Spatio-Temporal Variation Of Human Immunodeficiency Virus And Acquired Immunodeficiency Syndrome (HIV/AIDS) In Maiduguri, Borno State, Nigeria

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ABSTRACT
Aim: *This study assessed the Spatio-temporal aspects of Human Immunodeficiency Virus infection and Acquired Immune Deficiency Syndrome (HIV/AIDS) occurrence in Maiduguri, Nigeria.*
Study Design: *A descriptive retrospective study based on reported hospital cases of HIV/AIDS.*
Place of Study: *The study was conducted in Maiduguri, Borno State in Northeast Nigeria located between latitudes 11˚ 27' 30" N and 11˚ 33' 30" N and longitudes 13˚ 2' 30" E and 13˚ 9' 10" E.*
Methodology: *The population for the study was all HIV positive patients in Maiduguri that showed up for treatment in healthcare facilities offering HIV/AIDS diagnosis and treatment in the city between 2016 and 2018. The total number of cases within this period was 9,016 which was presented in in maps and in the form of contingency tables using frequency counts and percentages.*
Results: *Results of the study revealed number of reported HIV/AIDs cases is more in the western and northwestern parts of the city. The availability of social dark spots in these areas is likely responsible for this pattern of infection. The southern and eastern parts of Maiduguri which are largely suburban in character were identified to record the least number of cases. The temporal pattern of reported cases of HIV/AIDs also showed a steady increase between 2016 and 2018.*
Conclusion: *The reported cases of HIV/AIDS in Maiduguri reflects the population pattern and areas of social activities. HIV/AIDS is largely confined to areas of high population and predominance of social dark spots characterized by night clubs and brothels.*

I. Introduction

The human body is a system with over 200 types of cells and each of the cells has specific functions. The white blood cell component defends the body against infections. The Human Immunodeficiency Virus (HIV) finds its way into the white blood cell of a human body and makes copies of itself after which   immune system cells that help the body fight infections become compromised. It is this compromised immunity of the human body that is called HIV. Human Immunodeficiency Virus (HIV) infection and Acquired Immune Deficiency Syndrome (AIDS) is a spectrum of conditions caused by infection with the human immunodeficiency virus (HIV) [1]. The infection interferes more with the immune system, increasing risk of developing common opportunistic infections like tuberculosis, and tumors that rarely affect people who have working immune systems.. These late symptoms of infection are referred to as AIDS [2].

The Human Immunodeficiency Virus infects cells of the human immune system, destroying or impairing their function. Infection with the virus results in progressive deterioration of the immune system, leading to immune deficiency. The immune system is considered deficient when it can no longer fulfil its role of fighting infection and disease. Infections associated with severe immunodeficiency are known as opportunistic infections, because they take advantage of a weakened immune system [3]. AIDS is a term which applies to the most advanced stages of HIV infection. It is defined by the occurrence of any of more than 20 opportunistic infections or HIV-related cancers [3].

In 2019, the WHO announced that AIDS was the nineteen biggest cause of death worldwide and number forth killer in Africa [4]. In 2016, about 36.7 million people were living with HIV and it resulted in one million deaths [5]. There were 300,000 fewer new HIV cases in 2016 than in 2015 [6] signifying a drop in infections worldwide. Most of those infected live in Sub-Saharan Africa [7]. From the time AIDS was identified in the early 1980s to 2017, the disease has caused an estimated 35 million deaths worldwide [8]. HIV/AIDS has therefore had a great impact on society, both as an illness and as a source of discrimination against people with disease

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(HIV/AIDS). The disease also has large economic impacts that affect economic growth by reducing the availability of human capital [9].

