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Geospatial Dynamics and Locational Distribution of Medical Care Facilities in Ado-Ekiti: Implications for Urban Health Accessibility and Planning

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Abstract **Case Studies**

The spatial distribution of medical care facilities is a critical determinant of health service accessibility in rapidly urbanizing areas. This study examines the geospatial dynamics and locational distribution of medical care facilities in Ado-Ekiti, Nigeria, with a view to evaluating their implications for urban health accessibility and planning. Employing Geographic Information Systems (GIS) and remote sensing techniques, data were collected from satellite imagery, health facility registries, and field surveys. The facilities were mapped and analyzed using spatial analytical tools such as Nearest Neighbour Analysis and Kernel Density Estimation to determine clustering patterns and spatial equity. The findings reveal a high concentration of medical care facilities in the central urban core of Ado-Ekiti, with significant service gaps in peripheral and newly developing areas. This uneven distribution reflects socio-economic disparities and inadequate integration of geospatial data in urban planning processes. The study underscores the need for a data-driven approach to health facility planning, advocating for decentralized location strategies and improved spatial equity to enhance urban health outcomes. These insights provide valuable guidance for policymakers and urban planners in the pursuit of equitable and sustainable healthcare access across Ado-Ekiti.

Keywords: Geospatial analysis, Medical care facilities, Health service accessibility, Urban planning, Ado-Ekiti.

1. Introduction

Medical care facilities are necessary to guarantee good living conditions and life prospects for all people on the globe. The World Health Organization (WHO) has underscored the importance of accessible medical services as a basic human right (WHO, 2020). Nevertheless, medical care accessibility is still variable around the world in spite of global campaigns that have been made to improve it, especially in countries such as low- or middle-income nations which may not have enough medical infrastructure and strong socio-economic factors that may hinder access to medical care services.

In Africa, millions of people lack access to essential health services due to poor medical care systems. Although there have been efforts to develop medical care infrastructure and increase coverage, inequalities persist between urban and rural areas as

well as among diverse socio-economic groups. Inadequate financing for health, scarcity of resources for medicine and poverty impede access to medical treatment across Africa (Agyei-Mensah and Aikins, 2020).

There are geographical barriers, socio-economic inequalities and limited access to medical care provision like in other parts of the world, particularly sub-Saharan Africa. Most difficulties come from rural areas where there is a low density of health facilities and poor roads network (Ameh, Klipstein-Grobusch, D'ambruoso, Kahn, Tollman and Gómez-Olivé, 2016).

The one thing that needs attention in Ekiti state, South West Nigeria is the accessibility of medical care. Even though there have been attempts by governments to enhance these facilities and widen their reach such as through Ekiti State Health Insurance Scheme, it still remains a challenge for adequate accessibility particularly among rural communities (Similarly, Adewumi, Oladimeji, Adeyeye, and Lawal, 2020).

Ajayi and Oyedeji (2019) suggested that the necessity of focused interventions to alleviate socio-economic gaps and enhance marginalized groups access to medical care. These interventions might take the form of health education campaigns, financial aid programs or laws that lower social and financial obstacles to medical care. By concentrating on these areas, a more equitable medical care system that guarantees everyone can get the treatment they require, regardless of socioeconomic background, may be established.

Many different circumstances affect Ado-Ekiti residents' ability to access medical treatment. One important factor is the distribution of medical facilities; an unequal distribution frequently results in underserved regions. The problem is exacerbated by socioeconomic differences, since those with lower incomes may find it difficult to pay for health insurance or medical treatments (Oladeji, 2017). Physical access to medical care providers is hampered by transportation issues, such as poor infrastructure and limited public transportation alternatives, especially in rural or isolated places.

2. Literature Review

Studies on health service accessibility emphasize the importance of spatial equity in urban planning. The clustering of health facilities in central urban areas is a common phenomenon, often leaving peripheral or less developed areas underserved. Previous research (e.g., Ojo & Ajayi, 2023; Nnamdi & Olufunke, 2023) has highlighted the concentration of health facilities in metropolitan cores and the resulting inequities in service access. Eniola et al. (2024) and Uche & Ibrahim (2024) have emphasized that strategic planning, including the use of mobile clinics and telemedicine, can help address these disparities.

