An analysis of the Flow Patterns of Patients to the Obafemi Awolowo University Teaching Hospital Complex's Cancer Treatment Centre (OAUTHC-CTC), Ile-Ife, Osun State, Nigeria

Abstract

This study analysed the flow patterns of cancer patients to the Obafemi Awolowo University Teaching Hospital Complex's Cancer Treatment Centre, Ile-Ife, Osun State, Nigeria. The study involved the use of GPS Receiver to obtain the geographic coordinates of the hospital and also the medical records of cancer patients. Data collected were analysed using descriptive and inferential statistics; and geo-spatial techniques. Data revealed that a total of 1809 patients from 15 states in Nigeria were enrolled for the treatment of cancer at the hospital. The volume of patronage at the centre was seen to be inversely related to the distance travelled by patients ($r = -.657$, $p > 0.05$). For instance, 85% of the patients came from the three (3) nearest states to the health facility, with Osun, the host State, accounting for about half (50.6%) of the total number. Also, the study revealed some demographic and socio-economic peculiarities among the cancer patients.

Key words: Cancer Patients, Flow Patterns, OAUTHC, Ile-Ife, Nigeria.

Introduction

The detection of patterns in the spatial distribution of features has been of great importance in many fields. An important goal in the detection process is to extract hidden relationships between some variables, possibly conditional on the values of other variables (Gebhert, 1998). Incidences of human diseases vary from place to place, and attempts at understanding this variation have shown that disease occurrence is a combination of environmental, socio-economic, cultural, physiological and other factors. For instance, the geographical distribution of diseases such as cancer, HIV/AIDS, tuberculosis, measles, influenza and pertussis among others reflects the social and environmental conditions that affect risk and susceptibility, and the social interaction and behaviours that facilitate occurrence (Croemley and MC Lafferty, 2002).

One of the major elements in improving efficiency in the delivery of healthcare services is patients' flow. An understanding of patients' flow can offer education and insight to healthcare providers, administrators, and patients about healthcare needs. Also, an understanding of patients' flow is needed to support a healthcare facility's operational activities. From an operational perspective, patient flow can be thought of as the movement of patients through a set of locations in a healthcare facility (Lovett *et al.*, 2002). Effective resource allocation and capacity planning are contingent upon patient flow because patient flow, in the aggregate, is equivalent to the demand for healthcare services. Given the natural complexity of the healthcare environment, the healthcare setting greatly influences both the perception and analysis of patients' flow. Fortunately, however, the healthcare environment can be easily characterized based upon the nature of healthcare services (Bretthauer and Côté 1998).

Resources and persons are not equally distributed in space and for obvious reasons of economic viability and politics the rural areas are disadvantaged in the distribution of facilities like hospitals (Babatimehin, 2013). However, increasing access to quality healthcare services in the rural areas might reduce the pressure on the secondary and tertiary hospitals mostly located in cities. According to the National Cancer Society 80% of cancer cases are curable if detected early (Oguntoke, 2002). The principal modalities used in cancer management, alone or in combination, are surgery, radiotherapy and chemotherapy (Oguntoke, 2002). Early detection is therefore pertinent for effective cancer management.

However, most cancer cases in Nigeria are detected at the late stage, which makes them difficult to cure. The late detection and reportage of cancer cases in Nigeria can be due to the lack of awareness among the population regarding cancer screening and inaccessibility to healthcare facilities which are largely concentrated in the urban centres (Lyons, 2004). Hospital and screening facilities are inaccessible particularly to the poor, who live in areas that are far away from the urban areas and where the public transportation can be quite inefficient (Philips, 1990; Murad, 2007). Accessibility to a hospital is essential in ensuring that patients get the necessary treatment easily. Ideally, the distance to a healthcare centre with treatment and screening

facilities should be less than 12 kilometres or a 50-minute drive using private transport at a normal speed (Jordon *et. al.,* 2004).

Undoubtedly, improved accessibility to treatment facility is a key factor that could help reduce the fatality of cancer disease. However, this remains a challenge in Nigeria. The geographical flow patterns of cancer patients to treatment centres are unequal and pose a greater threat to the survival of cancer patients. The uneven distribution of cancer registries in Nigeria presents a serious challenge to the delivery of immediate medical services to patients; and the zonal establishment of available centres meant that many cancer patients have to travel over long distances to receive medical attention. Interestingly, studies have revealed that where there are inequalities in the delivery and take up of cancer services by cancer patients, these inequalities tend to lead to death (Elkan, 2006). Also worthy of note is the poor socio-economic status of most patients which tends to limits their accessibility as they cannot afford the cost of treatment.

