Evaluating the Distribution of Health Services in Nasiriyah City By Utilizing Geomatics Techniques

Khaldoon T. Falih¹, Ali Salah. J. Al.Saedi ²

¹ Petroleum Engineering College, Al-Ayen University, Dhi-Qur, Iraq
² Surveying Department, Technical Institute of Amara, Southern Technical University, Misan, Iraq

khaldoontalib@gmail.com

Abstract: The growth of cities is one of the most important global phenomena, which is occurring under the influence of environmental factors on the human, economic and political, and giving services to citizens and the city are of the priorities of the urban planners and managers. To accomplish this, a variety of techniques have been used both classical and modern the use of quantitative methods in problems locating utilities increased and each of these methods in addition to the advantages and disadvantages in this field is used to study how the spatial distribution of health facilities in Nasiriyah city, has been studied as the case the system uses a multi-criteria analysis. The issue of site selection, service, and service centers in the city is better. The purpose of this study is to evaluate the efficiency of the current distribution of health services by using GIS and Population criterion is analytical and descriptive methods and the type of application. To achieve this objective the integration of GIS and hierarchical method (AHP) and GIS was used, the required layers, including the proximity to compatible land uses, access to the Road network, population density, Spatial distribution, Create an integrated database of health service sites to be established in the future to assist decision-makers and planners to for take decision-making. After conducting the analysis using the two criteria (population density and Spatial distribution ), the results were found, most of which was the apparent deficiency in the current health services, the city's need for various types of health services.

Keyword: GIS, Spatial Distribution, Public Hospital, Specialist Centre, Sattelite Image, Health center, Health Services,

1 Introduction:

The process of determining the efficiency of the distribution of services in the cities of the most important topics and the distribution of these services in an optimal manner taking into account all spatial dimensions, social, economic, and behavioral [1]. Geomatics engineering techniques are based on criteria for evaluating the spatial distribution of health services and selecting optimal spatial locations for services, which are adopted through the largest area covered by these services and
accessibility [2]. This study presents a model for the treatment and distribution of health services in the civil society, which can be generalized in the treatment of the rest of the services, and represents the possibilities of preparing the distribution model of health services, study the reality of distribution and efficiency compared to the distribution criteria to get to the appropriate maps and propose the new sites for services that will arise.

2 Case Study

The study area is the urban districts of Nasiriyah city is the capital city of Dhi-Qar Governorate in the southern of Iraq. is located at zone (38 N) according to UTM (Universal Transverse Mercator) geographic coordinate system between latitude (30°40' 00" to 32° 00' 00") north and longitude (45°40' 00" to 47°10' 00") east, The area of Dhi-Qar is (1277 sq. km) representing (31%) of the total area of Dhi-Qar Governorate, As shown in the figure (1). [3].

![Fig (1): Nasiriyah districts (Directed by researcher)](image)

3 Problem Statement

The main objective of the research is to address the problems related to natural planning issues to develop health facilities, in terms of location, distribution and levels in the light of the system of urban clusters, especially this starting point in the planning of health services in the city of Nasiriyah. We find natural planning of health services follow the views wishes, personal desires and achieve goals without considering the future status of the city.

4 Research hypothesis

Since the problem is to prepare a model for the distribution of health services in the city, the hypothesis will be summarized as follows:
1- The distribution of health services in the province after the regularity with the planning standards of the modern urban management of cities

2- The possibility of using geometrical engineering techniques to solve these problems because of its accuracy, speed and objectivity

3- The possibility of matching the maps Layer of the standards to get the optimal distribution of the signing of health services.

5 Aim of the study

Depending on the problem and hypothesis of the research, the research aims to:

1- Evaluate the efficiency of the current distribution of health services in the city using the GIS program and using GPS to prove the importance of spatial planning and optimal regional planning for services.

2- Examining the compatibility of health service sites with internationally accepted standards.

3- Create an integrated database of health service sites to be established in the future to assist decision-makers and planners intake decision-making.