The first case of HIV/AIDS in Nigeria was reported in 1986 [10]. In 1991, the Federal Ministry of Health (FMOH) conducted the first sentinel sero-prevalence survey in Nigeria. In this survey, and subsequent surveys conducted in 1993, 1999, and 2001, pregnant women attending antenatal clinics (ANCs), patients with sexually transmitted infections (STIs), patients with TB, and female commercial sex workers (FCSWs) provided the population for the HIV sero-prevalence estimates. These surveys show a fluctuation in HIV infection in Nigeria: from 1.8% in 1991 to 4.6% in 2008 and 1.4% in 2019. Even with a drop in prevalence rate, Nigeria's rising population ensures that the total number of infected persons remains high.at 1.4% prevalence rate, about 2.9 million Nigerians between the ages of 15 and 49 were infected with HIV/AIDS [16] (NAIIS, 2019); it is therefore a significant threat to Nigeria's development. Nigeria has the highest number of people placed on Antiretroviral Therapy (ART) in Africa, and this imposes a huge financial burden on the country [11]. The country has already surpassed the 5% explosive phase. By 2002, the epidemic had killed 1.7 million people and orphaned 1.5 million children and presently, 3.6 million Nigerians are living with the virus [11]. UNAIDS in its 2008 global report stated that there were an estimated 2,600,000 persons infected with HIV/AIDS in Nigeria and approximately 160,000 people died of AIDS in 2007 alone [5]. The Joint United Nations Programme on HIV/AIDS (UNAIDS) has reported that Nigeria purportedly has the second largest HIV epidemic in the world and one of the highest new infection rates in sub-Saharan Africa. This is just as it said 720,000 Nigerians are on United States President's Emergency Plan For AIDS Relief (PEPFAR) supported HIV treatment with approximately four million Nigerians having received HIV counseling and testing services in 2017 alone. [4] By the experience of countries that have surpassed the Nigerian HIV prevalence rate (5%), HIV/AIDS in all likelihood will pose a significant burden on the already stressed and depleted resources and dilapidated infrastructure available to fight the disease.

While prevalence rate of HIV/AIDS is declining in Nigeria due largely to awareness creation and other forms of intervention, the rural/urban divide remains a major source of concern. Due largely to the conflict witnessed in Borno State, one of the cities in Nigeria that has witnessed phenomenal growth in population in the last decade is Maiduguri the state capital. As such, the need to interrogate the population's HIV/AIDS situation becomes imperative. The spatial and temporal dimensions of the disease within the city is important for planning and health intervention. This study examined the residential location of reported HIV/AIDS cases as well as their temporal trends.

II.   Study Methods

The study was descriptive retrospective involving all HIV positive and AIDS patients in four major Maiduguri hospitals that showed up for treatment between 2016 and 2018 for which data was available at the time of data collection. These facilities are: University of Maiduguri Teaching Hospital, State Specialists Hospital Maiduguri, Mohammed Shuwa Memorial Hospital and Umaru Shehu Ultra-Modern Hospital, Bulumkuttu. Patients' records from these facilities were obtained from a database of the Epidemiological Unit of Borno State Ministry of Health and sorted. Only information on patients living in Maiduguri were extracted and used for this study. Ethical clearance was obtained from the Ministry of Health for this study.

For analysis of data, Statistical Package for Social Sciences (SPSS) was used and results presented in form of percentages and contingency tables. Geographic Information System tool (QGIS) was used to represent the data in form of maps. The scale of analysis for this study is the administrative districts within Maiduguri.

III.   The Study Area

The study was conducted in Maiduguri, Borno State, Nigeria. Located between latitudes 11˚27′30″N and 11˚33′30″N and longitudes13˚ 2′30″E and 13˚ 9′10″E (Fig.1) with land area of 543 km^2. The city was a colonial creation established in 1907 when Borno's erstwhile capital was transferred from Kukawa to Maiduguri by the British. Being in existence for slightly over a century, Maiduguri is presently a truly cosmopolitan city which has assumed the status of the commercial capital and hub of Northeast Nigeria. The city is shared by four Local Government Areas (LGAs) – Maiduguri Metropolitan, Jere , Konduga , and Mafa LGAs. In 2020, Maiduguri's population was estimated to be 2 million people. Ethnically, Maiduguri comprises of the Kanuri, Hausa, Shuwa, Bura, Babur, Marghi, and Fulani ethnic groups. The state is predominantly Muslim although there is also a considerable Christian population from LGAs in the southern part of the state, other states of the Northeast and people from the southern states such as the Igbo, Ijaw, and Yoruba.