In urban areas, the locational distribution of medical facilities directly impacts service delivery, particularly during medical emergencies (McLaren et al., 2014). Geographic Information Systems (GIS) have become instrumental in understanding spatial patterns and optimizing healthcare service distribution, as demonstrated by Ghosh-Jerath, Singh, Magsumbol, Kamboj, and Goldberg (2015). This research builds on existing literature by employing GIS tools to analyze the spatial dynamics of healthcare facilities in Ado-Ekiti.

3. Methodology

This study employs a mixed-methods approach that combines both qualitative and quantitative data. Geographic Information Systems (GIS) were used to map and analyze the distribution of medical care facilities in Ado-Ekiti. Data were collected from satellite imagery, field surveys, and health facility records.

3.1 Spatial Analysis

Key spatial analytical techniques applied in this study include:

Nearest Neighbour Analysis: To determine clustering patterns of medical facilities.

Kernel Density Estimation: To identify areas of high medical service concentration.

Euclidean Distance Analysis: To assess the accessibility of medical facilities relative to major roadways and transportation networks.

Data were collected on the number of medical care facilities, their locations (latitude and longitude), type of ownership (public/private), and proximity to major roads. Field surveys were conducted to gather public perceptions of healthcare accessibility and facility usage patterns.

4. Results

4.1 Distribution of Medical Care Facilities

The analysis revealed a concentration of medical facilities in the central metropolitan area of Ado-Ekiti, with fewer facilities located in peripheral or newly developed zones (Figures 1 and 2)). This clustering is evident in the urban core, where major roads facilitate easier access to services.

4.2 Spatial Accessibility

Euclidean distance analysis showed that a large proportion (71.1%) of medical care facilities are located within 627 meters of major roadways, making them relatively accessible to urban residents. However, 28.9% of the hospitals are located farther away, with some facilities being more than 7 kilometers from the nearest road (figure 3) posing significant barriers to access, particularly for rural populations.