6 Research Methodology

![Research Methodology Diagram]

**Figure 2:** Research Methodology (Directed by researcher)
7 Demographic description

The health services in Nasiriyah have been affected by the increasing population size, which reached (442829) thousand in 2006. This increase is also reflected in the increasing number of residential sectors with 111 residential districts and its area (1277 Km²). This increase is offset by the lack of development in health services according to international standards. According to future population projections, as shown in Table (1) and Figure(3), we will notice a significant increase in the population, which requires studying the health situation in the city to establish new hospitals and health centers to cover population numbers in an optimal manner [4].

| Year | Population (people) | Population increase (people) |
|------|--------------------|----------------------------|
| 2006 | 442829             | ----                       |
| 2010 | 501290             | 58461                      |
| 2014 | 567468             | 66178                      |
| 2018 | 642383             | 74915                      |
| 2022 | 727188             | 84805                      |

Figure (3): population projected increase in Nasiriyah city 2006-2022

8 Health Care planning

8.1 Health Care planning depend on Population

The classification of health facilities has been simplified in the interests of clarity and in practice, the size of the facility and the range of services available will vary according to local circumstances. Therefore the number of hospitals and health centers could be calculated by dividing the population of each city or district by the size of the population to be served depending on criteria [5,6]. As indicated above, the short term priority in the Dhi- Qar governorate is to improve the quality and range of services available, particularly at Nasiriyah hospital. This will require attention to staffing
levels, equipment and medical stocks, as well as improvements to local health facilities, Table (2) shows the proposed hierarchy of health facilities and its relationship to the settlement hierarchy [7].

**Table (2):** Hierarchy of health facilities

| Facility            | Location            | Population served | Typical size and range of service                                                                 |
|---------------------|---------------------|-------------------|--------------------------------------------------------------------------------------------------|
| Regional hospital   | Regional Center     | 20,000-25,000     | 400 -300 beds, able to deal with practically all medical problems, regional training facility    |
| district hospital   | Designated town     | 150,000-300,000   | 50-20 beds, wide range of medical services, some on a seasonal basis, referral hospital for health centers |
| Health center       | Village cluster and neighborhood | 5,000–15,000 | No beds; base for PHC, maternal and child health services, public health and outreach programs; larger centers may have dental, x-ray, lab and pharmacy facilities |

**8.2 Health Care planning depend on Plot Area**

Planning standards for health facilities that were reviewed are all quite similar. They have categorized a range of health facilities from the local to the regional facilities. The plot size allocations are all similar and range from (3000 to 180000 ) meter square. The existing health care system in Iraq requires an emphasis on primary health care facilities to ensure equitable access to health facilities for the population of Nasiriyah. While public health facilities are of primary concern, it is important to ensure adequate standards for private health care facilities are included. This will allow for growth and a variety of facilities for the population. Additional allocations for Ambulance Stations must also be considered since the Iraqi standards reviewed only had allocations of (12000 m²) for this type of facility at a town level. Health Care facilities can be categorized into three types to be used as the basis for the allocation of plots. To ensure continuity plot sizes will be similar to the previous Iraqi allocations [7].

1- Primary Health Care (Neighborhood)

2- Secondary (District)

3- Tertiary (Quarter/City)

Private and public facilities will be allocated the same plot sizes to ensure that an equitable allocation. The plot size for an Ambulance Station is allocated based upon previous standards; however, the requirements for this need to be monitored as the project city areas expand to ensure adequate and timely coverage.
Table (3): Criteria of plot area for health facilities

| Category     | Sub-category                                      | Plot Area (m²) | Indicative Catchment |
|--------------|---------------------------------------------------|----------------|----------------------|
| Primary      | Public Primary Health Centre                       | 5000           | Neighborhood         |
|              | Private Health Clinic                              |                |                      |
| Secondary    | Public Hospital                                    | 50000          | Quarter              |
|              | Private Hospital                                   |                |                      |
| Tertiary     | Regional Hospital                                  | 50000          | City                 |
|              | Specialist Centre (e.g. Mental Health Unit)       | 19000          |                      |
| Ambulance Station |                                              | 25000          | District             |

From the above criteria, we can develop a research abstract which will be the principle used in the analysis as shown in Table (3).

