FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 4 No. 1, March, 2020, pp 511 – 518

ANALYSIS OF SPATIAL DISTRIBUTION OF HEALTHCARE FACILITIES USING GEOGRAPHIC INFORMATION SYSTEM, JEMA'A LOCAL GOVERNMENT AREA, KADUNA STATE

[1]Doyani, B. I., Adamu, Y. M. (PhD), [2]Danjuma, E. S. and [2]Ayuba, B.

[1]Department of Geography, Faculty of Physical Sciences, Ahmadu Bello University, Zaria, Nigeria
iliyababaraus@gmail.com/babsite4god@gmail.com
[2]Department of Geography, Faculty of Earth and Environmental Sciences, Bayero University Kano, Nigeria
yusufadamu@gmail.com, emmydan2000@gmail.com, ayuba.buhari24@gmail.com

ABSTRACT
Healthcare facilities form integral component of healthcare system. It is centers where preventive and curative services are provided and allow referral from simple to complex service provision. Access to healthcare is multi-dimensional but one can narrow it to geographical availability. Jema'a LGA is faced with serious problem healthcare facilities provision and this is not disconnected with continuous increase in population and expansion communities without corresponding investment in healthcare sector by key actors. This has resulted in congestion and overstretching of existing healthcare facilities, making accessibility difficult. However, with recent behavior of patients toward some healthcare facilities, the study aimed at analyzing the distribution of healthcare facilities in Jema'a LGA using Geographic Information System. To achieve this, Geographic coordinates of healthcare facilities were acquired by hand held Garmin ETREX. Total sampling techniques was employed and questionnaire was administered to generate information for healthcare facilities. Data generated was used to create a database. The results revealed 55(100%) healthcare facilities in all; 30(54.5%) healthcare facilities were governments owned and 25(45.5%) private. Further query revealed 53 healthcare facilities were primary and 1 was secondary type. Only 2 out of 54 healthcare facilities were equipped and are discharging good healthcare services. Spatial auto-correlation was used to establish the pattern of distribution. The distribution pattern of healthcare facilities does not appear significantly different other than random. The study recommends all issues regarding healthcare facilities such as upgrade; equipping and new provision of healthcare facilities should be giving emergency attention by all stakeholders.

Keywords: Database, mapping, spatial distribution, healthcare facilities, geographic coordinates

INTRODUCTION

Availability locations of healthcare facilities in communities form the central component of health system which ensures that the right services are available and accessible to the population and that no one marginalized from essential healthcare services. Joseph *et al.*, (2019) are of the view that across sub-Saharan Africa (SSA), health services are offered with increasing from community providers who handle basic care to referrals which play a critical role in providing emergency care. However, these services are not available to everyone to access. This hindrance to quality assured healthcare services failed to provide lifesaving interventions which contributes to the burden of communicable and non-communicable disease morbidity and mortality in several regions of the world.

The Global health agenda that aims to ensure Universal Health Coverage (UHC), to ensure that all people obtain the health services they need and underpins the health-related. Sustainable Development Goals (WHO, 2018). To achieve this, planning and provision of healthcare facilities for universal equity in access demand better data on location of both services and populations the healthcare facility intended to serve. Countries are encouraged to develop health Master Facility Lists (WHO, 2013; WHO/USAID, 2018) and censuses of service provision (WHO, 2013). This is far been achieved while most inventories are stock without coordinates.

In Nigeria, the provision of healthcare system is largely the responsibility of federal, state and local governments within the overall national health policy (Akande, 2004.). This move was aimed at having a healthy population that is free from any form of diseases for developmental sustainability. Kaduna state government in an attempt to improve her healthcare system has prioritized healthcare revitalization as one of its agenda. It involves the upgrading of healthcare facilities, a plan to ensure that all electoral wards have at least two primary healthcare centers (PHCs), equipping three general hospitals, one in each senatorial district; free drugs for pregnant women and children under five years (Abbas, 2012). In Jema'a Local Government Area, the effort to improve healthcare system, with corresponding increase in population and community expansions has led to poor access and patronage to healthcare facilities

especially in the interior communities, where disease prevalence and death rate are high. Communities keep on increasing and expanding without corresponding provision of healthcare facilities which remains a serious challenge. This has led to lives been lost and productivity declined on every day count.

