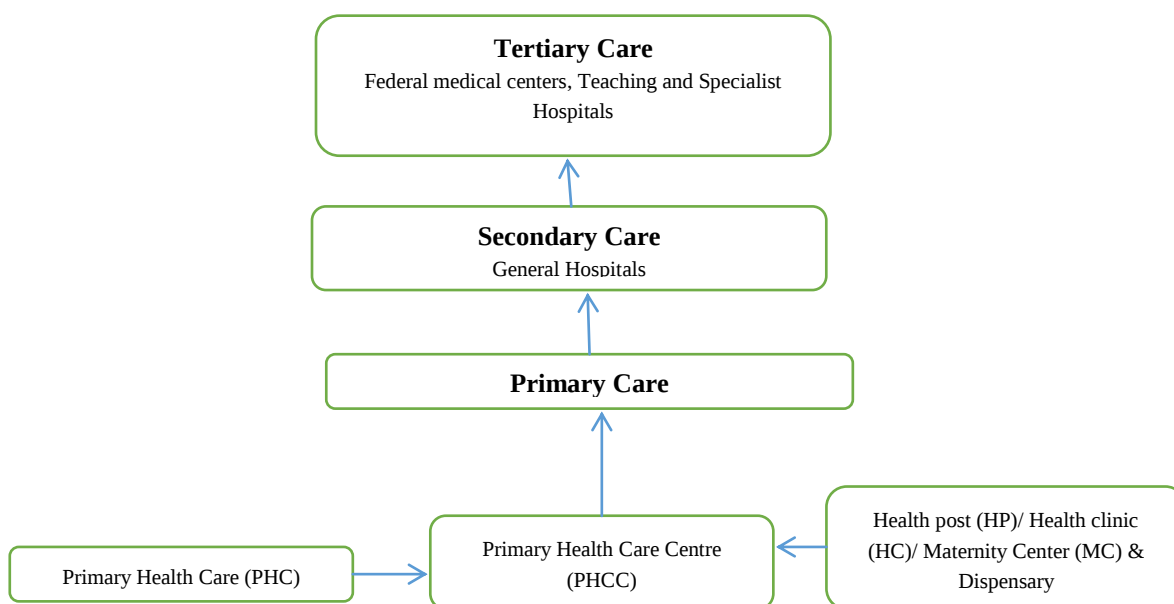


Figure 1: Nigerian healthcare system; relationship and referral pattern

The estimated number of all health facilities in the country in 2005 was 23,640; of which primary healthcare facilities were 85.8%, secondary healthcare were 14% and tertiary healthcare were 0.2 % (Amaghionyeodiwe, 2008). There are 22 Federal medical centers, 20 Federal Teaching Hospitals and 13 Federal Specialty hospitals in the country (Federal Ministry of Health, 2014). The private sector also makes significant contributions to the Nigeria health system and its impact increases yearly. It provides 60% of health care in the country also owns 38% of the facilities (Amaghionyeodiwe, 2008). The number of private health facilities doubled between 1987 (1,905) and 2000 (3,987) (Amaghionyeodiwe, 2008). Charity health facilities are few. In most cases, international and local charities provide support to existing public healthcare facilities. Traditional medicine in the country stays uncoordinated and there is little evidence about them. The influence of traditional health care practice tends to be stronger in the suburban and rural areas where geographical access to modern healthcare is limited.

The overall objective was to strengthen the national health care system and provide affordable, quality, equitable and accessible health care to the population while achieving the MDGs. In July 2009, the national health policy was upgraded to the National Strategic Health Development Plan Framework (NSHDP 2009 – 2015) (Federal Ministry of Health, 2009). The main aim of NSHDP (2009 – 2015) was to make significant improvements in the health status of Nigerians, through developing and strengthening efficient health care system. The Nigerian government has made a considerable number of policies in the last three decades with the aim to improve the weak healthcare system in the country. However, most of them lacked measurable goals and sustainability. Some of the policies and interventions were inspired by politics, some were tailored to the budget size and most of them lacked geographical accessibility. Therefore, successfully implemented interventions faced low utilization or clustered in locations with similar services; and the health system experienced insignificant or no improvement in the end.