The prevailing climate in Maiduguri is known as a local steppe, which translates to BSh class in the Köppen-Geiger climate classification. Average temperature in the city is 25.8°C while the average annual rainfall is 613mm. The driest month is January with no precipitation. Most precipitation falls in August, with an average of 215mm and average temperature of 30.0°C, with May being the warmest month. In January, the average temperature is 21.4°C which is the lowest monthly temperature of the year. The average temperatures vary during

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the year by 8.6℃ [11]. The generally warm nature of Maiduguri's climate especially in the hottest months of April, May and June has great implications for the trigger and spread of diseases.
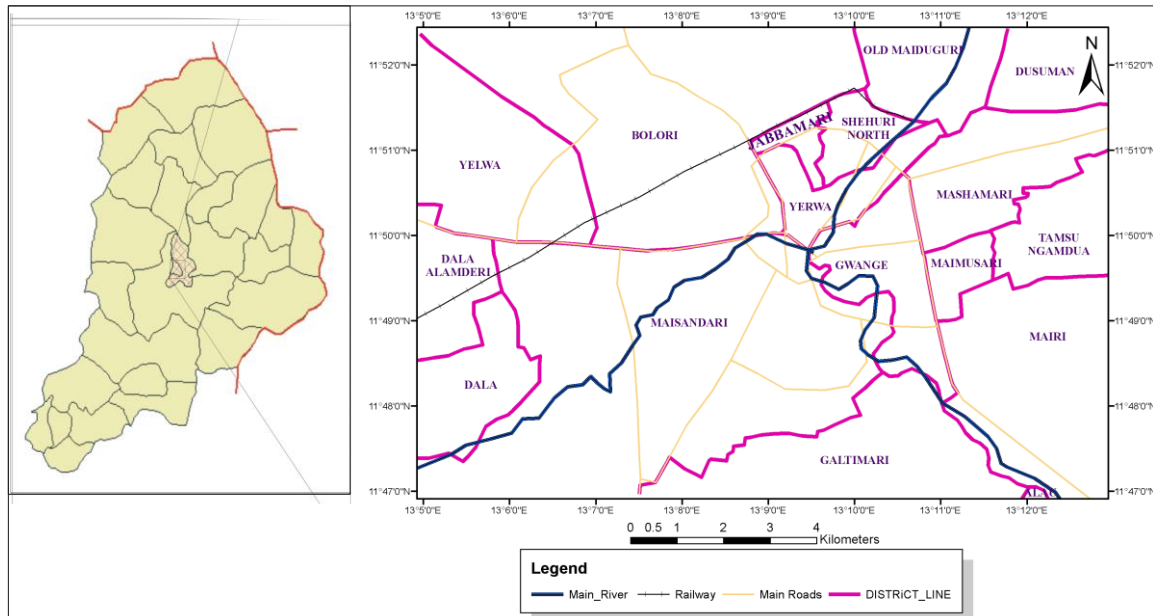

Figure 1: The study area
Source: Modified from UN Office for the Coordination of Humanitarian Affairs, (2016)

IV. Results and Discussion

Socioeconomic and Demographic Characteristics of HIV/AIDS Patients

     Table 1 shows the socioeconomic and demographic characteristics of reported HIV/AIDS patients in Maiduguri. Majority of respondents were over 20 years with 21-30 year age group being the most preponderant. Greatest proportion of patients over 40 years was observed in Mashamari (23 percent), Gwange (21 percent) and Dala Lawanti (21 percent). Females constituted more than two-thirds of the reported cases while married patients were greater than singles by almost the same proportion. All the districts had reported cases more from female than male but the highest percentage of 71 percent of female reported cases was from Old Maiduguri District. Most patients (40 percent) did not attend any formal level of education; Gwange District had the highest percentage of such cases. Only about a quarter of the patients were educated up to secondary level. A greater percentage of patients were also of poor economic background being mostly unemployed, those gainfully employed represented only one-third of the total.