To summarize the criteria for health services from (the covered population ratio, the required space for these services and the covered distance by type of health facility) Table (4) was created.

Table (4): Summary of criteria health services

| Category     | Population served | Plot Area (m²) | Coverage of services (Km) |
|--------------|-------------------|----------------|---------------------------|
| Public Hospital | 20,000-25,000    | 50000          | 20                        |
| Specialist Centre | 150,000-300,000 | 19000          | 30                        |
| Health center   | 5,000-15,000     | 5000           | 0.8                       |

9. Health services surveys in the city

The survey identified some 35 health care facilities in the city Distributed to (2 Public Hospital, 3 Specialist Centre and 30 Health center ). In relation to these important regional facilities, the indicated ratio is probably around 5 beds per 10,000 people at present, taking the population at 442829 people as estimated by COSIT for 2006. This is far less than internationally accepted norms and the targets envisaged by the Ministry. Nationally in Iraq, the ratio was 13 beds per 1,0000 people in 2005 and the average bed occupancy rate was 52.9%, although this varied significantly. (WHOSIS 2008) By way of comparison, both the USA and the UK have ratios over 30 beds per 10,000 people. Likewise in Iraq, there were some 7 doctors per 10,000 people in 2000-2006. However, in Nasiriyah city, the later ratio was probably around 5 per 10,000 people but this drops to below 2 per 10,000 people when the whole of the catchment area is considered. (WHO 2008) Both of these figures are much lower than the desirable ratio of 23-26 doctors per 10,000 people found in the developed world.[4]
Table (5): Some health indicators in Nasiriyah city

| Factor              | Public Hospital | Specialist Centre | Health center |
|---------------------|-----------------|-------------------|---------------|
| Building Area (m2)  | 12200           | 11598             | 93            |
| Employees           | 1928            | 219               | 344           |
| Doctors             | 211             | 57                | 93            |
| Patients            | 900             | 355               | 180           |
| Wards (Rooms)       | 420             | 71                | 124           |
| Halls               | 44              | 8                 | 12            |
| patients/doctor     | 4               | 6                 | 2             |
| patients/Wards      | 2               | 5                 | ----          |

Figure (4): Distribution of health services in the city (determine coordinates of health services by (GPS) and using the program of (GIS) for produced the map)
10. Evaluation of health services

10.1 Population criterion

Providing an appropriate number of public health facilities at each administrative urban unit is certainly the main concern of most health planners. Furthermore, analyzing health facility to population ratio is essential for every government to enable policy-makers to determine how best to meet the health basic needs of the population. Provider to population ratios also differs enormously both across rural areas and between rural and urban districts. The geographic aspects of the health delivery system have direct influences on the allocation of health resources. Thus, health service units should be geographically adeptly distributed according to population concentration and density. [6,10]

Health center

Based on this criterion, the required health center covers about (5000 to 15000) inhabitants by analyzing the number of health centers available in the city (30) health center we note a clear shortage in the number of health centers where if we perform the following calculations:

\[
\text{Population criterion} = \frac{\text{No. of population (2018)}}{\text{No. of health centers}}
\]

\[
= \frac{642383}{30} = 21412 \text{ inhabitants}
\]

From the calculations above we note the large shortage in the number of health centers, noting that the population is increasing with arrivals from outside the city, and therefore requires in the city about 30 other health centers to cover the health requirements of the population and be within the natural standards.

Public Hospital

With regard to public hospitals, international standards indicate that the number of served population is about (20,000-25,000), the local standard is about (1) public hospital to (100000) person. That city has (2) public hospitals, by conducting the following calculations:

\[
\text{Population criterion} = \frac{\text{No. of population (2018)}}{\text{No. of Public hospital}}
\]

\[
= \frac{642383}{2} = 321191 \text{ inhabitants}
\]

From the calculations above we note that a number of public hospitals it’s very few when compared with standard criteria, noting that the population is increasing with arrivals from outside the city, and therefore requires in the city about (20) other public hospitals to cover the health requirements of the population when compared to international standards, but depend on the local standard the city needed (4) public hospitals and be within the natural standards.
Specialist Centre