Spatial accessibility

Spatial accessibility otherwise called geographical access is the physical link between the potential user and the facility; considering travel time, distance and cost (Hansen et al., 2008). It is concerned with accessibility and availability of health services (Guagliardo, 2004). This dimension of access is a function of good road networks and transport systems. It varies depending on the location of residence and the number of facilities; therefore, some locations are more accessible than others. For instance, the distribution of health services tend to favor urban areas with high population density more than the rural dwellers; hence, deprivation (Hansen et al., 2008).

Apart from the bad road network, geographical access can be limited by environmental features like climate change, rivers, valleys and mountains. In low-lying locations, access tends to reduce in the wet seasons because of flooding. Some developed countries in the last decade have reduced the barriers of physical access by use of safety helicopters and drones in times of emergency. With the advancement of mobile telecommunication and information technology, some countries have also used telemedicine to connect patients via smartphones and the internet to medical services. In the developing countries where these technologies are unavailable or unreliable, the solution is to increase geographical accessibility of health facilities.

Prioritizing spatial access to healthcare in Nigeria

The focus of planners and researchers over the years have been on financing healthcare and increasing human resources, without that realization that making geographical access a priority would have solved both problems. Every year, a substantial portion of Nigeria's meager budget on healthcare is lost to healthcare interventions that were incomplete, never used or lying redundant. New health facilities fold up or remain underutilized shortly after commissioning because location accessibility was not considered at the planning stage. A typical example is the NHIS, in which some people who subscribed to the service are unable to use it because of distance; since the majority of the facilities are crowded in urban areas.

Considering the limited resources in the country, incorporating geographical access to healthcare planning can reduce the number of facilities to be sited while serving a larger population at a shorter distance. The solution is in the use of Location-Allocation Models (LAMs). LAMs allow planners to site health facilities at optimized locations using simple parameters about the users and the proposed facilities (Oppong, 1996; Rahman & Smith, 2000). Many countries have successfully used LAMs to increase population access while reducing the budget for healthcare. A typical example was the reallocation of dialysis centres in the United States of America which saved the state \$5 million (Pliskin & Tell, 1981). Locating fewer health facilities at optimal locations will leave a substantial amount which can be plunged back into the health system to improve the quality of the service and human resources.

The distribution of health facilities in Nigeria has always been the prerogative of the top manager of the health system (e.g. Minister of Health) who is usually a politician (Ayeeni et al., 1987). Therefore, new health facilities locations are sometimes selected based on party commitment or used as a reward to faithful voters. Setting aside political sentiments and embracing location viability of healthcare interventions will enable health planners to target locations with genuine health needs instead of political interests. Distance to healthcare is a major determinant of prompt utilization of effective treatment (Sabde et al., 2014). The delay in the use of healthcare can lead to disease severity, hospitalization or death. Also, long distance to the health facility could lead to incomplete antenatal care, pregnancy complications, maternal mortality and neonatal death (Ronsmans et al., 2006). Reducing maternal and under-five mortalities in Nigeria requires a conscientious effort to bring healthcare closer to the population; especially in the rural areas where the outcomes are higher.

Apart from saving lives and the budget; prioritizing geographical access in healthcare planning will reduce the cost of care, road travel, and the risk of accident and save the environment. The overall cost of treatment is expected to increase as the distance to health facility increases. Therefore, the proximity of facilities will encourage the population to seek health care promptly (Kurihara & Kato, 2007), and they will have extra money to save. When the need to travel is reduced, less fuel will be used, and environmental pollution will be reduced. Apart from environmental pollution, excessive travels to health facilities on Nigeria's bad roads may increase the risk of accident (Ekanem et al., 2017), disease severity and complication.

Spatial Pattern and Accessibility to Health Care Facilities

A number of studies have attempted to determine the spatial accessibility to Health Care facilities in various communities. Prominent among such investigators are (Bindu & J., 2013) these researcher's used a geospatial approach to assessed and model the spatial accessibility of primary Health Care facilities in the tribal Talukas of the Vadodara District of Gujarat State of India. Findings showed that, the locational pattern of the PHC in the study area was randomly dispersed as obtained by Average Nearest Neighbor analysis and all such PHCs are overburdened, serving large population as

per the norms, where 8 PHCs were serving total population of more than 22,000 which goes up to 51,000. In terms of the time and distance, findings also convey that, the central and southern villages of the study area were relatively accessible as compared to the eastern and northern villages. The analysis suggest that the population of the study area can optimally be accommodated by allocating only a few new facility but emphasis has to be given to improving the connectivity especially in the inaccessible area which are rendered as dark zone on the basis of poor road connectivity.