The use and emergence of Geographic Information Systems (GIS) in 1980s and 1990s conceptually, covers wider scope of health planning and management and relates to allocation of resources, efficient delivery of healthcare services and improving efficiency in the healthcare system (Burrough, 2001).With recent advances in computing, geospatial analysis and environmental health gaining ground on daily basis, it has strengthened the ability to view maps and identify areas of shortages of healthcare services, and prevalent diseases at a snap shot.

The aim to analyze spatial distribution of healthcare facilities using GIS was achieved through the following objectives: Identify and mapping of healthcare facilities; examine the distribution pattern of healthcare facilities and created a database for healthcare facilities. Healthcare service is available in healthcare facilities and has been a major topic for many health studies research and discussions for many decades. To-date there has not been a single, geo-referenced and comprehensive health facility database for study area. Though, Ouma *et al.,* (2003) emphasize that primary healthcare is an important step in providing 'health for all', and is widely acknowledged as a universal solution for improving population well-being by world Health organization and the UNICEF. Again, Guagliardo (2004) added in his argument that primary healthcare is essential form of healthcare necessary for maintaining population health as it is relatively inexpensive and easily delivered. He maintained that it is most effective in preventing disease progression on a large scale if they are adequately provided in space.

Spatial mapping has the ability to locate health facilities and identify their capabilities in terms of services and hours of operation has been underscored due to lack of proper mapping facilities, unlike in the developed world where all health facilities are of equal standard and are map out (Abubakar and Ibrahim, 2013).This has strengthened those needing medical help not to wonder as to which facility to visit. Finally, Abbas *et al*., 2012) also investigated the spatial distribution of Healthcare facilities in Chikun local government area of Kaduna State Nigeria by employing GIS and GPS to map existing healthcare facilities, evaluate adequacy based on World Health Organization standard and was able to propose new alternative for additional new ones. The analysis of spatial distribution of healthcare facilities using GIS in the study is necessary and will serve as a guide for spatial distribution of new healthcare facilities in the study area.

MATERIALS AND METHOD

Materials and equipment used are administrative map of Jema'a local government area obtained from the local government head office, a hand held Garmin ETREX for the acquisition of geographic coordinates of healthcare facilities, a laptop that houses all software's used and allows data preparation, processing, storage, manipulations and presentation of analysis. HP Laser Printer was used for printing hard copies of analysis presentation. ArcGIS 10.3 software used for GIS operations such as conversion of all analogue maps to digital format, geo-referencing, sub-setting of map and creation of database that allow queries and updates.

Check list obtained from department of records Kaduna State ministry of health as a guide for ground truth verification. Questionnaires as an instrument is used to gathered information in each health facility.

The administrative map was used as base map; scanned, digitized and used to generate point maps. Geographical coordinate of healthcare facility were taken by the used of GPS and the questionnaires were administered in different locations to register relevant information in each healthcare facility. Total sampling technique was employed during the field survey, and all healthcare facilities were sampled to 55 healthcare facilities. Meanwhile, two healthcare centers were said to have relocated outside the study area.

Point map database was created using ArcGis 10.3 software. A folder was created for the work in the C-Drive. The map of the study area was scanned to obtain a soft copy that was imported in to the workable folder incorporated in the ArcGIS environment. The scanned map was geo-referenced and digitized to produce entity and relational database using relevant attributes obtained from the healthcare facilities and a point map and database was created.

The spatial data were organized in layers, and the ability to query was made possible using the query builder in ArcGIS environment. A few of the queries were performed for example Primary healthcare facilities, and secondary healthcare facilities etc. Finally produce a single database and point maps containing all information needing for proximity by patients to visit a health facility.