Table 1. Socioeconomic and Demographic Characteristics of Respondents

Age	Percent (n=6,222)
0 - 10	4.36
11—20	8.02
21 – 30	34.71
31 – 40	31.73
41 and above	21.18
Sex	
Male	36.26
Female	63.74
Marital Status	
Married	65.43
Single	24.32
Divorce	2.02
Separated	0.39
Widowed	7.84
Education	
None	40.66
Qur'anic	3.41
Junior Secondary	1.96
Primary	7.91
Secondary	25.23
Post-Secondary	20.83
Employment Status	
Employed	33.93
Unemployed	60.88
Retired	0.3
Student	4.89

Spatial Distribution and HIV/AIDS Infection 2016 - 2018

Table 1 shows the total number of HIV/AIDS patients who obtained care from the four health facilities for the three year period. The total number of those domiciled in Maiduguri i.e. 6,222 patients and their distribution within the city is shown on Table 2. A better view of Table 2 is presented as Figure 2 where it can be discerned that the spatial distribution of HIV/AIDS infection in Maiduguri reveals distinctive differences in the pattern of HIV/AIDS infection within the districts. The figure reveals that Bolori District has the highest number of HIV/AIDS patients with 22.55% of all cases. *Ceteris paribus*, a few reasons may be suggested for the predominance of patients in Bolori district. The District is a one of commercial areas of Maiduguri with a lot of red-light activities taking place in hotels, beer parlors, and night clubs where regular social activities take place. The district is essentially a settler zone preferred by people from southern part of Nigeria who are predominantly traders and highly mobile, moving momentarily between the northern and southern part of the country facilitating exchange of goods and services. Thus, it is likely that this constant mobility and the presence of these social activities taking place in the district may have accelerated HIV/AIDS transmission in the district. Popular dark spots within the district include Chez Coan Hotel and Night Club and 7 Division Mammy Market. This finding agrees with that of Januaris' which reveals that alcohol users find themselves not being able to make wise decisions when getting involved in sexual activities so that people who are addicted to alcohol become careless on sexual behaviors which is fueling its transmission [13]. Most people living in the developing countries are fully aware of the disease (HIV/AIDS), but continue to get involved in practices that fuel its transmission [14]. This ignorance is adversely driving the HIV/AIDS epidemic across the world especially in developing countries where many people do not care about measures that are required to protect themselves from the infection such as the use of condoms. In some respects, this can also explain what obtains in the 'non settler' part of Bolori district such as Zajiri, Umarari and Telari wards characterised by low educational attainment and awareness.

Demographically, females outnumbered males in all the districts as earlier stated but highest percentages were observed in Bolori and Gomari districts which had in particular more confirmed cases than other districts (71 percent and 65 percent female). Highest percentage of married patients were found in Gwange (66 percent)

while highest percentage of unemployed patients was observed in the core city district of Shehuri North (57 percent).

Table 1. Number of Patients by Facility in Maiduguri, 2016 - 2018

S/No.	Health Facility	Numbers of patients
1	University of Maiduguri Teaching Hospital	3,445
2	State Specialist Hospital	2,957
3	Mohammed Shuwa Memorial Hospital	1,786
4	Umaru Shehu Ultra-Modern Hospital	828
	Total	9,016

Table 2. Distribution of HIV/AIDS Patients Living in Maiduguri by District 2016 - 2018