Murad (2004) created a GIS-Based spatial profile for exploring health services supply and demand in Jeddah city, Saudi Arabia. Level of accessibility was identified using accessibility indicators scores. Also a demand based catchment area was created to define the growth and extent of health catchment area. The outputs of his application provides health planners with spatial tools for evaluating the location of health services supply and demand and considered as a spatial decision support system for health planners in the city.

Abdurrahman & Nurunnisa (2013), explored the potential use of GIS for modeling the spatial distribution and accessibility of the healthcare delivery system in Yola. Several digital and non-digital data sets were collected and transformed into GIS data. Spatial analysis tools, including symbols, overlay operations; Kernel Density Estimations (KDE), buffer operations, and a raster calculator were used for the analysis. All identified public and private facilities were classified as primary, secondary, or tertiary. The majority of these facilities were concentrated in Jimeta.

The findings revealed that there were 56 health care facilities in Yola, of which 64% were public and 36% were private. However, 71.43% of these health care facilities were located in the southern and western parts of Jimeta which reflects an imbalance of health care facility provisions in the central part of Jimeta and Yola-Town, which had the larger population sizes but a limited supply of health care facilities. Even though 71.43% of the health care facilities were located in Jimeta, Yola-Town had a higher density of physicians. Based on this analysis, it was concluded that a gross inadequacy exists in terms of health care facilities and physicians. Thus, these results identify the need for urgent improvements in the Yola health care delivery system, including the construction of new facilities, upgrades for existing facilities, increased physician employment, and the adoption of GIS technology by Yola health care planners and policy makers for effective planning and resource allocation.

Onokerhoraye (1999), examined access and utilization of modern healthcare facilities in the oil-producing region of Nigeria: A case study of Bayelsa State. The study used both cartographic and geographic information techniques to examine the spatial pattern of health care delivery facilities in one part of the oil producing region of Nigeria which in recent years has been characterized by violence as a result of perceived deprivation in the provision of social services by the people. The location of tertiary, secondary and primary healthcare services in the eight local government areas of Bayelsa state were presented against the background of the pattern of population and settlement location. The study also examined the utilization pattern of the available services by a sample of households in three of the local government areas. The findings showed that the available healthcare facilities in the state were concentrated in the northern part of the state where the population density is lower largely because it is the upland part of the state.

Conversely the central and southern part of the state where population and settlement density are higher, there were limited health care facilities located in them. The inaccessibility of the available health care facilities had obviously affected the utilization of modern health care services by a vast proportion of the people in the state who still depend on traditional medical care and self-medication. It was concluded by recommending a policy of deliberate dispersal of health care services to the central and southern parts of the state where there were no facilities. It was also suggested that the community members should be trained to provide the needed staff in the primary health centers located in the smaller settlements.

Adetunji (2013), examined the spatial distribution pattern and accessibility of urban population to health care facilities in Ilesa Southwestern Nigeria. The findings revealed that Health Care facilities were unevenly distributed. Health trips in Ilesa were therefore skewed towards zones with more health services. The result of the analysis of variance (ANOVA) further showed significant variations in accessibility to the facilities among the sampled population in the area. It was concluded and recommended that some of the public health care facilities in the area should be upgraded to the status of General Hospitals due to the growing nature of the town.

Abdurrahman & Nurunnisa (2013), analyzed the spatial accessibility of health care facilities in Yola, Adamawa state, Nigeria. Models of accessibility were built based on distance to Health Care facility in the state. Density of health facilities and Physicians were considered as well as health facility to population ratio. The model was tested using ArcGIS raster calculator operation. The result shows gross in-adequacy both in terms of Physicians and distance to Health Care facilities.