RESULTS AND DISCUSSION

The result obtained from the field show government owned healthcare facilities 30(54.5%) and private owned healthcare facilities 25(45.5%). It indicates strong desires by key actors wanting to improve healthcare system and guarantee wellbeing of inhabitants. But looking further, the study discovered one General Hospital Kafanchan to be the only secondary health facility and is always crowded with no referrals cases at the expense of the primary healthcare facilities, based on visits observations. This portray the lack of confident people have on primary health centers. Only cases that are beyond the manageability capacity of the primary healthcare are supposed to be referred to the General Hospital Kafanchan. But this is not so even with the 54(98 %) primary healthcare facilities. The study assumed both private and faith base healthcare facilities

are group as primary healthcare facilities. This is because of the similarity of kind of services they provide.

With the geographic coordinates of healthcare facilities and other information gathered during field survey, the database was created using various attributes that allow queries. Considering how important a database is to the healthcare system, it was created to covers wider scope of health planning, management, allocation of resources, efficient delivery of services and improving efficiency in the overall healthcare system. Attributes used for the creation of database include Coordinates of healthcare facility, Facility Name, Facility Type, Address, Owners, Doctors, Nurses, Midwives, Lab Scientist, Lab Technicians, Pharmacists, Pharmacist Technicians, Radiologist, Radiography, X-Ray Technicians, Dental Technicians, Ward Attendance, Drivers, Wards, Beds, theaters, Drugs, Water Supply, Delivery Rooms, Maternity Bed, Theater equipments, Lab Equipment, Ambulance, Electricity, Pharmacy Department, Dental Department and Administration Block. For example, some queries done revealed that, the General hospital Kafanchan was the only healthcare facility equipped with 17 doctors, 132 nurses, 65 midwives, 12 laboratory scientist, 9 wards, 2 theatres, 3 delivery rooms, 350 beds, 36 maternity beds, 2 ambulances, adequate drugs etc and follow by Bethel hospital (Faith base facility). This further explains the strategic role, the secondary healthcare facility play in the local government and why it will continue to be congested with patients all the time. It also retraces why patients have to wait for long before seeing a doctor. On the other side, virtually all primary healthcare facilities which are government owned had no single medical doctor physically with the exception of some faith base healthcare. Again, this further justified the general attitudes of the people of not patronizing primary healthcare facility; which in it designed supposed to be the first point of contact of the patients Ojo *et al*., (1991).

Table 1: Query of attribute in table showing healthcare facilities in yellow from the database

FID	NOTHINGS	EASTINGS	FACILITY_N	FACILITY_T	ADDRESS	OWNERS	Doctors	Nurses	Midwives	Human_Reso	Lab_Sc	Lab_Tech
1	9.35488	8.18171	Bethel Hospital Kafanchan	Private	No.24 Sokoto Street Kafanc	Private	1	3	1	0	0	1
2	9.34045	8.17917	PHC Takau	Primary	Takau Village	Government	0	2	1	0	0	0
3	9.3502	8.17768	New Era Clinic and Maternity	Private	No.8 Funtua Street Kafanch	Private	3	10	3	0	1	4
4	9.30343	8.32437	PHC Nimbia Forest	Primary	Forestry	Government	0	2	2	0	0	0
5	9.35116	8.1764	Jema'a Nursing Home	Private	Jema'a Street Kafanchan	Private	1	2	1	0	1	0
6	9.34972	8.1754	Family Health Clinic	Primary	Emir Palace Road Kafanchan	Government	0	4	6	0	0	1
7	9.35578	8.18106	Calvary Clinic and Maternity	Private	No.8b Kagaro Road Kafanch	Private	3	5	2	0	1	1
8	9.35062	8.17888	Rahama Hospital	Private	No.3 Jos Street Kafanchan	Private	5	7	2	2	2	1
9	9.29175	8.16449	HC Bakigogi	Primary	Bakigogi Village	Government	0	2	1	0	0	0
10	9.32142	8.18976	Sauki Clinic	Private	Ung. Mission	Private	1	3	1	0	1	1
46	9.19037	8.02217	HC Barde	Primary	Barde Village	Government	2	5	1	0	0	1
47	9.29022	8.08975	PHC Paki 1	Primary	Paki 1	Government	0	1	1	0	0	0
48	9.24024	8.21503	Alheri Clinic	Private	Gada Biyu	Private	0	1	0	0	0	0
49	9.3046	8.10447	Sauki Clinic	Private	Fadan Kagoma	Private	1	1	1	0	1	0
50	9.35917	8.18118	HC Aduwan II	Primary	Aduwan II	Government	0	1	0	0	0	0
51	9.35707	8.17596	Salem Medical and Orphana	Private	Throneroom Bajju Street Kaf	Private	8	10	2	1	1	1
52	9.34636	8.17734	Radiant Clinic	Private	Takau Kafanchan	Private	1	2	1	0	0	1
53	9.30026	8.23081	Life Hospital	Private	Takau	Private	0	0	0	0	0	0
54	9.26016	8.21367	Good Health Clinic	Private	Takau	Private	4	3	0	0	1	0
0	9.3542	8.17805	General Hospital Kafanchan	Secondary	Hospital Road Kafanchan	Government	17	132	65	1	12	9

