

Indicators of the Urban Impact of Health Projects and the Dimensions of Their Sustainable Development: An Analytical Study of Projects at the Holy Shrine of Imam Hussein in the City of Karbala

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Abstract

BACKGROUND AND OBJECTIVES: The urban impact of healthcare infrastructure has become a crucial driver for sustainable development and restructuring city layouts. Although the Holy Shrine of Imam Hussein has implemented several health projects in Karbala, there was a lack of comprehensive spatial measurement regarding their urban influence. This study aimed to analyze and measure the urban impact of these health projects on supporting sustainable urban development and reshaping the city's urban structure.

METHODS: The descriptive-analytical approach supported by spatial analysis using Geographic Information Systems (GIS) was adopted to evaluate the data. The study examined three major health projects—Imam Zain al-Abidin Hospital, Sheikh Ahmad al-Waeli Medical Foundation, and Warath International Foundation for Cancer Treatment—across five key urban indicators: accessibility, land-use patterns, urban expansion, infrastructure efficiency, and economic developmental impacts.

FINDINGS: The results revealed that 100% of the examined projects transcended their traditional healthcare roles to serve as active urban drivers. In terms of spatial transformation, the Warath International Cancer Foundation successfully directed 100% of its associated urban growth vector towards the northwest fringes, significantly increasing regional connectivity. Furthermore, the analysis of the five urban indicators confirmed substantial, measurable improvements in healthcare delivery rates, infrastructure system capacity, and the revitalization index of local economic and service activities surrounding the project zones.

CONCLUSION: These findings provided urban planners and policy-makers with empirical evidence demonstrating that health-oriented projects served as essential pillars for sustainable urban development. The integration of GIS-based spatial indicators proved effective in evaluating how healthcare infrastructure transformed land-use patterns, enhanced urban environmental conditions, and stimulated localized economic development...

Keywords: Health services, sustainable urban development, major health projects, geographic information systems (GIS), urban impact, the Holy Shrine of Imam Hussein, the city of Karbala, accessibility, land use, urban infrastructure.

Introduction

Contemporary cities are undergoing rapid urban transformations as a result of population growth and increasing urban expansion, which poses significant challenges for planners in providing essential services and achieving sustainable urban development. Health services are among the most critical components of urban infrastructure due to their pivotal role in improving quality of life and promoting social and economic stability, as well as their direct impact on the organization of urban space and the direction of urban growth patterns.

The role of health institutions is no longer limited to providing medical care; rather, in many global contexts, they have become active agents in urban development due to their ability to attract investment and associated service and economic activities, making them (Anchor Institutions) that contribute to reshaping land uses, improving infrastructure efficiency, and enhancing local development opportunities. This shift in perspective regarding health projects has led to their being viewed as influential planning tools in guiding urban growth and achieving a balance between the urban, social, and economic dimensions of sustainable development.

The city of Karbala is one of the Iraqi cities that has witnessed, in recent years, the implementation of a number of major health projects affiliated with the Holy Shrine of Imam Hussein, which represent important models of

health facilities with broad spatial and functional impact. These projects have contributed to enhancing the level of health services, as well as having urban and developmental impacts on the surrounding areas by improving accessibility, developing infrastructure, revitalizing economic and service activities, and directing urban expansion toward new areas within the city.

Based on these findings, this study aims to examine and analyze the urban impact of the health projects affiliated with the Holy Shrine of Imam Hussein in the city of Karbala, by utilizing Geographic Information Systems (GIS) and analyzing a set of urban and development indicators, with the aim of revealing the extent to which these projects contribute to supporting sustainable urban development and reshaping the city's spatial structure, leading to a set of findings and recommendations that can be utilized in guiding future planning policies

1. Research Problem:

The problem centers on the short-sighted approach to planning hospitals as isolated medical facilities, overlooking their role as “anchor institutions” capable of reshaping the urban landscape and guiding land use. This shortcoming leads to uncontrolled urban growth and an imbalance in land uses in the areas surrounding these projects.