Geographic Information System (GIS) has many useful applications in the health services industry (Richards, *et al*. 1999; Gardner and Harrington 2003). Various examples abound, especially in the developed countries, where GIS has been deployed to carry out analysis relating to spread of disease, accessibility to healthcare facilities, and a host of other factors relating to healthcare delivery. For instance, GIS analysis was used to develop a normative model of patients' flow to hospitals using estimated travel times in North Carolina (Walsh, *et. al.*, 1995), and used to investigate inequalities in healthcare coverage in rural North Carolina (Gesler, *et. al.*, 1995). It has also been used to identify areas with low accessibility to health services and their socio-demographic traits through overlay functions (Horner and Mascarenhas, 2007), and to model patient flows (Murad, 2004). GIS analysis of hospital care, specifically a Canadian study by Lin *et. al.*, (2002) and a Kentucky study of cardiovascular care by Hare and Barcus (2007) yielded a few typical findings. Essentially, the studies show the distance decay effect. Basically, this study analyses the spatial dimensions of cancer patients' patronage of a tertiary healthcare facility in a Nigerian traditional city, Ile-Ife.

Conceptual Models

The conceptual basis for this study was drawn from two models in urban geography, namely: the gravity model and the central place theory.

The Gravity Model

The gravity model of migration is a model in urban geography that can be used to predict the degree of interaction between two places (Rodrigue *et al*, 2009). This model is based upon the idea that as the importance of one or both of two locations increases, there will also be an increase in movement between them. The farther apart the two locations are, the lesser will be the volume of interaction between them. This phenomenon is known as distance decay. Therefore the gravity model can be used to estimate traffic flow, migration between two areas as well as the number of people likely to use one central facility. The gravity model can also be

used to determine the sphere of influence of a central place by detecting point at which customers find it preferable to travel to one centre rather than the other on account of distance, cost, time and other considerations (Rodrigue *et al*. 2009).

The gravity model of migration can be used to explain the flow pattern (or the movement) of cancer patients to Obafemi Awolowo University Teaching Hospital Complex (OAUTHC). Significantly, the hospital is centrally located to serve its surrounding communities and to provide the basic medical cancer diagnosis and care to the affected individuals. The various patients report at the cancer treatment centre because the hospital boasts of a number of trained medical experts in cancer treatment, the availability of treatment equipment for the disease as well as good delivery of medical services. These act like a force of attraction of the cancer patients from their various origins to the hospital. Since all the factors highlighted above are not readily available across all the other medical institutions spread in other adjoining states, it is expected that a large number of patients will be attracted to the OAUTHC from other states on referral. Therefore the hospital can be viewed as a high order service with a considerably wide range and threshold population.

The Central Place Theory

The central place theory was propounded by Walter Christaller in 1933. The main thrust of the theory is that towns act as central places for the country side, and that they come into being to carry out, at a central accessible place, the tasks which the life of the country side creates. Although central place theory deals with the location of towns and cities, it has come to be applied to the location of services within the city and the crucial thing is the centrality which to a large extent determines accessibility of the goods and services concerned. For the purpose of this study, healthcare provision is a good and at the same time service. Different levels of healthcare provision can also be categorized as either high order or low order healthcare services which are consequently provided by a corresponding high order town or a low order town. Conceptually, the theory holds that places or towns providing higher order healthcare services are fewer in number compared to those providing low order healthcare services. High order healthcare facilities are also widely spaced with a comprehensively vast hinterland while the opposite is the case for low order healthcare facilities. Hence, cancer care services which are the core focus of this study are viewed as high order healthcare services which obviously are provided at high order centres or towns through highly specialized hospitals and facilities. The theory would therefore be utilized in understanding, analysing and explaining the spatial patterns of flow of cancer patients to treatment centre in Ile-Ife with Obafemi Awolowo University Teaching Hospital Complex's Cancer Treatment Centre (OAUTHC-CTC) as high order service centre providing a high order healthcare services to others places such as towns and cities around it.