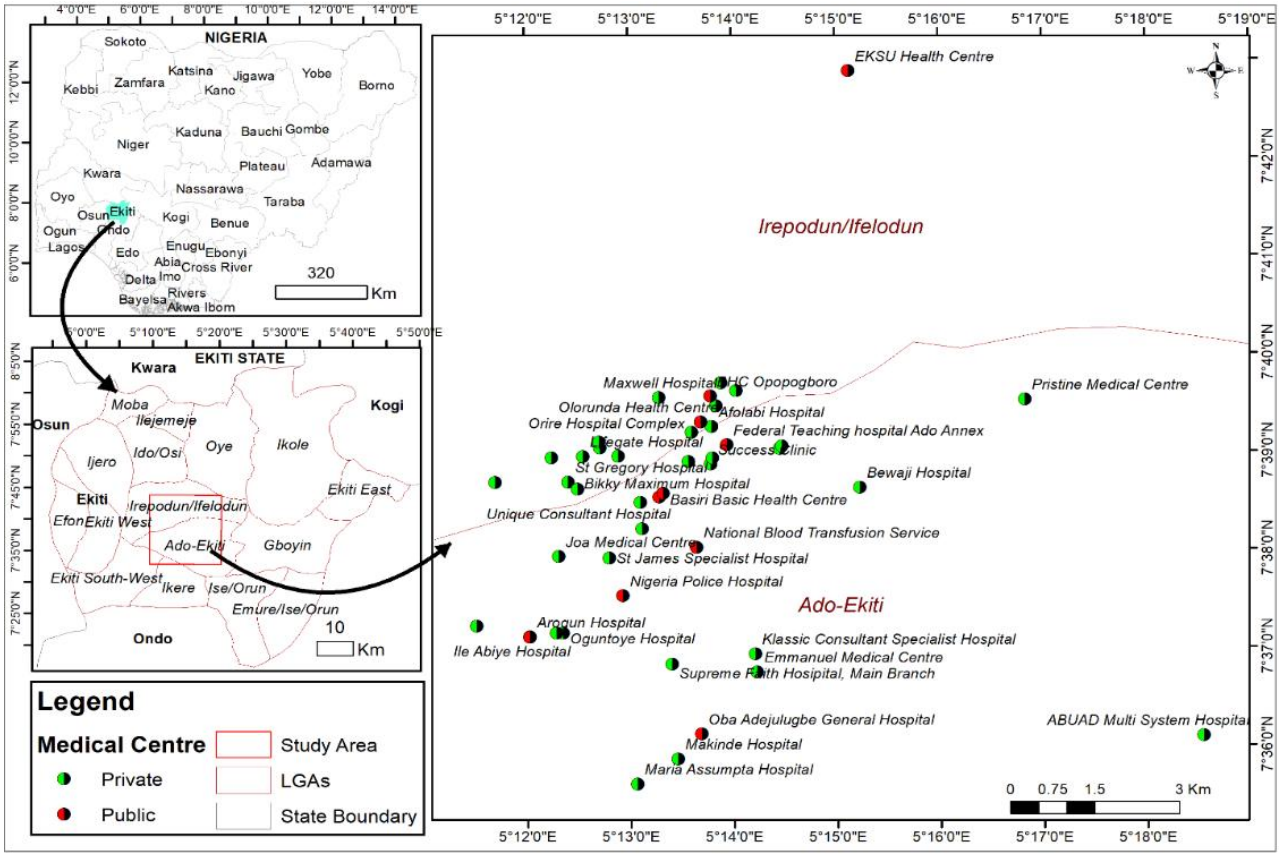

Figure 1: Location of Medical Centres

Source: ArcGIS Extract, 2024