2. Research Hypothesis:

The research suggests that strategic investment in similar projects as the ones discussed in Al-Hussein Health Hub Projects such as the Imam Zain al-Abidin Hospital and Warith Foundation will become a catalyst to sustainable development via improved access and infrastructure as well as changes in the use of land.

3. Research Objectives:

- analyze the urban impact of health projects affiliated with the Holy Shrine of Imam Hussein in the city of Karbala and to highlight their role in supporting sustainable urban development.
- assess accessibility to the health projects under study and analyze the impact of their spatial locations using Geographic Information Systems (GIS).
- study the impact of health projects on changes in land use and the reshaping of the urban fabric of surrounding areas.
- evaluate the role of health projects in developing infrastructure and stimulating economic and service-sector growth within the city of Karbala.
- derive a set of indicators and planning recommendations that contribute to strengthening the role of major health projects as drivers of sustainable urban development.

1. Theoretical aspect:

1.1. Health Services and Their Role in Urban Planning:

Health services are significant components of contemporary cities because they have evolved into indispensable features of the urban infrastructure that facilitates quality life. Apart from the fact that they form a key component of the current-day healthcare infrastructure, health services have also acquired extra significance on account of their economic and urban dimensions. (Barton, Grant, & Guise, 2010, p. 45).

As per recent literatures regarding urban planning, it can be seen that health facilities have been grouped under what is called social infrastructure which acts as an important factor behind urban stability by facilitating the equitable provision of various amenities to the population residing within the city. (UN-Habitat, 2020, p. 67).

1.2. Health Services

Health services are defined as a set of organized activities aimed at promoting human health, preventing and treating diseases, and providing rehabilitation; they include hospitals, health centers, specialty clinics, and various medical support facilities (World Health Organization, 2010, p. 12).

From a planning perspective, health services are also viewed as a spatial element within the city, distributed according to criteria related to population density, accessibility, and transportation networks, making them part of the spatial system that determines the distribution of activities within the city (Geurs & van Wee, 2004, p. 130).

1.2.1. Levels of Health Services in the City

The organization of health facilities within cities is characterized by a hierarchical system depending on the nature of service delivery and its range; it may be divided into three major categories:

A. Primary Healthcare Services:

This comprises basic healthcare facilities that are provided locally to the population, emphasizing preventive measures (World Health Organization, 2010, p. 18)

B. Secondary health services:

These include general hospitals that provide intermediate specialized services and serve a wider range of the population.

C. Specialized health services:

These include advanced hospitals and major specialty centers, which have a broad urban impact due to their ability to attract related economic and service activities (World Bank, 2014, p. 95).

This last category is considered the most influential in shaping the urban landscape, given its large scale and the nature of the services it provides.

1.2.2 The Relationship Between Health Services and Urban Structure.

Health care systems are closely related to urban structures since health care systems affect the distribution of population, the utilization of land areas, and transportation systems in the city. Studies show that the existence of large hospitals leads to a transformation of urban spaces in terms of creating economic activity, services, residential areas, etc. (pharmacies, laboratories, etc.) (Barton et al., 2010, p. 52).

Urban studies in the current context emphasize that the achievement of urban resilience is based upon the integration of infrastructure, natural environment, and society, hence contributing to the adaptation and sustainability of the city, implying the relevance of integration in improving the effectiveness of urban services, including health services, and that Geographical Information System is one of the means that help in analyzing the relationship between urban development and health services through measuring the accessibility levels and examining the spatial impact of health projects on urban spaces (Khashoggi & Murad, 2020).

1.2.3. Health Services as a Tool for Sustainable Urban Development.

Within the context of sustainable development, health services have an important role in establishing the balance between the social, economic, and environmental aspects of development since they are responsible for the improvement of population health and economic productivity. Additionally, the World Health Organization indicates that the integration of health services within urban planning is the key component that leads to healthy and sustainable cities if it is linked to the transportation systems and distributed evenly among different parts of the city (World Health Organization, 2020, p. 34).