Study Area

Obafemi Awolowo University Teaching Hospital Complex, a tertiary hospital located in Ile-Ife, Osun State constitutes the study area. Ile-Ife lies between Latitudes 7^{o} 31' N and 7^{o} 35' N and

Longitudes 4^{o} 30'E and 4 ^{o} 35'E. Ile-Ife lies on the southern flank of the western highlands of Nigeria. Ife constitutes both Ife Central and Ife East Local Government Areas (LGA) and is bounded by Ife North LGA in the north, Ife South LGA in the south, and Atakunmosa LGA in the West. Ile-Ife consists of 21 wards, with Ife Central having 11 wards while Ife East has 10 wards. Generally, Ile-Ife is an undulating terrain mainly in form of plains and valleys (see Figure 1).

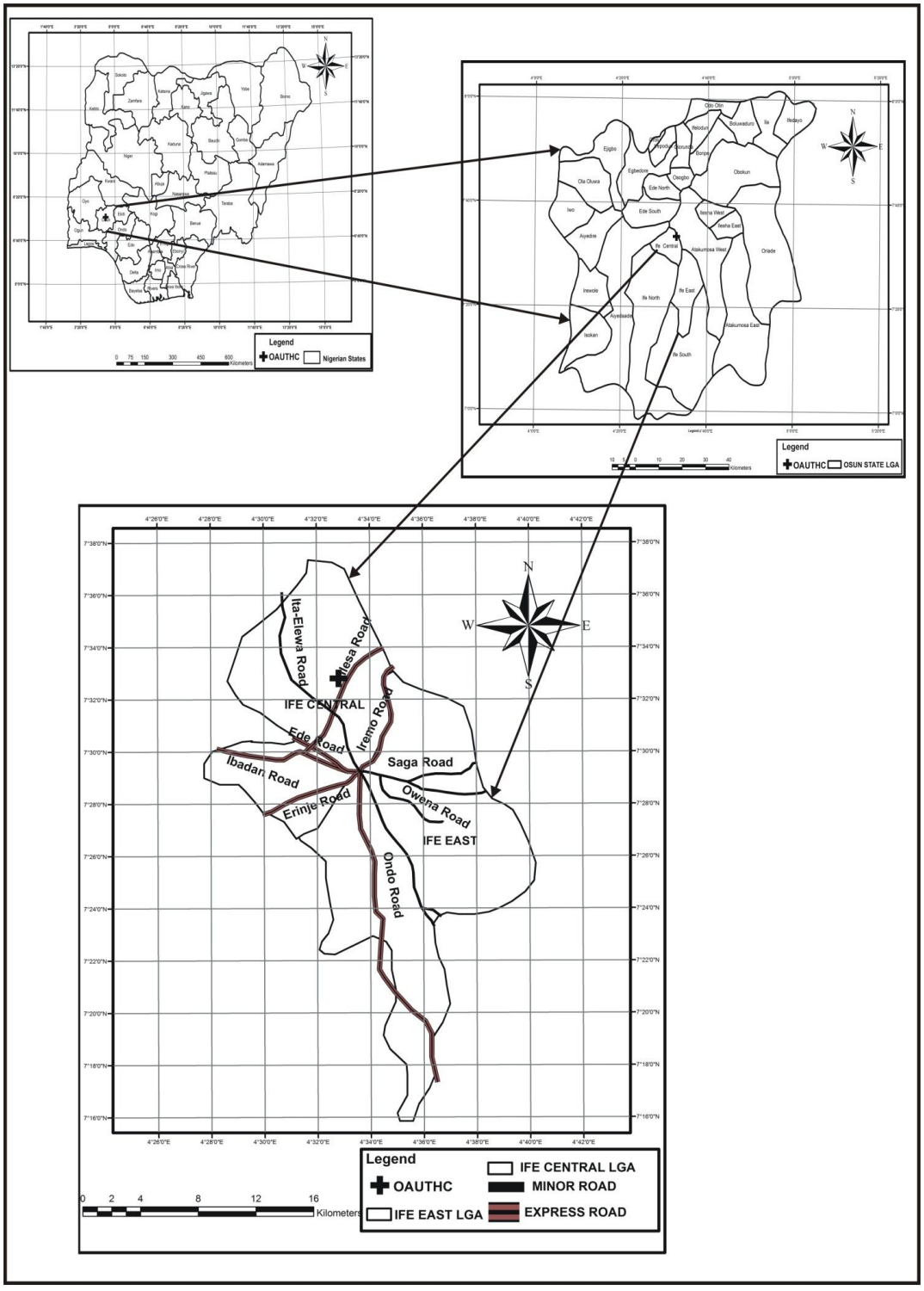

Figure 1: The Study Area, Ile-Ife in its Regional setting

Materials and Methods

The data for this study were derived from primary and secondary sources. The primary data involved the use of Global Positioning System (GPS) receiver to obtain the geographic coordinates of Obafemi Awolowo University Teaching Hospital Complex (OAUTHC). The secondary data used was mainly the records of cancer patients between 2000 and 2010 which were obtained from the medical library of the cancer registry from where information about cancer patients such as residential address, age, sex, date and month of admission and cancer type among others were retrieved. Also, relevant base maps were derived from the GIS unit of the Department of Geography, Obafemi Awolowo University, Ile-Ife.

The data collected were analysed using descriptive and inferential statistics. The spatial interaction of cancer patients with OAUTHC Cancer Treatment Centre was analysed using correlation analysis. The Inverse Distance and Weighted analysis was employed for interpolation and for predicting flow patterns of cancer patients to the hospital. Also, various analyses and cartographic enhancement of maps were done in the ArcGis environment.

Results and Discussion

Types of Cancer Cases Reported and Characteristics of Cancer Patients at the OAUTHC Cancer Treatment Centre, Ile-Ife

In all, 1809 cases of cancer were reported at the OAUTHC-CTC between 2000 and 2010. Most of the reported cases were on referral (1429, 78.9%) from other hospitals from within and outside the State. Most of the non-referral cases were reported directly to the hospital mostly from communities within Osun State where the hospital is situated. Others came from neighbouring Ondo, Ekiti, Lagos, Kwara and Edo State (see Figure 2). About 54% of the cancer patients were females as opposed to 46% males. Well over half of the cancer patients were within the middle age bracket of 31-50 years and most of them are skilled (see Table 1).

The cancer cases reported at the OAUTHC-CTC between 2000 and 2010 included 21 different types out of which breast cancer was the most occurring with 261 (14.4%) cases, followed by cervical (180, 10%), abdominal (141, 7.8%) and ovarian cancer (112, 6.2%) respectively. The least occurring were brain (28, 1.5%), leukaemia (29, 1.6%) and bone cancer (38, 2.1%) (see Table 2).