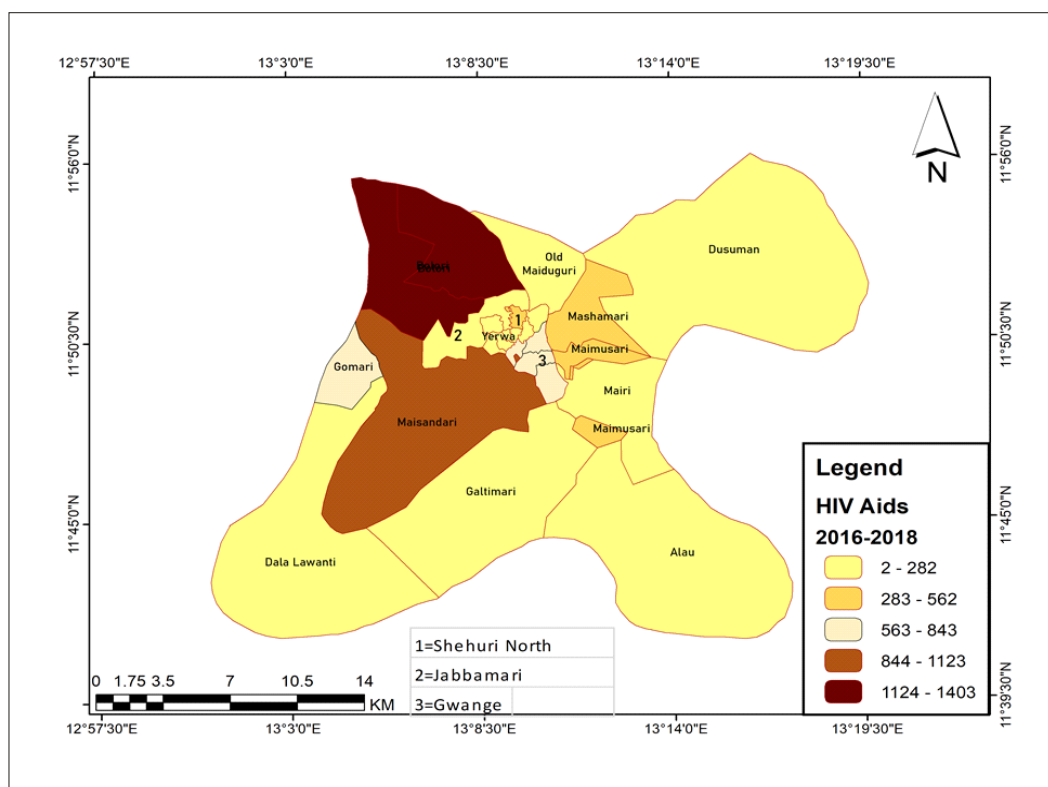| S/No.	District	Total	Percent
1	Alau	2	0.03%
2	Dusman	49	0.79%
3	Galtimari	126	2.03%
4	Jabbamari	190	3.05%
5	Yerwa	256	4.11%
6	Dala Lawanti	238	3.83%
7	Old Maiduguri	259	4.16%
8	Maimusari	359	5.78%
9	Mairi	267	4.29%
10	Mashamari	435	6.99%
11	Shehuri North	368	5.91%
12	Gomari	565	9.08%
13	Gwange	704	11.31%
14	Maisandari	1,001	16.09%
15	Bolori	1,403	22.55%
	Total	6,222	100.00%

Figure 2 Spatial Distribution and HIV/AIDS Infection from 2016 - 2018 in Maiduguri

The result also shows that Maisandari, Gwange and Gomari Districts are in the order of decreasing magnitude the most affected districts after Bolori with 16.09%, 11.31% and 9.08% respectively as shown in Table 2 and Figure 2. This indication of high rise of HIV/AIDS infected persons in the districts could be due to the high-level influx of internally displaced persons (IDPs) within the districts where some IDPs camps are sited. These IDPs camps have been alleged to be home to many risky behaviours that increase people's vulnerability to HIV infection such as prostitution, drug abuse and survival sex as reported in some of the camps in 2016 by UN. The period 2016 – 2018 is characterized by high displacement into Maiduguri due to insecurity in the state. Another factor that may be important in the districts is cultural factor. It has been observed that lack of knowledge of HIV status mostly in polygamous settings was found to increase vulnerability. Many of the workers/clients married without knowing their spouse's HIV/AIDS status until after the death of the spouse which is in line with some reported findings [15]. This finding also agrees with the findings of [13], that refugee camps are well known to be home to all sorts of social vices, including drug abuse and prostitution which fuel the epidemic. It has similarly been observed that the most common cultural factors fueling the spread of HIV/AIDS in the developing world include polygamy and wife inheritance so that if one partner gets infected, he or she is highly likely to spread the virus to all the other partners.