The fast rate of urban changes in cities is due to the urban sprawl phenomenon, which reduces the effectiveness of urban tissue and causes a shift in the distribution of urban functions. Thus, there is a need for planning strategies that can help organize and improve urban tissue in terms of its effectiveness and performance through the use of project plans such as the health project plan as a strategy for improving the urban fabric and urban growth. (Mohammed and Hadi, 2011, p. 1)

1.3. Major Healthcare Projects as Urban Drivers

Literature in the recent past has identified the ability of major healthcare projects to go beyond the ordinary scope of their duties by acting as active agents in steering urban development through shaping the urban environment. Such healthcare projects are classified under "anchor institutions," which refer to investments that attract capital, create employment opportunities, and stimulate economic development (World Bank, 2014, p. 101).

Based on studies conducted recently, such investments seem to directly impact the growth of urban and service activity in areas surrounding the projects, depending on the geographical location of the projects within the cities and the type of land usage (Kucukpehlivan et al., 2023).

Catalytic elements are important instruments that facilitate the transformation of space and functions in the urban context since they attract activities and help redefine the relationships among the city's elements (Abdul Amir & Al-Kanani, 2024, p. 168).

Health Services Concept: This concept encompasses all types of organized efforts directed towards maintenance, prevention, and treatment of human health. There are various forms of health service facilities based on the degree of organization starting from primary services (health centers) to more complex tertiary and quaternary services (large specialized and scientific hospitals) which serve as growth poles within urban areas.

Urban Sustainable Development Concept: It is the concept of integrated urban growth which seeks sustainable economic development and environmental protection in urban areas in addition to social justice. It requires some fundamental dimensions for its sustainability:

- Urban (spatial) dimension: Emphasizing mixed land use planning and appropriate urban density.
- Social dimension: Guaranteeing spatial equality concerning availability of services by all segments of the urban community.
- Economic dimension: Functioning of hospitals as "anchor institution" providing job opportunities.

Large Hospitals as Urban Growth Poles: The literature shows that large hospitals are urban growth poles. They bring additional services and facilities (pharmacies, laboratories, hotels) in addition to development of transport and other urban services around the hospital.

2. Spatial Analysis of Health Projects in the City of Karbala

The goal of this chapter is to measure and examine the influence of three innovative health projects on the city of Karbala as a holy city, which were created under the auspices of the Holy Shrine of Imam Hussein. This study will endeavor to measure the effects of these three developments on being "drivers of sustainable urban development" through the use of a combination of quantitative spatial analyses conducted using GIS software as well as descriptive analysis.

2.1. Selected Health Projects and Their Geographic Locations

Health facilities used for comparison included three projects that vary widely in their spatial and functional roles within the city's urban context to assure reliability in the comparative analysis:

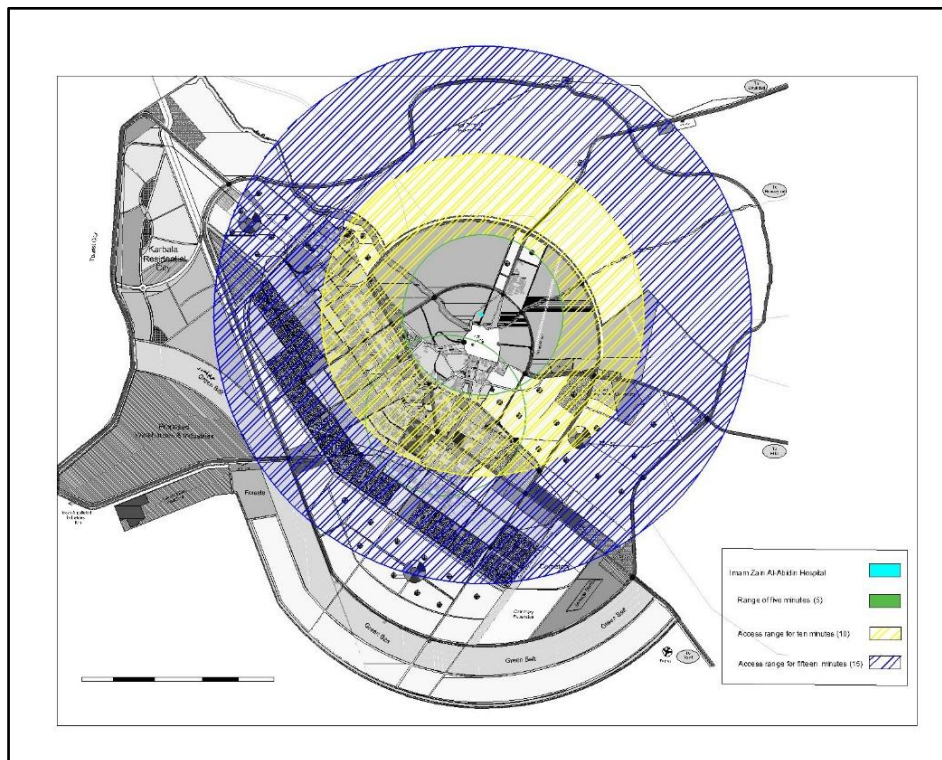
1. Imam Zain al-Abidin Hospital (peace be upon him): Found within a central urban location/near the city center, this hospital is a general hospital and is multidisciplinary with focus on densely populated areas.
2. Sheikh Ahmad Al-Waeli Medical Foundation: Located within the Al-Iskan area (semi-central area), this hospital comprises two hospitals named Sayyida Khadija Hospital and Imam Al-Hasan Al-Mujtaba Hospital, specializing in hematological disorders and women's health.
3. Warath International Oncology Center: Found at the fringe of the city (Zone 3), located on the road connecting Karbala with Al-Har, specializes in oncological care.

2.2. Applied Analysis of Urban Indicators

2.2.1. Accessibility Index

This isochronous index depends on a study on the efficiency of travel time through the roads of the healthcare facilities and population accessibility to those facilities. Isochronous mapping has been done for travel time ranging from 5, 10, and 15 minutes and the findings show that:

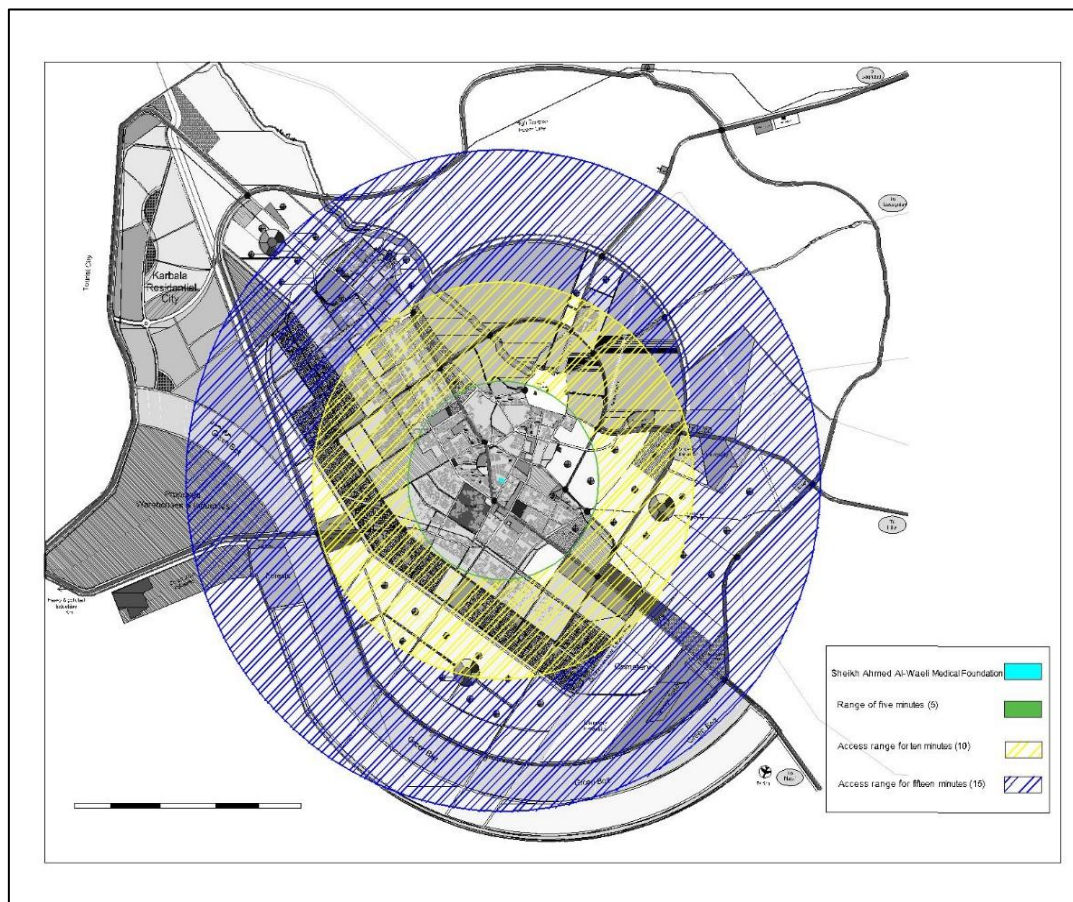
1. Imam Zain al-Abidin (A.S.) Hospital: It provides access to the central part of the urban areas where there are buildings with high density and population with a 5-minute travel time. This travel time up to 15 minutes includes most of the urban parts of the city apart from the distant southern area. As shown in Map No. 1 below



Map (1) Accessibility of Imam Zain al-Abidin Hospital

Source: Prepared by the researcher based on an analysis of the road network using Geographic Information Systems (GIS).

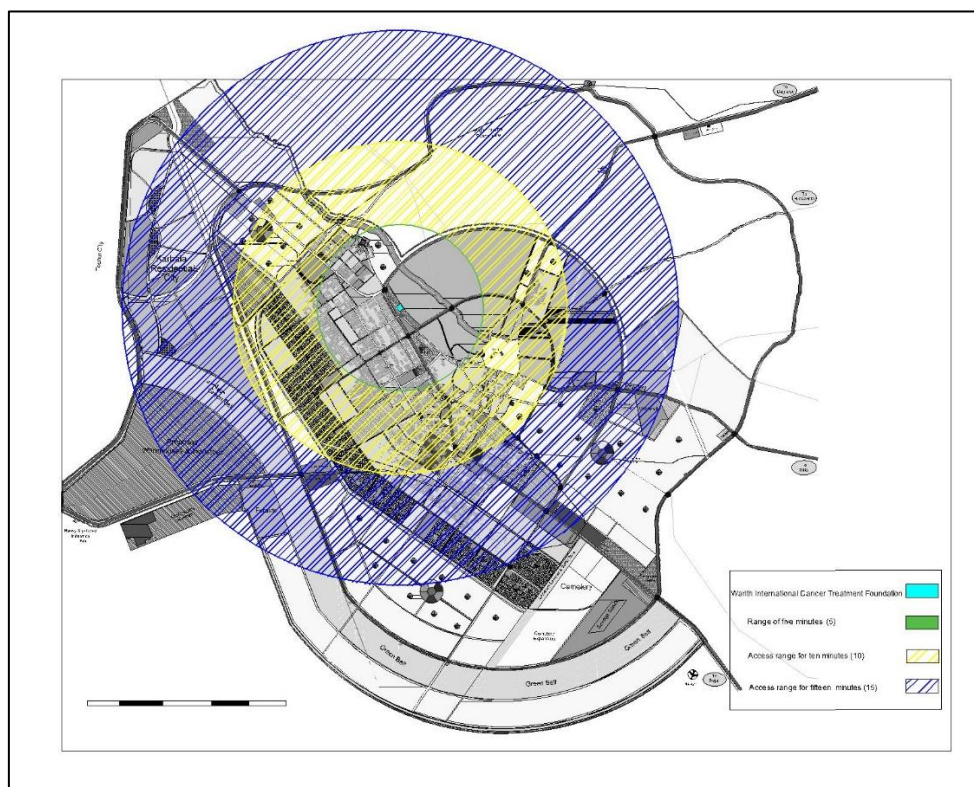
2. Sheikh Ahmed Al Waeli Medical Foundation: Situated in a flourishing medical environment (Al-Iskan area), surrounded by several hospitals and laboratories. The foundation's catchment area, for the purpose of 5 minutes, serves a semi-central area whereas, for the 15 minutes radius, the whole of urban area comes into its functional scope. See Map 2