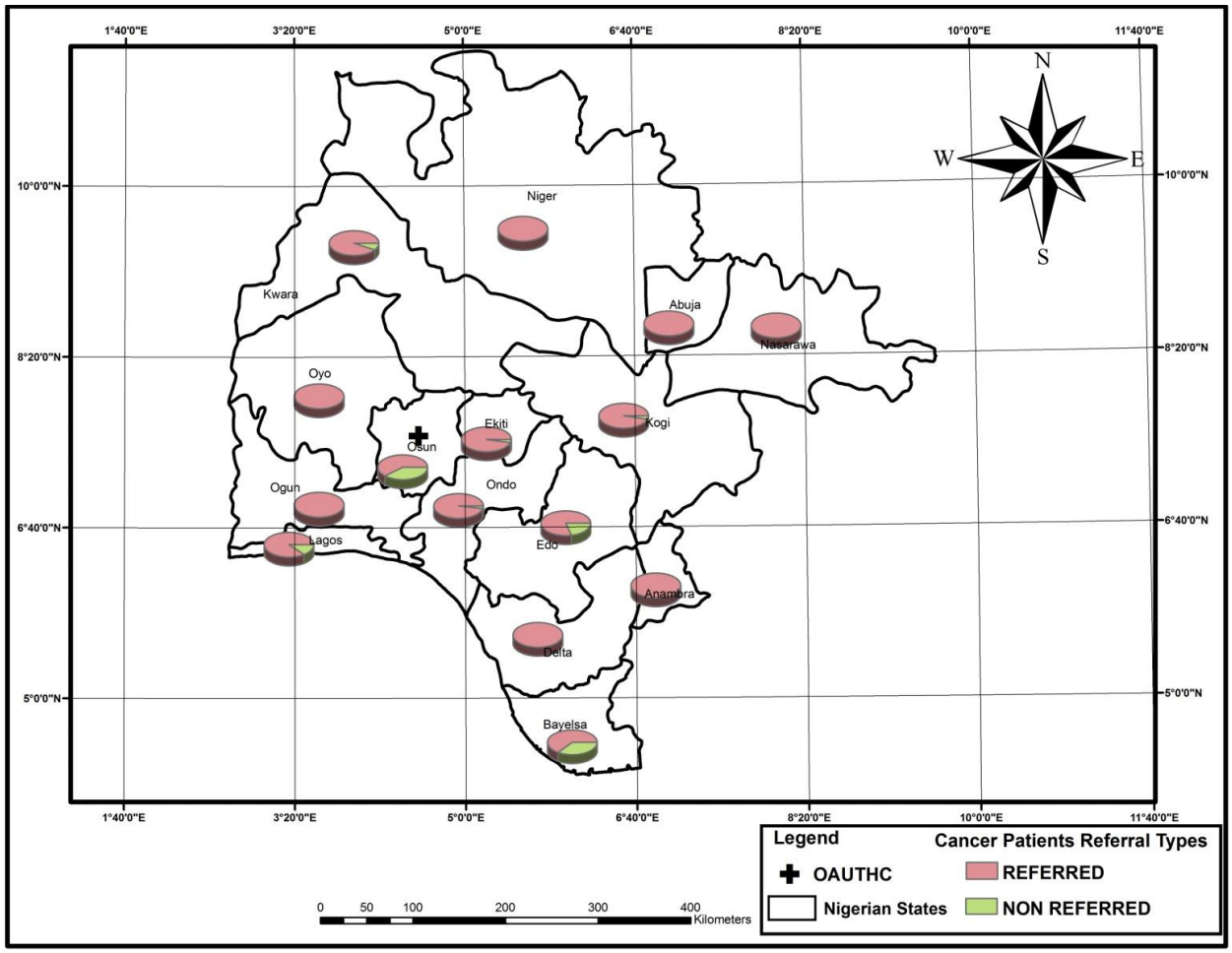

Figure 2: Referral and non-Referral Cancer Cases at the OAUTHC-CTC, Ile-Ife, 2000 - 2010

Table 1: Characteristics of Cancer Cases Reported at the OAUTHC Cancer Treatment Centre, Ile-Ife

Category	Frequency	Percentage
Referred	1429	78.9
Non Referred	380	21.0
Total	**1809**	**100.0**
Male	837	46.3
Female	972	53.7
Total	**1809**	**100.0**
10-30	178	9.8
31-50	1056	58.4
51 & above	576	31.8
Total	**1809**	**100.0**
Skilled	1228	67.9
Non Skilled	581	32.1
Total	**1809**	**100.0**

Source: Medical Records, OAUTHC, 2012.

Table 2: Reported Cancer Cases at the OAUTHC Cancer Treatment Centre, Ile-Ife

Cancer type	Frequency	(%)
Abdominal	141	7.8
Bone	38	2.1
Brain	28	1.5
Breast	261	14.4
Cervical	180	10.0
Colon	72	4.0
Connective tissues & soft skin	41	2.3
Bile ductal	45	2.5
Eye	42	2.3
Vaginal	100	5.5
Kidney	44	2.4
Leukaemia	29	1.6
Liver	89	4.9
Lung	89	4.9
Non Hodgkin lymphoma	55	3.0
Ovarian	112	6.2
Pancreatic	92	5.1
Prostate	86	4.8
Stomach	102	5.6
Skin	92	5.1
Oral	71	3.9
Total	**1809**	**100**

Source: Medical Records, OAUTHC, 2012.

Spatial Interaction of Cancer Patients with OAUTHC Cancer Treatment Centre

The study revealed that the 1809 patients that patronised the OAUTHC Cancer treatment Centre between 2000 and 2010 originated from 15 out of the 36 states in Nigeria. The states were expectedly located in the south-western part of the country, though some other states in the south-eastern and north-central parts of the country also recorded considerable number of patients. The states were Osun, Ondo, Ekiti, Ogun, Lagos and Oyo in the south-west; Kwara, Kogi, Niger, Nasarawa and the Federal Capital Territory in the north-central; Edo, Delta and Bayelsa in the south-south and Anambra was the only state in south-east. The states form a kind of cluster with no break in distribution as shown in Figure 3.