Sanni (2010), examined the distribution of healthcare facilities in the thirty local government areas of Osun State, Nigeria. Twelve indices, representing the totality of healthcare delivery by State and local governments in the state were used for the analysis. Findings indicated existence of gaps in access to healthcare facilities between local government areas in the state, though the observed gap could not easily be attributed to rural-urban dichotomy. The study concluded that there was an urgent need for serious intervention on the part of the government in the provision of healthcare facilities in the state, focused on equitable distribution and accessibility to enhance regional development.

However, a number of studies have utilized Network and Neighborhood analyses within the ArcGIS software environment to analyze pattern and physical accessibility to healthcare in various parts of the world. A good example is found in the work of Brabyn & Skelly (2002), the study utilized Cost Path Analysis Network Spatial Analyst Tool to estimate the geographical accessibility of Public hospitals in New Zealand via a road network. In this case, minimum travel time and distance to the closest hospital were determined.

Ejiagha et al., (2012), employed network analysis to determine the closeness of a facility and shortest route to the healthcare facilities in Enugu urban area of south eastern Nigeria. The study also identified areas deprived of healthcare facility within the GIS software environment. Furthermore, Mohammed et al., (2015) employed both Network and Neighborhood GIS analyst tools to analyze the spatial distribution and accessibility to Health Care facilities in Giwa and Tofa LGAs of Nigeria. OD (Origin Destination) matrix was created and the average nearest neighborhood analysis was done. Findings showed that healthcare facilities are grossly inadequate, their distribution is random. Also some people travel a distance of up to 30km to access the nearest healthcare facility.

Umar (2016) analyzed the spatial distribution of PHC facilities in some selected LGAs in Kano South Senatorial Zone, Kano State Nigeria. Data were analyzed using multiple GIS Techniques (Neighborhood and Network Analyst) and descriptive statistics. Results showed variation in the distribution of PHC facilities within the study area, with Sumaila having the highest percentage (36.03%), Ajingi (26.13%), and Gaya (25.23%) while Rano accounted the least (12.61%). However, there was similar regularity in the spatial pattern of the facilities. Also the communities travels within the minimum range of WHO standard distance (Sumaila, (0.5 – 5.4 km); Gaya, (1 - 3.8 Km); Ajingi, (0.5 – 5.1 Km); and Rano, (0.6 - 3.6 Km)) to access some of the nearest facilities. However, the disparity between what is required of the facilities for the entire population and what is available based on WHO criteria, apparently appeared to be greatly engrossed (with a shortfall of 411 Health Posts, 32 Health Clinics and 6 primary Health Centers), where the existing coverage offers one facility to 8,833 people. Therefore, it is recommended that, more facilities should be provided and located at central places with respect to population sizes within the Senatorial District.

Network and Neighborhood Analysis

Network and Neighborhood Analysis have been used by scholars and researchers to analyze pattern and accessibility in various parts of the world. For example, (Brabyn & Skelly, 2002) used cost path analysis to estimate the geographical accessibility of public hospitals in New Zealand via a road network. In this case, minimum travel time and distance to the closest hospital were determined. In addition, Alabi(2011) utilized Nearest Neighbor Analysis to assess the spatial distribution of health centers in Lokoja City of North central Nigeria. His findings revealed an indication of weak randomness, because p – value (0.99228) exceeds the Z-score table value of -0.723417 which is indicative of insignificant accessibility. He concluded that this scenario is a picture of state of health facility distribution in typical Nigerian cities where health facility distributions do not adhere to any particular criteria. Also, Eklund & Mårtensson(2012) utilized Geographical Information Systems (GIS) and network analysis to generate different estimations of accessibility based on the existing road network and transport barriers. Moreover, Ejiagha et al., (2012) employed network analysis to determine the closeness of a facility and shortest route to the healthcare facilities in Enugu Urban Area of south eastern Nigeria. They also identified areas deprived of healthcare facility. Furthermore, Abdurrahman & Nurunnisa (2013) used buffer operations and Kernel Density Estimation to analyze the spatial distribution and accessibility of the healthcare delivery system in Yola. They concluded that healthcare facilities and physicians in Yola are grossly inadequate.