Map (2) Accessibility of the Sheikh Ahmed Al-Waeli Medical Foundation

Source: Prepared by the researcher based on an analysis of the road network using Geographic Information Systems (GIS)

3. Warath International Oncology Foundation: According to the analysis carried out, the initial catchment area is limited within the northwestern fringes and Al-Har Road. The 15 minute catchment area allows the health care provider access to major roads and highways (e.g. Baghdad – Karbala highway) thus making the facility accessible regionally even for patients arriving from outside the province without creating traffic in the downtown area. See Map (3)



Map (3) Accessibility of the Warath International Oncology Center

Source: Prepared by the researcher based on an analysis of the road network using Geographic Information Systems (GIS).

Based on the spatial analyses and the specific time horizons defined for the three projects, the volumetric and spatial comparisons of these time horizons (5, 10, 15 minutes) to demonstrate the urban coverage efficiency of each project individually. Table 1 illustrates this detailed comparison and the comprehensive evaluation criteria for each time interval.

Table (1) Comparison of Time Horizons for Health Projects

Overall Assessment of Accessibility	-15minute service area	-10minute delivery radius	-5minute drive	Health Project
High-altitude / Urban interior	It covers most of the city except for the outlying southern neighborhoods	covers a wide range of urban neighborhoods	Covers the city center and high-density neighborhoods	Imam Zain al-Abidin Hospital
Very broad / Comprehensive	Covers a large area of the city in a reasonable amount of time	It extends to large parts of the paracentral tissue	Covers the Housing District and the immediately adjacent neighborhoods	Sheikh Ahmed Al-Waeli Foundation
Regional Foreign Policy	Extensive and well-connected to the regional network and road system	extends to include the western urban area	Limited and restricted to the Karbala-Al-Har Road and outlying areas	Warath Cancer Foundation

2.2.2. Urban Expansion Index (Urban Expansion)

- Peripheral Expansion via Guidance: With the help of the Warith Cancer Foundation, peripheral expansion took place in an orderly fashion in the northwest direction (Karbala-Al-Har axis) in the case of Karbala, unlike any other unorganized expansion.

- Building Density: The urbanization activities carried out inside the city (Zain al-Abidin and al-Waeli) have improved land use efficiency and building density in semicentral regions.

2.2.3. The "Building Height" and "Land Coverage" Indicators (Building Height & Land Coverage)

- Characteristics of Building Height: The newly constructed medical facilities are characterized by tall buildings consisting of many floors and also modern architectural designs. This means that their construction has changed the skyline of the area due to the modern architecture that is different from those of the surrounding areas.

- Efficiency in Land Usage: There is evidence of efficiency in the usage of land based on the plans, which ensured even distribution of land between the hospital buildings and the open spaces for parking among others.

2.2.4. The Job Opportunities and Local Economic Development Index

The hospitals act as true economic drivers for the city by:

- Generating jobs directly through the provision of numerous job opportunities for health care professionals, nurses, and technicians.