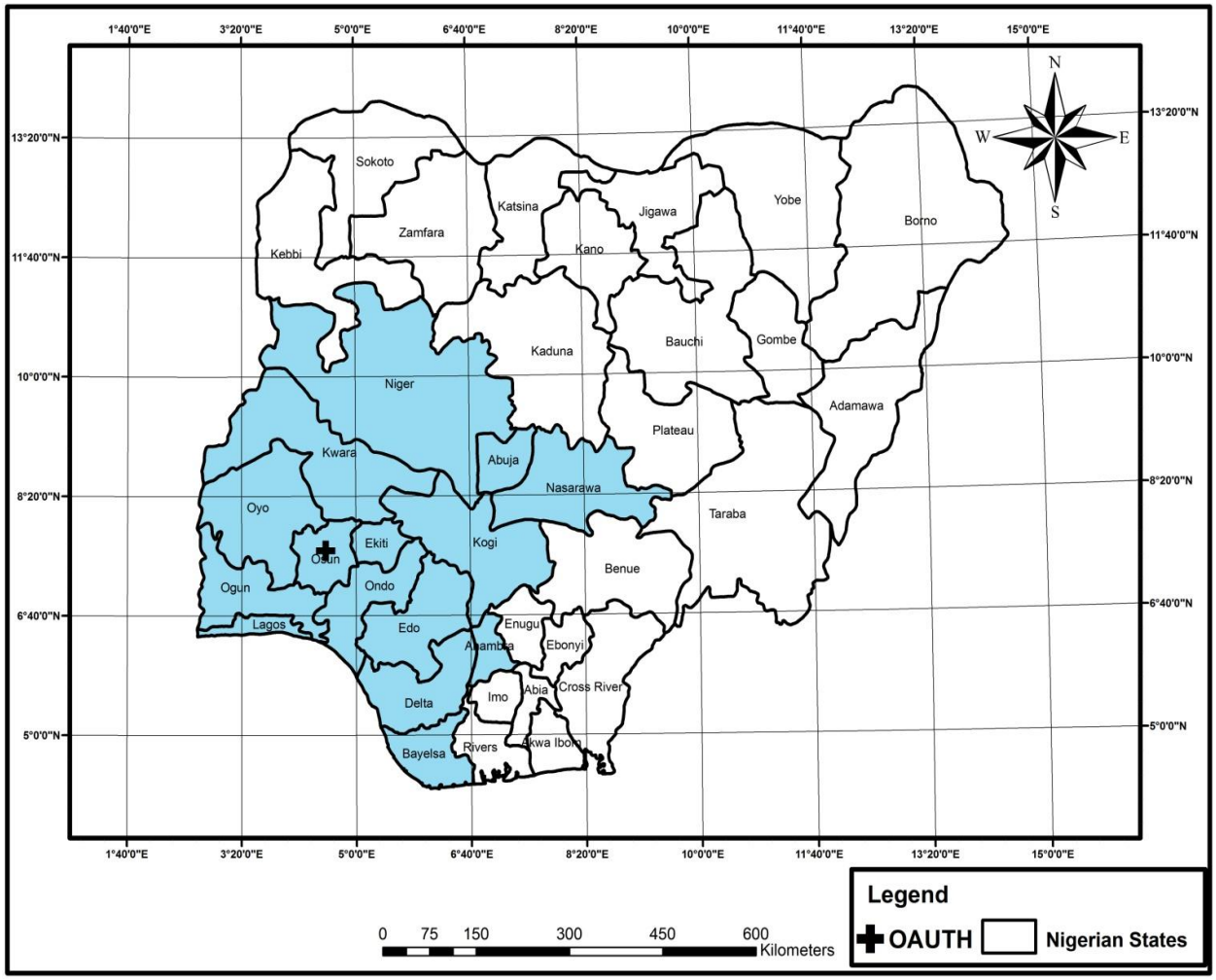

Figure 3: The Origin of Cancer Patients that received treatment at OAUTHC Cancer Treatment Centre, 2000 - 2010.