To produce a health facility, single visual map containing all information that could be required by persons needing to visit a health facility, we used the updated map with locations of health facilities and the information processed from the database to make further queries such as….

Secondary Healthcare Facility**:**

Secondary healthcare facility provides specialized services such as general medical, surgical, paediatrics, obstetrics, gynaecology and community health services. Therefore, accept referral through in-patients and out-patients services from primary healthcare facilities. The query shows only one of such facilities exist and where it located does not conform to centrality.

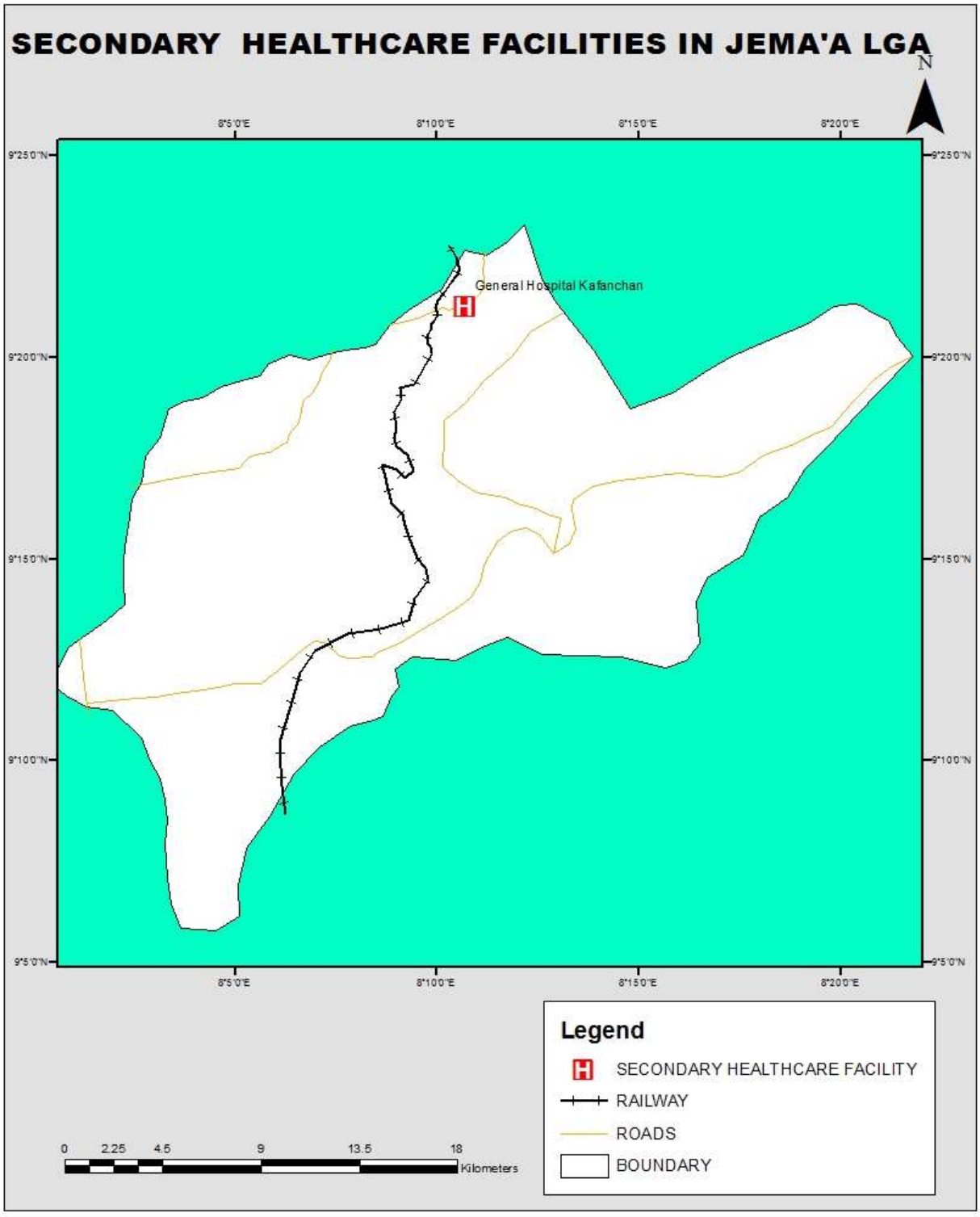

Fig. 1: General Hospital Kafanchan represent 1.8% of the entire health care facilities.

Primary Healthcare Facilities

In selecting primary healthcare, the policy intent was to use healthcare as a vehicle to promote development while focusing on the major causes of morbidity and mortality that are largely preventive. Primary health centers are supposed to be the first point of contact for patients, providing preventive, curative, and health promoting and rehabilitative services. Any patient that cannot be

managed at the primary healthcare level can be referred to other levels of care as appropriate. But what we have on ground is mere locations that in the 'researcher view' are neglected dilapidated structures that are far from addressing healthcare facilities.