- Generating jobs indirectly, such as through the supply chain, the transportation industry, and hotels due to the influx of tourists seeking treatment within the city, especially those arriving from other provinces in the country or abroad.

2.2.5. Indicator of Improved Infrastructure Efficiency Around Projects

The building of the following projects was followed by actual development within the infrastructure of the locality as follows:

- The widening and paving of roads leading into and around the project area, complete with adequate lighting and flexible traffic junctions.

- The improvement in water supply, storm drains, and sewers, which are then connected to uninterrupted power lines (except for the emergency power lines), improving the infrastructure efficiency of the nearby residential areas where the projects were built.

2.3. Final Comparative Assessment Matrix of Urban and Developmental Impacts

Based on the numerical data and previous geographic analyses, the matrix below summarizes the comprehensive analytical comparison of the urban impacts of the three projects: see Table (2)

Table (2) Comprehensive analytical comparison matrix of the urban impact of the three projects:

Warath International Cancer Foundation	Sheikh Ahmed Al-Waeli Medical Foundation	Imam Zain al-Abidin Hospital	Urban Impact Index
Regional access (ideal for serving provinces and foreign delegations)	Comprehensive access (close ties to surrounding clinics and centers)	Direct urban access (highly efficient for local residents)	Type and Nature of Accessibility
Converting vacant and agricultural land into attractive developed areas	Formation of a Health Consortium) Medical\ Cluster (Within the urban fabric	Converting the surrounding residential area into a high-density commercial/medical services zone	Impact on land use
Creating a distinctive contemporary urban landscape on the outskirts of the city	Updating the Architectural Style of the Semi-Central Housing Area	Add a prominent landmark and harmonious vertical lines	Impact on the horizon) Skyline(
Opening new road corridors and improving infrastructure in outlying areas	Highly integrated service lines and continuous, stable power supply	Improving the efficiency of internal roads and surrounding utility networks	Level of infrastructure support
Supporting medical tourism and attracting significant investment in infrastructure and services	Providing specialized medical services and supporting private clinics	Revitalizing local markets near the city center	Economic and Developmental Impact

This practical case study showed that the health projects connected with the Husseiniya shrine in the city of Karbala have ceased to be simple institutions responsible only for giving medical assistance and have instead turned into planning instruments playing a significant role in the process of reshaping the urban area and implementing sustainable urban development. Central projects (Zain al-Abidin and al-Waeli) have managed to overcome a gap in services in the densely populated environment and increase the effectiveness of the existing local infrastructure, whereas peripheral project (Warith Foundation) spearheaded urban growth towards city fringes.

3. Conclusions

1. As evidenced by the study, the healthcare facilities related to the Holy Shrine of Imam Hussein do not only provide medical services but have also become powerful urban factors that contribute to directing urban development and shaping the new structure of the city of Karbala.
2. According to the accessibility analysis, Imam Zain al-Abidin (A.S.) Hospital and Sheikh Ahmad al-Waeli Medical Foundation have high access to urban space, which increased the effectiveness of providing healthcare services for people living in central and semi-central locations.
3. Based on the analysis, the Warath International Oncology Center can be considered an important regional resource because its location at the periphery helped meet the needs of patients from other provinces and reduced the burden on the central part of the city.
4. The effect of health facilities investigated was observed through significant changes in the types of land use around the facilities since they attracted commercial, service, and medical facilities, which increased the functional efficiency of these territories.
5. It was found that such projects played an important role in improving the efficiency of urban infrastructure through the formation of road networks and providing basic services and increasing spatial connectivity between different zones of the city.
6. The healthcare projects were able to contribute to the stimulation of the local economy through providing both direct and indirect jobs in addition to stimulating the sectors related to health services and health tourism services.
7. Such study proved the potential role that could be played by significant health projects as anchor institutions to achieve sustainable urban development in the framework of urban planning vision of cities.
8. Through such study, there emerged the necessity to increase the linkages between health projects and urban planning policies to maximize their developmental impacts and spatial equilibrium of service distributions.