Source: Authors Analysis

The spatial analysis of the distance travelled by cancer patients to OAUTHC for treatment from various states involves a straight line measurement of the various distances of the patients' states to the hospital using a straight-line or Euclidean distance tool in GIS. The statistic shows that Osun State accounted for 915 patients travelling within the distance of 52.7km, followed by Ondo with 421 patients located within 80.2km from the hospital and Ekiti located within 86.9km from the hospital accounted for 203 of the patients. However, the distant states such as Nasarawa, 406.2km; Bayelsa, 345.0km; Abuja (FCT), 326.9km; and Anambra located 305.9km away from the hospital recorded 3, 5, 3 and 2 patients respectively. When analysed on a broad basis, it can be shown that a total of 1539 patients, 85.1% of the sum total of patients generated during the period under consideration came from 3 states namely: Osun, Ondo and Ekiti located within 0km-100km from the Teaching Hospital. For states such as Lagos, Oyo, Edo, and Ogun as well as Kwara, Niger, Kogi and Delta located within 100km to 300km from the Teaching Hospital, they jointly accounted for 257 (14.2%) patients of the total patronage recorded leaving the Federal Capital Territory, Anambra, Bayelsa, and Nasarawa States all situated at over 300km from the Hospital with a paltry 13 patients i.e. 0.8% of the total patronage recorded (see Table 3 and Figure 4).

Table 3: Flow of Patients to OAUTHC Cancer Treatment Centre, Ile-Ife

State	Distance (Km)	Number of Patients	Percentage
Osun	52.7	915	50.6
Ondo	80.2	421	23.2
Ekiti	86.9	203	11.2
Ogun	172.1	68	3.8
Lagos	152.1	25	1.4
Oyo	129.1	48	2.7
Kwara	218.9	58	3.2
Edo	178.9	15	0.8
Kogi	260.9	30	1.7
Niger	289.7	5	0.3
Abuja	326.9	3	0.2
Anambra	305.9	2	0.1
Delta	274.5	8	0.4
Bayelsa	345.0	5	0.3
Nasarawa	406.2	3	0.2
Total		**1809**	**100**