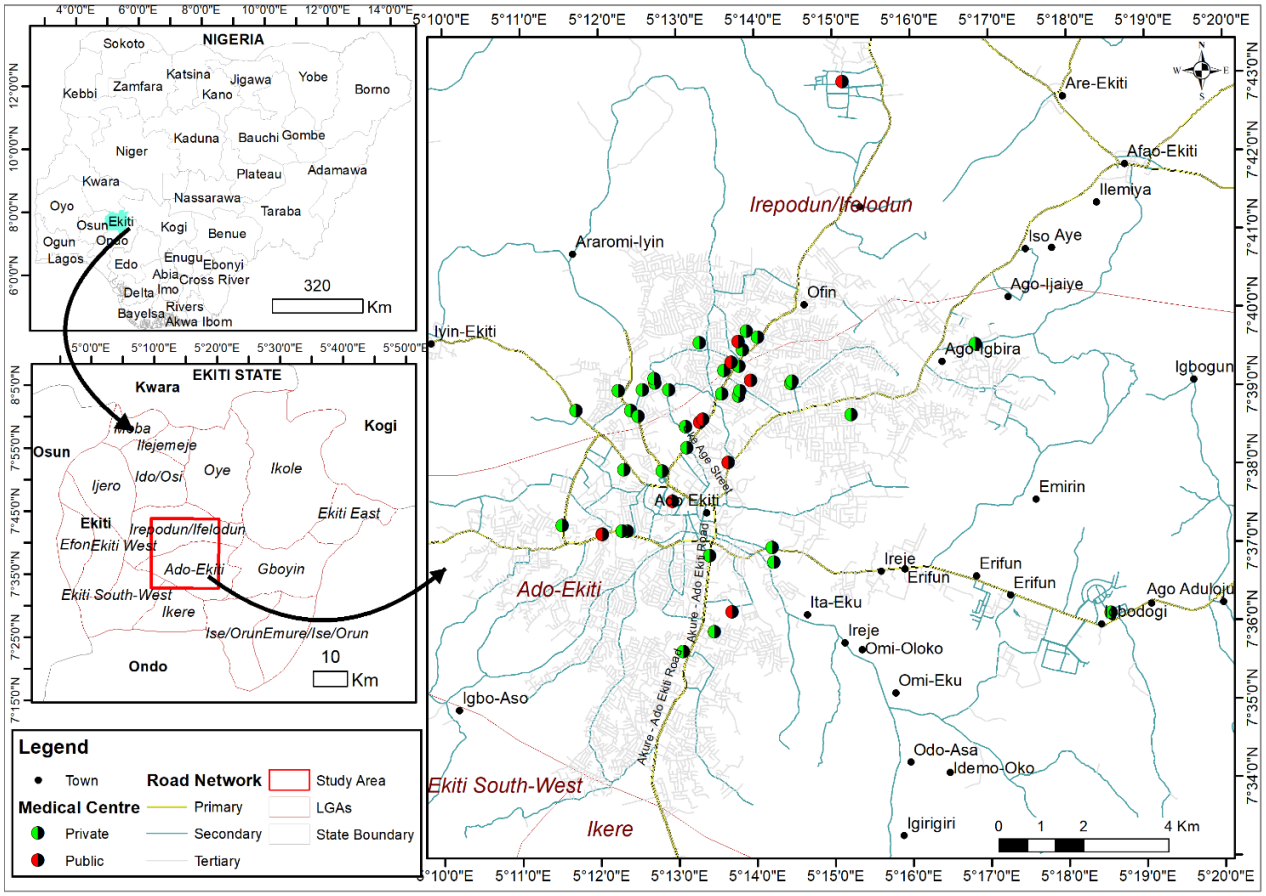

Figure 2: Distribution of Medical Centres and Road network

Source: ArcGIS Extract, 2024.