With regard to the Specialist Centre, international standards indicate that the number of served population is about (150,000-300,000) and that the city has (3) Specialist Centre, by conducting the following calculations:

Population criterion = \( \frac{\text{No. of population (2018)}}{\text{No. of Public hospital}} \)

\[ = \frac{642383}{3} = 214127 \text{ inhabitants} \]

From the calculations above we note that number of Specialist Centers its few when compared with standard criteria, noting that the population is increasing with arrivals from outside the city, and therefore requires in the city about (2) other Specialist Centers to cover the health requirements of the population and be within the natural standards.

10.2 Determine the efficiency of the spatial distribution

Determining the efficiency of spatial distribution is a very important topic, especially after the increasing development of computer systems. Transportation costs by reducing the distance from residential sites and diagnosing the current disadvantages in the distribution of these services.\[8,9,11\] A database was created within the GIS program which included several layers:

- satellite image Quick bird with Resolution (50 cm)
- The internal transport network is equipped with several parameters including (Street Width - Street Length - Street Name - Street Type .... etc)
- locations of health services by type (health center, public hospital and Specialist Centre)
- residential units in the city.

The Network Analyst (Service Area) tool was used to analyze the ability to determine the scope of services by using the distance factor that determines the areas that this service reaches or not.

Spatial distribution of health centers

The data mentioned above was used to analyze the distribution of health services (Health Center), where the coverage range was used for this type 800 meters as in Table (3) and the results as shown in the following map figure (5):
From the map we see a clear weakness of the distribution of health centers in the province and the small number when compared to the number of housing units and areas that need these centers are clearly shown on the map.
Spatial distribution of public hospital

Depend on Table (3) the coverage range was used for this type 20 km. The analysis process is demonstrated in map, figure (6).

Figure (6): Efficiency of spatial distribution for Public Hospital

From the map above and according to the spatial distribution was the distance factor in this type is very high, reaching a coverage range of only 20 km. These indicators note that city is fully covered regardless of the quality and potential of these public hospitals.
Spatial distribution of Specialist Centers

Depend on Table (3) the coverage range was used for this type 30 Km. The analysis process as shown in map, figure (7).

Figure (7): Efficiency of spatial distribution for Specialist Centers

The analysis of specialized centers showed that the current centers cover the city using the distance factor, but it is necessary to diversify these centers to cover the largest number of individuals in the community.
11 Conclusion

1- The population size in the city was estimated until 2022, and it became clear from the nature of the future population increase for the city that it will reach (727,188) people by the year 2022, which calls for expansion by developing health institutions.

2- There is a clear lack of health services in Nasiriyah, where the current it represents (30 health centers, 2 public hospitals, 3 specialized centers).

3- There is an imbalance in the spatial distribution that appears clearly in the completed analysis maps.

4- Upon analysis using the population factor, it was found that the city needs to be added (30 health centers, 20 public hospitals, 3 specialized centers)

5- When analyzing using the distance and coverage factor using GIS, it was found that the distribution of health centers was somewhat poor, and areas of poor distribution and shortage are clearly shown. As for general and specialized hospitals, they are distributed in a way that covers the entire province.

6- When comparing the two analyzes using the (population factor - distance and coverage factor) we notice that the results of the two analyzes are contradictory and the reason for this is that the city area to the large population is relatively few

12 Recommendation

1- Providing primary health services in the areas surrounding the Governorate Center to reduce the crowding of health services in the Governorate Center.

2- The need to increase the number of health institutions of all kinds in a way that guarantees the individual to obtain the appropriate amount of health services and according to a process of spatial distribution appropriate to the needs of the population and to reduce the average distance traveled in order to obtain the service.

3- Its necessary to use GIS technologies into health planning processes to integrate with the health data management system.

4- The necessity of guiding the planners and designers concerned in updating the basic plans, taking into consideration the criteria for signing services and land uses in signing health services and the rest of the services, taking into consideration planning at the level of the Neighborhood, district and City
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