Source: Authors Analysis

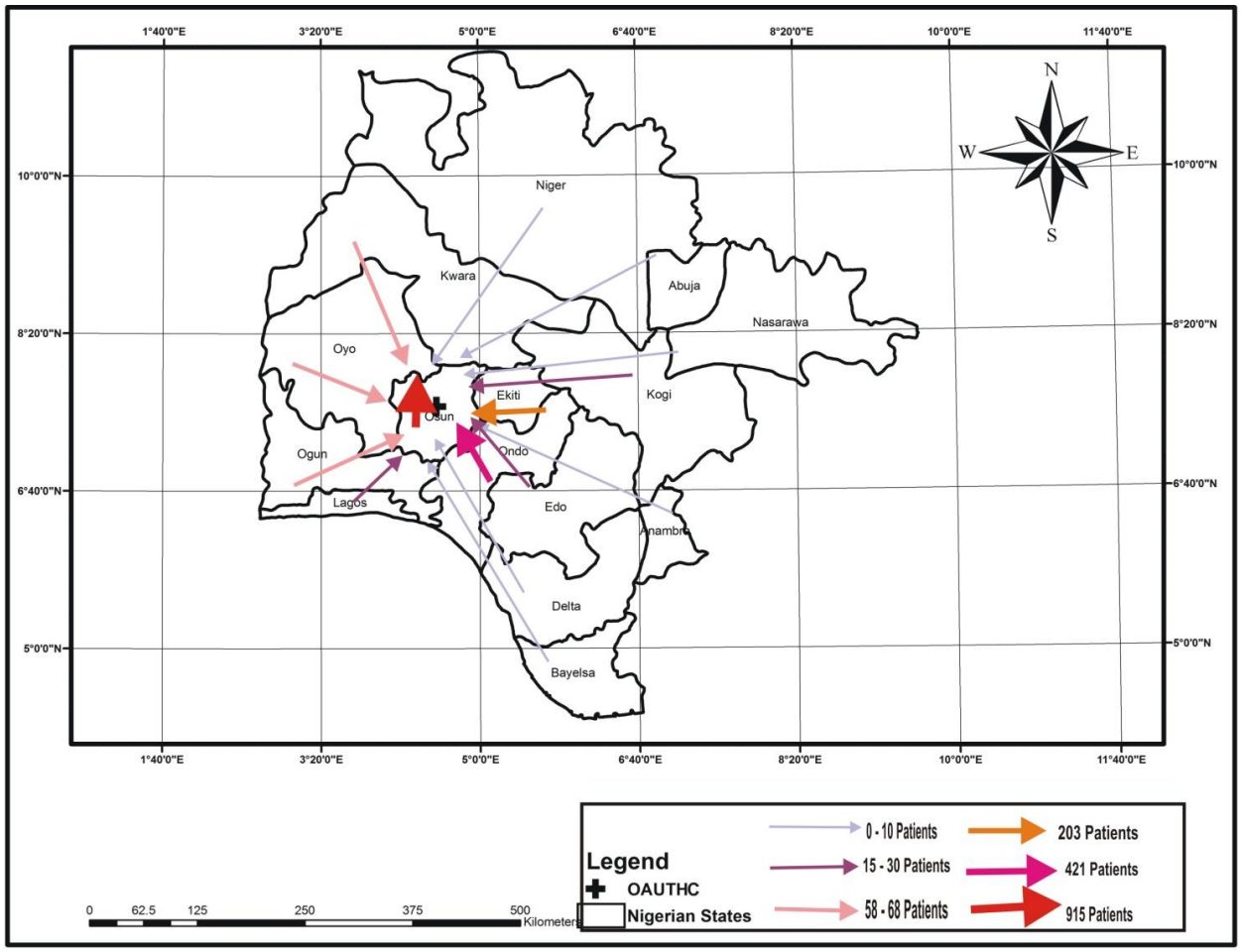

Figure 4: Flow of Patients to the OAUTHC Cancer Treatment Centre, Ile-Ife, 2000 - 2010

The flow patterns of cancer patients to the cancer treatment centre of OAUTHC, Ile-Ife shows that the facility is a high order service centre which provide specialized medical services which are either inadequate or totally unavailable in the other hospitals around it. The range of the hospital's services is wide as people are willing to travel over long distances to enjoy the services provided at the hospital. For instance, data showed that people travelled from far away Nasarawa State covering about 406 kilometres to utilize the services provided at the centre.

The relevance of the distance decay concept in the gravity model is brought to bear by the inverse relationship between the volume of patronage of patients at the hospital and their travel distance to the hospital. As the distance to the hospital increased, the volume of patients flow decreased (see Table 3). This was corroborated by the results of the correlation analysis presented in Table 4. The r = -.657 and significance level is 0.01. Which shows that about 66% of patronage is explained by distance. This however implies that there are other factors other than distance that influence patronage.

Table 4: Results of Correlation Analysis between Distance and Patronage

Variables		Distance	Patronage
Distance	Pearson Correlation	1	-.657(**)
	Sig. (2-tailed)		.008
	N	15	15
Patronage	Pearson Correlation	-.657(**)	1
	Sig. (2-tailed)	.008	
	N	15	15

** Correlation is significant at the 0.01 level (2-tailed).
Source: Authors' Analysis.