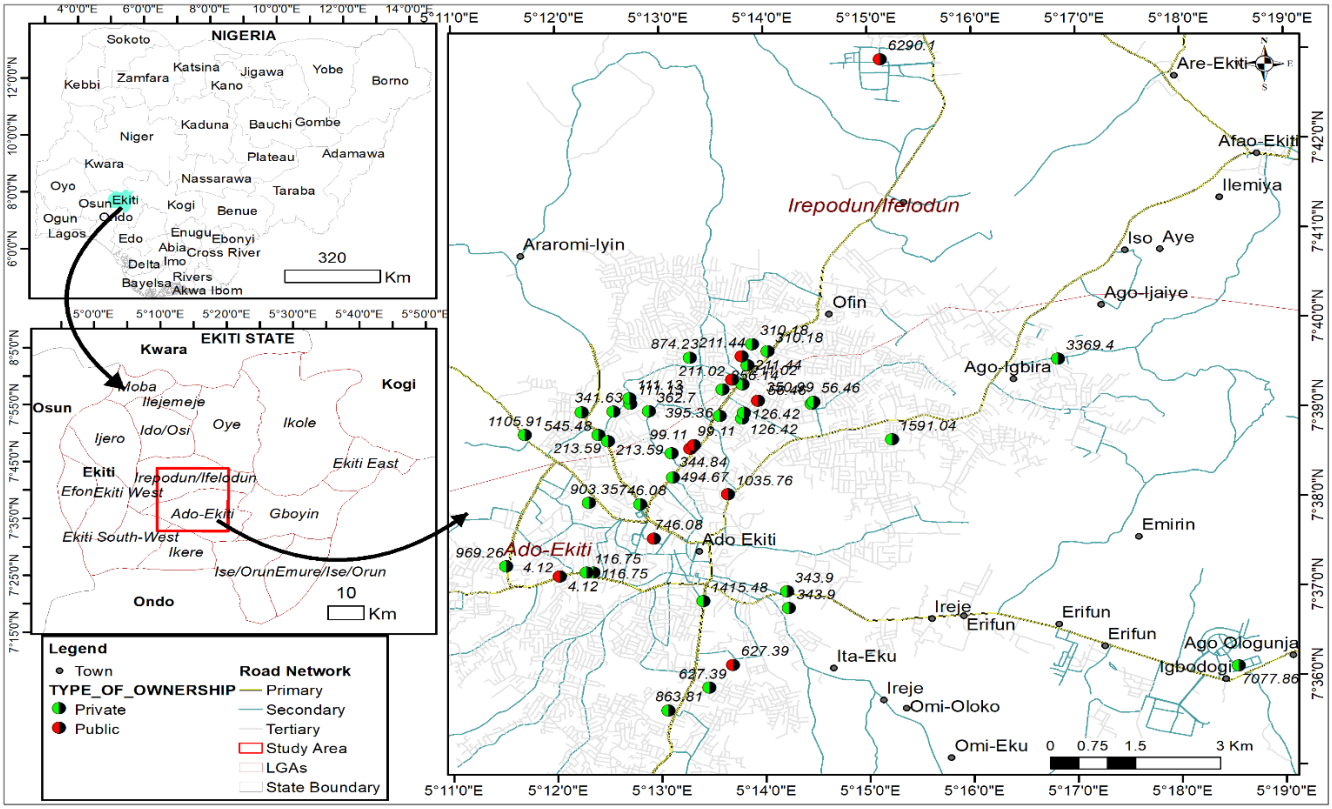

Figure 3: Distance of Medical Centres to the nearest Road

Source: AcrGIS Extract, 2024.

4.3 Impact of Location on Health Service Utilization

The analysis of nearest neighbourhood is shown in figures 4 and 5. As seen in the figures a large fraction of Ado-Ekiti medical care facilities is grouped in specific areas rather than being evenly dispersed throughout the city. This clustering pattern implies that medical facilities are very close together within specific zones, rather than being widely distributed. The concentration of facilities in specific places can make them more accessible to those who live nearby. According to Ojo and Ajayi (2023), concentrating medical facilities on main roadways or central sites makes them more accessible to a larger number of people, particularly in urban areas. Because of its proximity to transportation lines, this clustering can allow for more quick medical interventions and improved emergency response.

Concentrating medical facilities in specific areas can also result in more efficient resource allocation. Clustering, according to Eniola, Adeyemi, and Olatunji (2024), allows for the sharing of facilities and equipment, which reduces duplication and may cut operational expenses. It also allows for improved collaboration across surrounding facilities, which improves overall medical care delivery.

The main downside of this clustering is that residents in more remote or underdeveloped locations may have difficulty receiving medical care. According to Nnamdi and Olufunke (2023), people who live more out from the core clusters must travel longer distances to medical facilities, which can cause treatment delays and worsen health inequities. This unequal distribution might be especially problematic for people with mobility challenges or who do not have dependable means of transportation.

According to Olufemi (2023), concentrating facilities in specific regions can result in congestion. High patient loads in clustered facilities may put a burden on resources and staff, thereby reducing care

quality and increasing patient wait times. This condition may reduce the overall effectiveness of the medical care system in certain locations.

While clustering can improve accessibility for urban people and resource efficiency, it also emphasizes the need for more equitable distribution. According to Uche and Ibrahim (2024), resolving the mismatch by strategically locating more facilities in disadvantaged areas is critical to attaining equitable medical care access. They advocate establishing mobile health units and extending telemedicine services to fill care gaps for more rural people.