Other districts with high prevalence are Mashamari, Shehuri North, and Maimusari Districts as shown in Table 2 with 6.99%, 5.91% and 5.78% respectively. Also, poverty among the people in these districts (being very deprived and underserved communities could trigger the practices that fuel the spread of the epidemic as drugs, alcohol use and prostitution are common social ills observed in these districts especially among youths. This finding is consistent with the view that the developing world with a large population of people living in poverty may be forced to engage in promiscuity and other high-risk behaviours responsible for the spread of the disease (HIV).[13] Indeed, there have been many reported cases of young people getting involved in commercial sex in these countries. This activity has been reported to tremendously increase the disease prevalence in these regions [13]. Mairi, Yerwa, Dala, Lawanti, and Jabbamari Districts as shown in the table have 4.29%, 4.11%, 3.83%, and 3.05% respectively while Alau, Galtimari and Dusuman, show the least infections from 2016 -2018. These districts are located in the fringe of the city having a mixture of rural and urban lifestyle. As a result of this, there is low presence of socioeconomic activities which also explains the near absence of city red light zone in these districts.

The Temporal Trend of Reported HIV/AIDS Cases

The temporal trend of reported HIV/AIDS cases from 2016 – 2018 in Maiduguri is summarized in Table 3. For all the three years, there is a rising trend of infections in nearly all the districts with 2018 having the highest rate of infection and 2016 the least. The table shows that 2018 accounts for 37 percent of all reported cases while 2017 and 2016 account for 36 percent and 28 percent of infections respectively. It is unclear what is responsible for this steady rise but we suspect that it is due to the higher number of people reporting for testing at the testing facilities. Radio jingles, talk shows and visual adverts that were consistently sponsored by state and non-state actors may also have contributed to increase in reporting. Further analysis of the data on a spatio-temporal basis revealed a clearer picture of both the spatial and temporal trends (see Table 3 and Figures 3, 4 and 5). What is clear from Table 3 and the three figures is that Bolori and Maisandari are consistently the districts with the greatest HIV/AIDS infection between 2016 and 2018. These two districts account for about 50 percent of the cases in Maiduguri in the study period. Other districts with high infection rates are Maimusari, Mairi, Mashamari and Old Maiduguri districts. Except for few districts like Dusuman and Shehuri North, this rising temporal trend of infections appears to be a common feature in Maiduguri.

Table 3. Spatio-temporal Trend of HIV/AIDS Reported Cases in Maiduguri 2016 - 2018

S/No.	Districts	2016	2017	2018	Total	
1	Alau	0	0	2	**2**	
2	Dusman	13	28	8	**49**	
3	Galtimari	27	31	68	**126**	
4	Jabbamari	47	62	81	**190**	
5	Yerwa	58	74	124	**256**	
6	Dala Lawanti	64	80	94	**238**	
7	Old Maiduguri	76	99	84	**259**	
8	Maimusari	81	135	143	**359**	
9	Mairi	107	59	101	**267**	
10	Mashamari	107	172	156	**435**	
11	Shehuri North	131	166	71	**368**	
12	Gomari	139	249	177	**565**	
13	Gwange	193	240	271	**704**	
14	Maisandari	262	379	360	**1001**	
15	Bolori	420	437	546	**1403**	
	Total	**1,725**	**2,211**	**2,286**	**6,222**	