Also worthy of note here is the concept of intervening opportunity and its effect on the patronage of the hospital. For instance, as presented in Table 3, Oyo State which is relatively close to Ile-Ife (the site of the hospital) recorded a relatively low patronage at the hospital. This might not be unconnected with location of the University College Hospital (another tertiary hospital) in Ibadan, the Oyo State capital. Many patients that would have been attracted from Oyo and neighbouring Ogun and Lagos States might find it more convenient and cost effective to patronise the University College Hospital, Ibadan for their health needs rather than travel to the OAUTHC for the same service.

Summary and Conclusion

The study has analysed the flow patterns of cancer patients to the Obafemi Awolowo University Teaching Hospital Complex (OAUTHC) Cancer Treatment Centre. It was revealed that a total of 1809 patients located within 15 states of the federation had patronised the cancer treatment centre of the hospital in the period under review. The study established the veracity of the distance decay concept. The volume of patient's interaction with the OAUTHC-CTC decreased with increasing distance from the hospital. The six south western states where the hospital is located, viz: Osun, Ondo, Ekiti, Oyo, Ogun and Lagos, accounted for 92.9% of the total number of patients. Patronage was not recorded from the far North-eastern and North-western zones of the country. Another important point worthy of note is the concept of intervening opportunity and its effects on the range of a high order service such as the tertiary hospital under consideration. Whereas states such as Ondo and Ekiti that are very close to Osun state, the service centre, recorded high number of patronages at the cancer treatment centre, the same cannot be said of Oyo state, another equally closely located state, which recorded a relatively low patronage. The low patronage from Oyo State is attributable to the presence of the University College Hospital (a foremost teaching hospital of high repute), in Ibadan, Oyo State which presents a cheaper and more accessible alternative to the residents of the state.

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