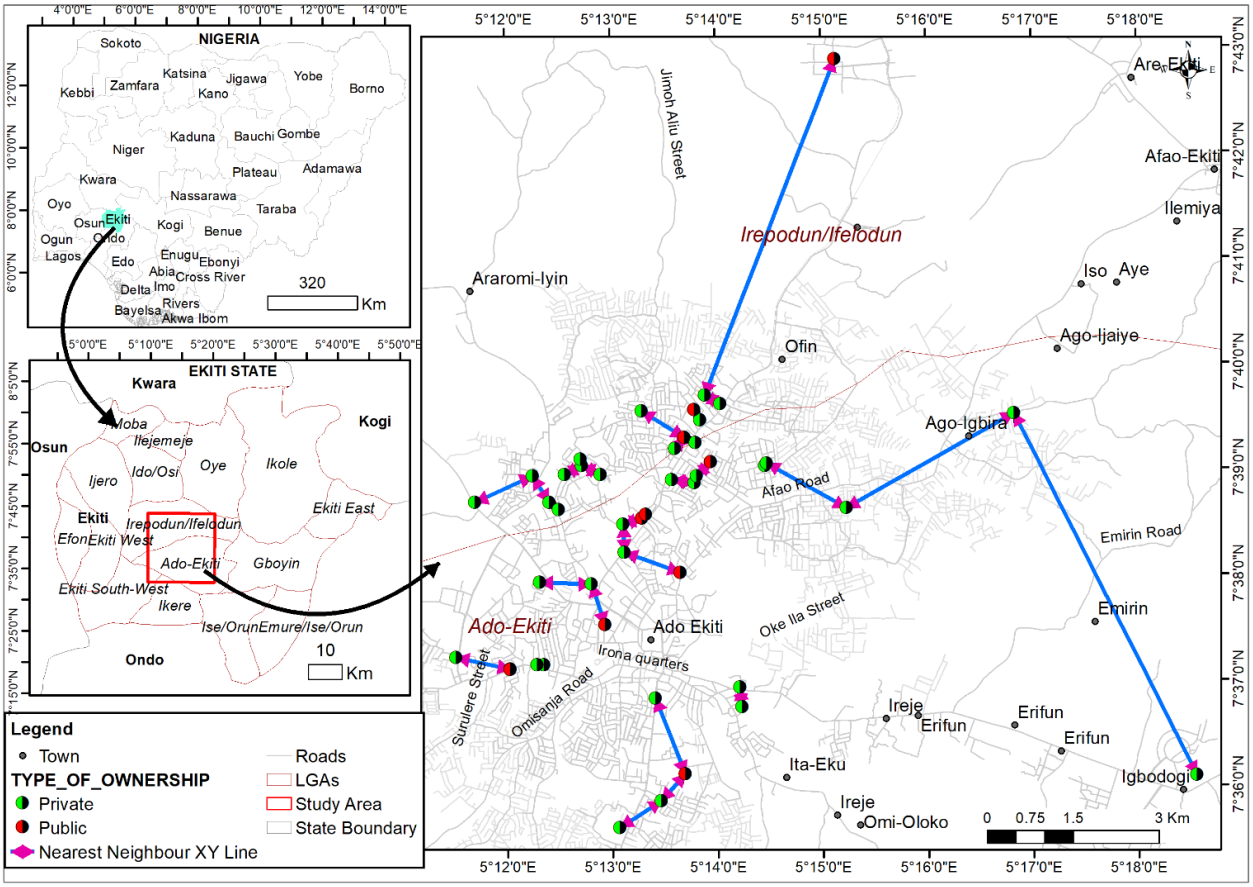

Figure 4: Nearest Neighbour Analysis of Medical Centres in the Study area.

Source: AcrGIS Extract, 2024.