4. Recommendations

Recommendations:

1. Integrate major health projects into essential components of future urban developments and plans for the city of Karbala, rather than considering them as health facilities independent from urban development planning processes.
2. Work on coordinating efforts between health, planning, and municipality sectors to make sure that urban developments take place through the health project facilities in a systematic and sustainable way.
3. Construct transport systems and roads to connect major health projects to increase the connectivity of these facilities while reducing traffic problems in the present and future.
4. Encourage the formation of medical and other service clusters adjacent to major hospitals to improve efficiency and integrate functionally within the city.
5. Expand the application of Geographic Information Systems (GIS) in the health sector and city planning process in the assessment of accessibility factors and future requirements for health facilities.
6. Facilitate investments in the areas of medical tourism and associated health facilities in order to enhance the economic significance of health ventures and encourage the diversification of sources of development within the region.
7. Guide future expansion to areas with modern infrastructures and health facilities so that unnecessary expansion will be minimized and the utilization of space maximized.
8. The undertaking of future research projects on the effects of large-scale health projects in terms of their social, economic, and environmental impacts....

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References

1. Abdul Amir, Marwi Alaa, and Al-Kanani, Amer Shaker Khudair. (2024). The Impact of Stimulating Elements on the Future Urban Landscape (A Case Study of Baghdad). *Journal of Planning and Development*, 29(1), p. 168.
2. Mohammed, Maysa Nazara, and Hadi, Ihsan Sabah. (2011). The Optimal Approach to Dealing with the Old City Center of Najaf. *Journal of Planning and Development*, 23(1), p. 1. Ahasan, R., & Güneralp, B. (2022). Transportation in urban land change models: A systematic review and future directions. *Journal of Land Use Science*, 17(1), 351–367. <https://doi.org/10.1080/1747423X.2022.2086639>
3. Alnajar, A. A. M., & Al Nedawe, Z. A. I. (2024). Analyzing the climate characteristics of Khanaqin city using Thom's equation to derive the ideal tourist climate for sustainable tourism development. *AIP Conference Proceedings*, 3105(1), 050107. <https://doi.org/10.1063/5.0212797>

4. Jedi, Z. A. J., & Al-Jawari, S. M. (2023). Prediction of Formal Transformations in City Structure (Kufa as a Model) Based on the Cellular Automation Model and Markov Chains. *International Journal of Sustainable Development & Planning*, 18(5):887.
5. Barton, H., Grant, M., & Guise, R. (2010). *Shaping neighborhoods for local health and global sustainability*. Routledge
6. Yusr, Haider Kamel Mushtat, "Solid Waste Management and its Role in Protecting and Improving the Environment / Strategic Vision / Case Study of Rashid Municipality", Diploma Research in Strategic Planning, Faculty of Management and Economics, University of Baghdad, 2016.
7. Al-Khafaji, Hussein Reda Said, "Solid Waste Management using Geographic Information Systems, (Applied Research in Hilla Municipality Directorate)", Higher Diploma Research, Faculty of Administration and Economics, University of Baghdad, 2017
8. United Nations Human Settlements Programme (UN-Habitat). (2020). *Urban Indicators Guidelines*.
9. Geurs, K. T., & van Wee, B. (2004). Accessibility evaluation of land-use and transport strategies. *Journal of Transport Geography*, 12(2), 127–140
10. Biu, A., et al. (2024). GIS in Healthcare Facility Planning and Management: A Review. *World Journal of Advanced Research and Reviews*
11. Kucukpehlivan, T., et al. (2023). Determination of the Impacts of Urban-Planning Implementations on Urban Amenities Using GIS. *Computers, Environment and Urban Systems*
12. UN-Habitat. (2023). *Urban October Report 2023*. United Nations Human Settlements Programme.
13. World Bank. (2014). *Urban Development Overview*.
14. World Health Organization (WHO). (2010). *Health Systems Strengthening Glossary*.

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