Spider-diagrams (Desire-lines)

In GIS a set of points representing population settlements can be assigned a variable corresponding to each point's distance from its linked facility (nearest or otherwise defined). The linkage can be mapped visually using Spider-diagrams, at the center of each "spider" is a point representing a health facility, while the "legs" represent the shortest distance from the facility to its linked settlements, visualization approaches which have been enhanced by GIS include spider-graph approaches showing linkages between patient and service as a series of straight lines (Bullen et al., 1994). These diagrams are useful visual tools as it is easy to identify long lines which represent settlements with low access. Spider diagram is a diagram generated by drawing lines connecting points in one layer to their linked points in another layer. These diagrams resemble spiders because the lines radiate out of a central point. The method is also known as "desire-line analysis". Some studies have shown that one of the main factors that determines how likely an eligible individual is to utilize a health service is their geographic proximity to a health facility (Al-Taiar et al., 2010, Yao et al., 2012). Therefore, a potential indicator for health service accessibility could be the distance in a straight-line between a population settlement and a linked health facility. It is often convenient to define this linkage in terms of distance, so that a settlement is linked to whichever health facility is nearest to it in a straight line.

However, linkage can be defined in other ways. For example, if in a survey, a respondent has specified a particular health facility as one that they actually utilize, and then the linkage can be defined based on reported actual usage, even though this will mean that not all the population is linked to their geographically closest facility (Noor et al., 2003). Spider line Diagram also known as desire lines, are series of lines drawn from each facility location (PHC) to Demand Points (Village Centroid). They can be either un-weighted or weighted. Spider lines show Village Connectivity with the nearest facility location i.e. PHC's. A line is drawn from each PHC to its nearest Village Centroid, making it easy to see the actual area of influence of PHC (Divya, 2014). Desire line shows the behavior of the people, they always prefer to go to the nearest facility point, rather than the facility point located relatively far away from villages. The health administrative service area method is not a realistic as the people are not always visit the PHC in their administrative jurisdiction, when compared to service area of the desire lines or spider diagram. According to Divya (2014), the number of villages covered with the given distances, has been categorized into 3 categories, such as Below 3 Km, 3 to 6 Km and Above 6 Km. There are 430 revenue villages in the district; out of which 15.59 percent of the villages covering 16.64 percent of the population have close access to health services through PHC radial distance of within 3 Km. Around 35.34 percent of the villages with 41.01 percent of population have to travel between 3 to 6 Km of distance to access the nearest health service center (PHC). About 49.01 percent of the villages with 42.35 percent of the population have to travel more than 5 Km to reach PHC to get health services.

Conclusion

The article presents the reviews mainly on the different practical aspects of the spatial analysis of physical accessibility to rural health care facilities. Spatial access is a vital component of the health system. Although this paper does not undermine the importance of quality and human resources, it stresses that they are magnified by the lack of inclusion of location accessibility at the planning stage. After the implementation, it becomes difficult to adjust the locations of facilities without having to make a huge financial sacrifice. Since the recession is still looming and the health system is failing, it is high time we used a few locations of health facilities to achieve more. In conclusion, a common feature that reappears is the improvement spatial analysis of physical accessibility to rural healthcare facilities. The reviews of this paper will not only guide the geographers in effective improvement of spatial analysis of physical accessibility to rural healthcare facilities using GIS but also researchers in other field of studies.

Recommendation

The healthcare facilities should not only be available, but also accessible to the general public. In most remote areas there are available healthcare facilities, but having access to them is another stumbling block. Government needs to prioritize training health personnel that could be sent to rural hospital especially the primary healthcare centers. There is also an issue of poor service delivery in most of our healthcare centers. To resolve this issue, federal, state and local government together with non-governmental organizations have to ensure that the health personnel have the required knowledge and technical expertise to work effectively with healthcare facilities. We also need a commitment from the Nigerian policymakers to bridge the gap between the healthcare service delivery in the urban and rural areas. The number of population in the rural areas outnumbered that of the urban areas; therefore, special consideration must be given to rural dwellers. The country must have high performing healthcare service delivery that would be accessible to the general public. When primary healthcare performs well, it meets the vast majority of people's needs, and that is crucial if at all we want to make improvement in our nation's healthcare service goals.

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