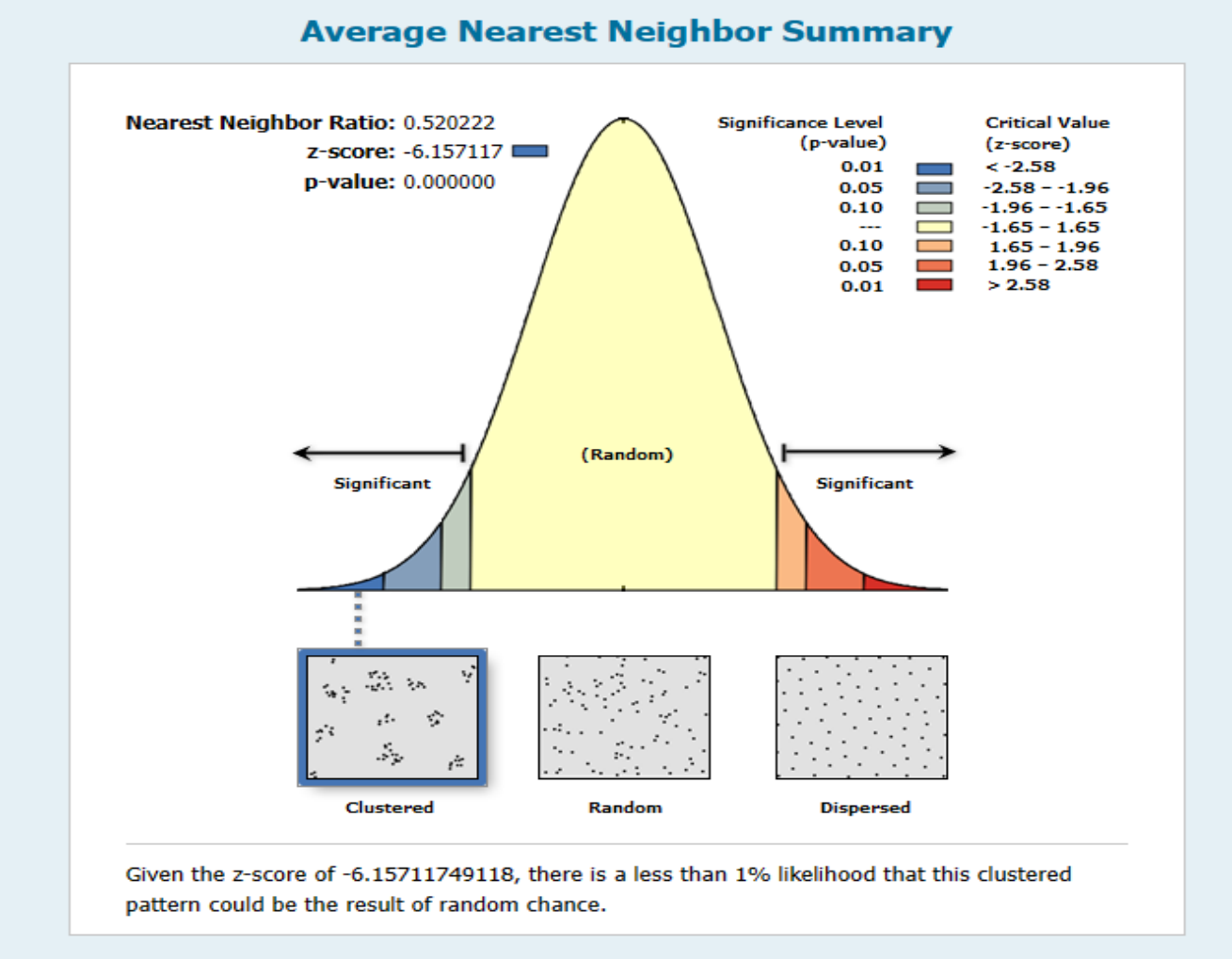

Figure 5: Nearest Neighbour Analysis of Medical Centres in Ado-Ekiti

Source: AcrGIS Extract, 2024.

5. Discussion

The geospatial distribution of medical care facilities in Ado-Ekiti reflects significant imbalances in access to healthcare. The concentration of medical facilities in the urban core increases accessibility for residents in central districts but leaves peripheral and rural areas underserved. The proximity of medical facilities to major roadways is beneficial in improving accessibility and reducing emergency response times. However, the uneven distribution of healthcare facilities may worsen health inequalities, particularly for vulnerable populations such as the elderly, disabled, and those with limited mobility.

This study emphasizes the need for strategic planning that incorporates spatial data to achieve a more equitable distribution of medical care services across Ado-Ekiti. Policies should focus on improving transportation networks to remote areas and expanding healthcare infrastructure in underserved zones. Additionally, mobile health units and telemedicine services could be integrated into the healthcare delivery system to bridge gaps in access.

6. Conclusion and Recommendations

This study underscores the importance of geospatial analysis in urban health planning. The concentration of medical care facilities in Ado-Ekiti's central urban core highlights the need for more equitable distribution strategies. To enhance urban health accessibility, policymakers should prioritize decentralized healthcare planning, improve transportation infrastructure, and explore innovative solutions such as mobile clinics and telemedicine services. These efforts will contribute to reducing health inequities and ensuring that all residents, regardless of their location, can access timely and quality healthcare.

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