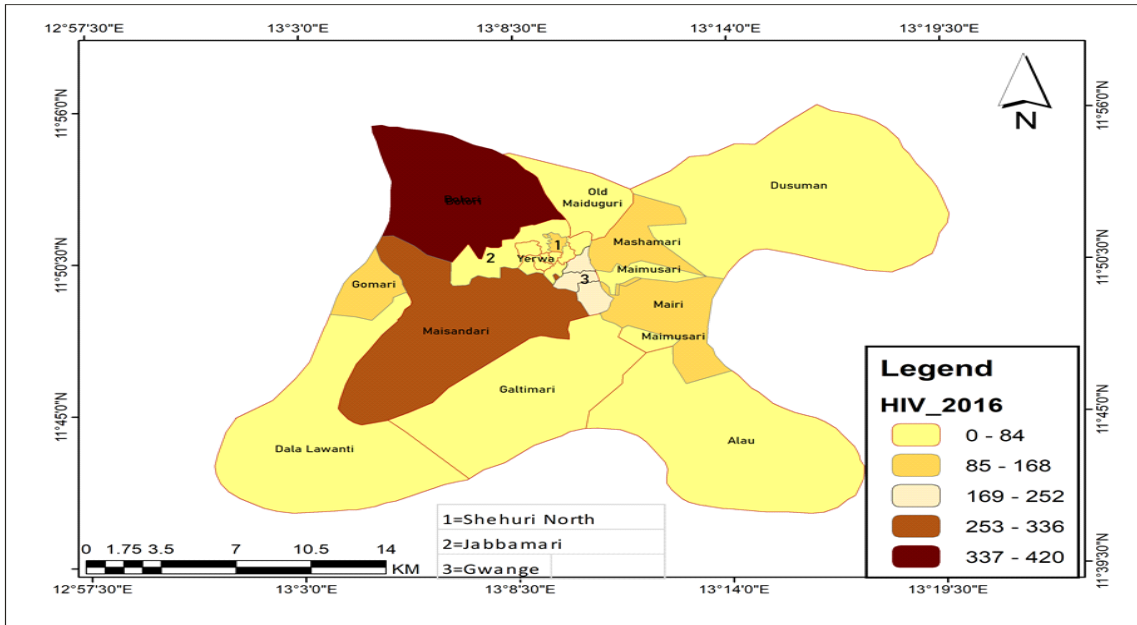Source: Epidemiological Unit, Borno State Ministry of Health, 2019

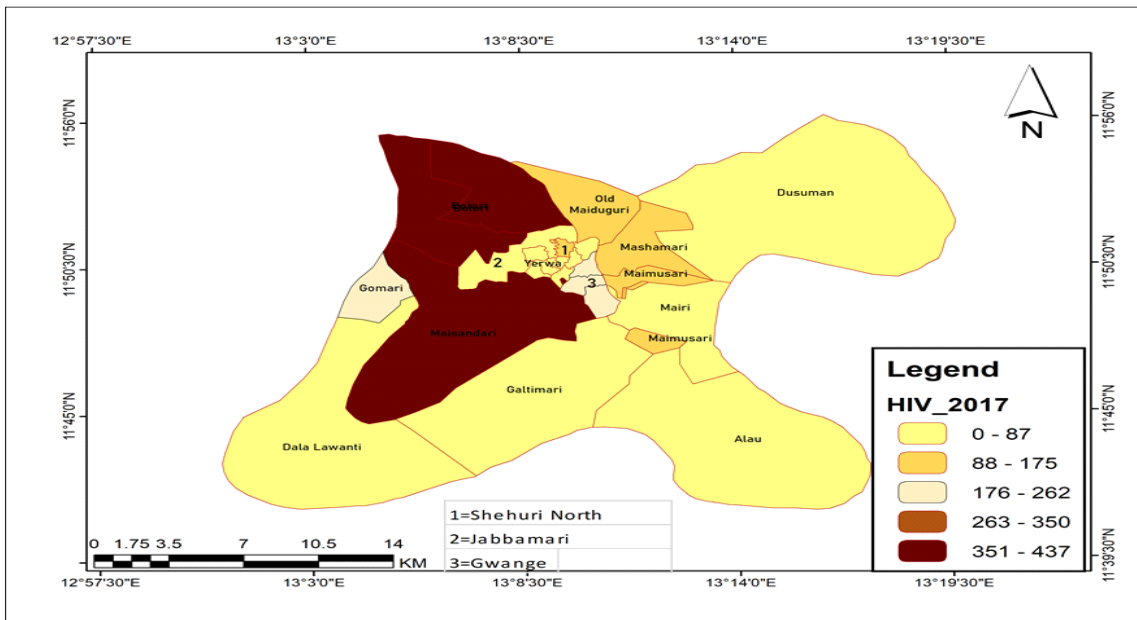**Figure 3: Temporal Pattern of HIV/AIDS Infection in 2016 in Maiduguri**