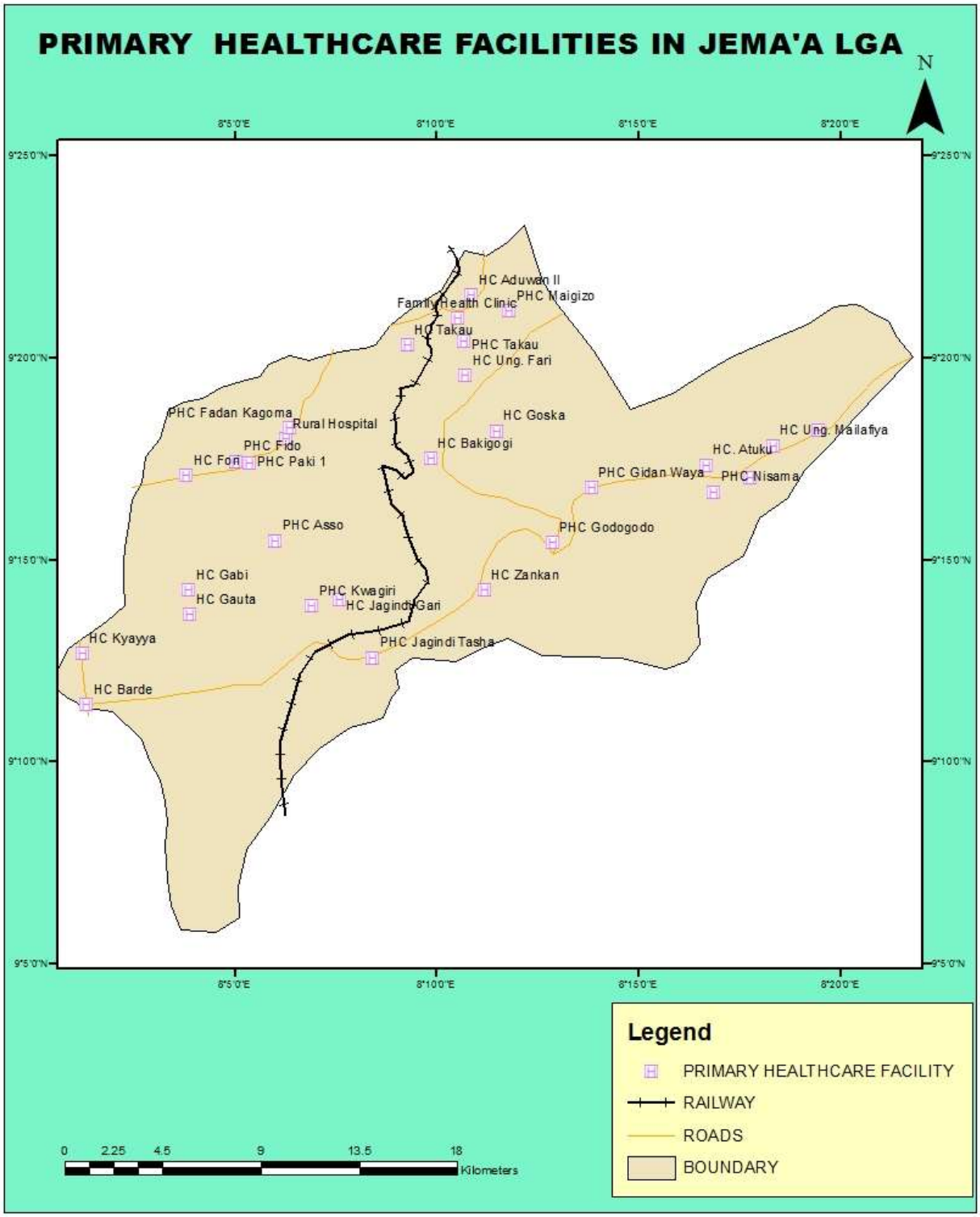

Fig. 2: Primary Health care facilities represent 98.1% of healthcare facilities.

Spatial distribution pattern of healthcare facilities in the study area.

Spatial auto-correlation based on the Moran's Index (Moran's I) spatial statistics was used to ascertained whether the spatial patterns of the healthcare facilities are clustered, dispersed or random. Using the ArcGIS 10.3 spatial statistical tool, the Moran's I value, the Z score or P value was calculated to assess the index. A Moran's I value close to +1.0 indicates clustering, while a value close to -1.0 indicates dispersion. The result from the report shows the following values: Moran index value 0.349164, Z score 1.044666 and P value 0.296178. Given the Z-score of 1.04, the pattern does not appear to be significantly different than random.

The result from the report shows the following values: Moran Index value 0.349164, Z score 1.044666 and P value 0.296178. Given the z-score of 1.04, the pattern does not appear to be significantly different than random.

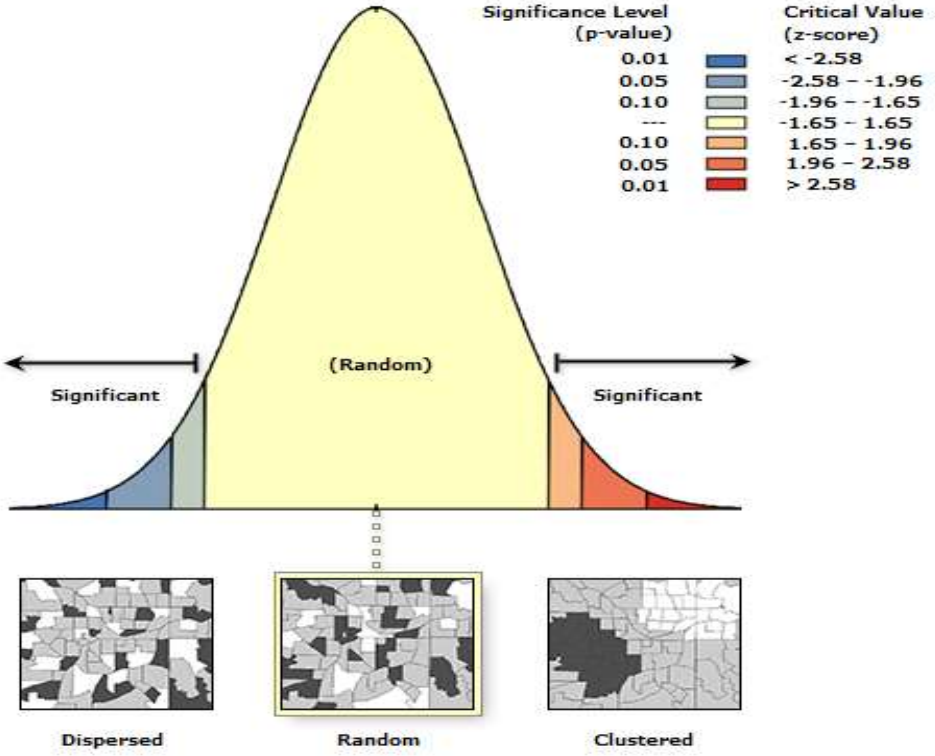

Fig. 3: Auto- correlations Analysis

CONCLUSION

Using GIS to analyze the distribution of healthcare facilities in Jema'a Local Government area is necessary and timely to overcome to problems emerging from health related issues. the database created and could serve as a guide in the healthcare system in areas of proper planning and prompt decision making that may eventually lead to good service delivery within the overall healthcare system. The study discovers 55 healthcare facilities. Only General hospital Kafanchan and Salem Medical and Orphanage Kafanchan are said to be fully equipped and fit to deliver good services. Meanwhile the research has come to conclude that all authorities and relevant stakeholders should do anything humanly possible to revive the respective primary healthcare facilities through upgrades and better funding to equip to standard, to gain patients confident back and guarantee better service delivery.

Acknowledgement: The authors are grateful to the management and staff of Kaduna State ministry of health, local government staff of Jema'a and to the anonymous reviewers for taking their time to improve this article.

REFERENCES

Abbas, I.I., Auta, S. Z., and Muhammad, R. (2012). Health Care Facilities Mapping and Database Creation Using GIS in Chikun Local Government, Kaduna State, Nigeria. *Global Journal of Human, Social Science*, Geography and Environmental Geosciences. (12), Issue 10, No1.