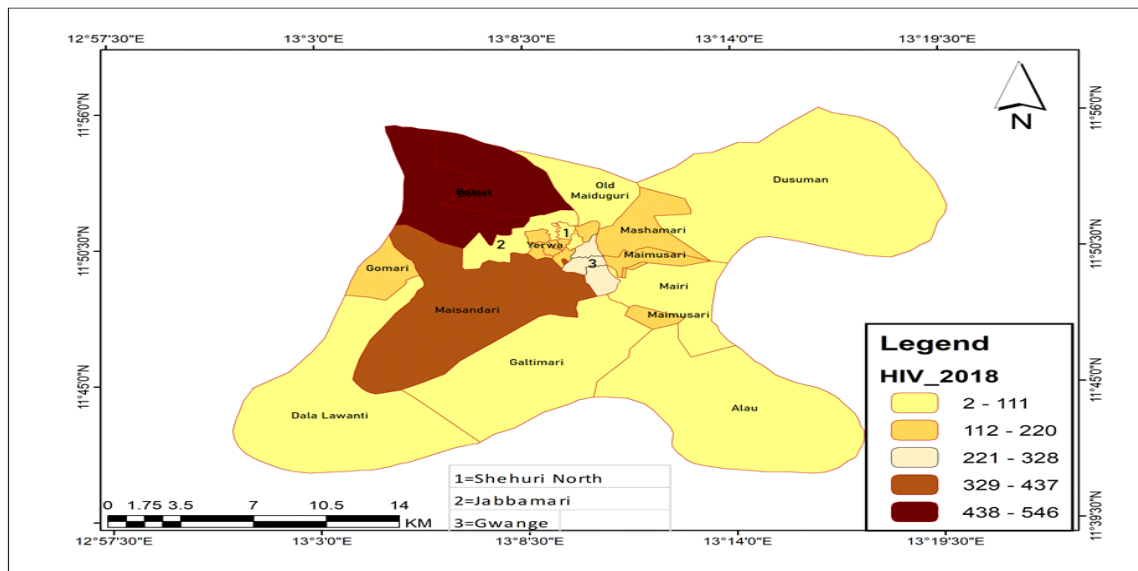**Fig. 4: Temporal Pattern of HIV/AIDS Infection in 2017 in Maiduguri**

Fig. 5: Temporal Pattern of HIV/AIDS Infection in 2018 in Maiduguri

V. Conclusion

Data on PLHIV living within the city of Maiduguri revealed that the spatial pattern of the HIV/AIDS was found to be in the high densely populated sections of the city where social activities take place. These are the western and northwestern parts of the city. The eastern and southern sections of the city, which are typically suburban in character, exhibited having the lowest reported cases both in time and space. To help reduce rates of infection in areas of high reported cases, massive enlightenment campaigns in the city's red light zones is necessary. Public service messaging including drama skits for sponsorship by both government and non-state actors is essential. Such campaigns should include the need for voluntary counselling and testing and behavior modification especially in the high-risk areas but also in other parts of the city.

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