Abubakar S. B, Ibrahim M. (2013).Geospatial Mapping of Health Facilities in Yola, Nigeria *Journal of Environmental Science, Toxicology and Food Technology: 7-8*

Akande T.M. (2004). Referral system in Nigeria: Case study of a tertiary health facility. *Annals of AfricanMedicine*3(3):10-13.

Burrough, P. (2001). Principles of Geographic Information Systems Spatial Information Systems and Geo-informatics. New York; Oxford University Press PP.20.

Guagliardo M.F (2004). Spatial accessibility of primary care: concepts, methods and challenges, *International Journal of Health Geographics* .(3), 1:. 3.

Joseph M, Ouma P, Macharia P, Alegana V. A, Mitto B,Fall I, Noor A, Robert W. and Emelda A. O (2019). A spatial database of health facilities managed by the public health sector in sub Saharan Africa; Scientific Data*:* pp1-6. https://doi.org/10.1038/s41597-019-0142-2

Ojo M. R, Sorungbe, A.O., Oyegbite, K.S. and Bamisaiye, A. (Eds.) (1991). Strengthening Primary Health care at Local Government Level: The Nigerian Experience.Academy Press.

Ouma, P. O. Ouma P, Macharia P, Alegana V. A, Mitto B,Fall.(2018). Access to emergency hospital care provided by the public sector in sub-Saharan Africa in 2015: A geocoded inventory and spatial analysis. *Lancet Glob. Heal*: 1–9

USAID and World Health Organization. (2018). Master Facility List Resource Package: Guidance for countries wanting to strengthen theirMFL. WHO/USAID

World Health Organization.(2018).World Health Statistics 2018: monitoring health for the SDGs World Health Organization. Creating a Master Health Facility List. World Heal. Organ: 1-49