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Locating Health and Treatment Centers (Hospitals) with a Passive Defense Approach; Case Study: Babol City

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Abstract

The application of the principles and requirements of passive defense in urban spaces and facilities has attracted special attention in the country. Health care service centers are one of the centers that are directly involved in ensuring the health of the individual and society. Since the duty of the hospital is to respond to its users and to treat them, and this response should be as complete and useful as possible, it is believed that the proper assistance, facilitating the access of patients to treatment places depends on the correct location of the hospital and quick and timely access to these centers is very important and necessary during crises.

In most cities, the lack of appropriate allocation of space and optimal placement of medical centers (hospitals) and the number of effective factors in the location of these centers has led to an increasing number of urban and citizen problems.

This research seeks to optimally distribute the use of medical services in the city of Babol by observing the rules of passive defense.

In this research, spatial data was prepared from digital and linear maps, and descriptive data was collected using statistics and field research and connected to the database. Then, for each of the influencing factors in the location of treatment centers (hospitals), related layers were prepared and the privacy of users was specified in each layer; the results of the integration of the information layers, the lands of the desired area for choosing the right place for healthcare use were divided into five categories: very excellent, excellent, good, average and poor, and finally the very excellent and excellent category lands for the construction of health-treatment centers were determined.

Keywords: passive defense, healthcare service centers, crisis, positioning

Introduction

Since the beginning of creation, man has always been dealing with all kinds of injuries and disasters. Our land, Iran, due to its special geographical and political situation, has always been exposed to all kinds of natural hazards and man-made threats, and has suffered heavy human casualties and financial losses. According to these conditions, paying attention to passive defense is one of the necessities of our country. Paying attention to the necessity of applying the principles of passive defense in the vital plans of the country will greatly reduce the vulnerability of the crisis.

Among the many components of disaster management in the health sector in unexpected events, the most important role is played by health and treatment systems, especially hospitals, as the main unit of providing services in the initial phase. Correct location for hospitals is of particular importance considering the type of use and the need for security and peace for the users of these spaces. Paying attention to the location of the hospital by respecting the neighbors, easy access, etc. to different urban areas, eliminating noise pollution is considered a necessity, which considering the principle of passive defense and using it to protect people, is a step that has been tried in this Research should pay attention to it.

In this research, spatial data was prepared from digital and linear maps, and descriptive data was collected using statistics and field research and connected to the database. Then, for each of the influencing factors in the location of medical centers (hospitals), related layers such as land compatibility, proximity to the center of regions, one to fire stations, access to first-class communication networks, distance from existing industrial workshops, proximity to regional parks, slope of the area and distance from the center of the neighborhoods were prepared; and in each layer, the privacy of users was specified; And by superimposing the mentioned layers based on specific patterns and criteria, it was analyzed and investigated.

Research Methodology

In this research, by using descriptive-analytical methods, as well as field observation and studying the plans made in relation to the city of Babul, the desired information has been collected, then the data was entered into the database and stored as different layers of information, and after analysis using the index overlap model, the right place to establish new health centers was determined.

Background Research

Although the provision of healthcare services in cities has a long history, there is no long history in locating healthcare centers. The idea of locating hospital centers was carried out by a person named "Leslie Mayhew" at Birk College, London and his main work has been the creation and development of a spatial model for predicting the flow of patients to the hospital, which resulted from changes in the supply and demand of non-hospital services. We can also refer to an article by Ortega Goetz at the University of Kansas entitled "The use of GIS in emergency management operations", which was published in the Journal of Urban Planning and Development in September 2000.

In the field of locating using GIS technique, it should be said that this technique has not yet found its proper place in Iran due to its import. However, studies have also been conducted in Iran in the field of localization of healthcare services, among which the following studies are among the most important related studies in this field:

1. Master's thesis of FarhadAlmaspour, entitled "Network, Spatial and Spatial Distribution of Pharmacies, Case Example: District 6 of Tehran", TarbiatModares University, 2010.
2. JafarShaali's article entitled "Spatial distribution of medical service centers in urban areas of Tehran" was published in the Journal of Geographical Research No. 38, October 2019.
3. Caesar Darabi's Master's Thesis with the title "Evaluation of Spatial Performance and Organization of the Distribution of Medical Services, Case Study: Shiraz City" in the Urban Planning Department of Shiraz University, 1384.

Hospital location standards

The establishment of health-treatment centers is required to comply with standards due to its special needs, so that these standards are different in relation to different cities and types of health-treatment units.

Different standards for health-treatment applications are as described in table number (1).

Table (1): location criteria and hospital usage adjacencies (at the regional scale)

Title	Specifications based on general criteria
To the service provider	1. At least 10,000 households 2. A maximum of 14,000 households 3. The population under coverage with an average capacity of 300 beds is 10,000 households
Access radius	The distance to residential areas is 1-1.5 km
per capita and required space	1. 1- The area required for each bed is at least 50 square meters, in general, 370 square meters and 1.73 hospital beds are required for every 1000 people. 2. For every 100 beds, at least 10,000 square meters, for each additional bed from 150 to above, 50 square meters will be added. 3. The minimum separation for the hospital is 25,000 square meters.
Type of communication	1. To be placed on 1st grade arterial streets
Design criteria	2. The maximum distance to residential areas is 2 km 3. The minimum distance from disturbing industrial workshops is 1 kilometer 4. It should be placed within the boundaries of 1st grade arterial streets 5. To be built on flat land 6. There should be no noise in production areas
Prioritize compatibility	7. Adjacent to the uses of the center of the region 8. Adjacent to regional greenery 9. Close to the fire station

Source: (Pourmohammadi, 1382: 61)

Analysis of findings

The following steps are required to implement the location of the optimal treatment space using the geographic information system:

1. Identifying influencing factors in locating medical centers;

Identifying and selecting the factors that influence location is one of the important stages of the study. Although these criteria can be different according to the influencing factors in choosing the right place for healthcare centers, 13 layers have been used in this research:

Green space: Green space is one of the neighborhoods suitable for health centers. This application has various functions such as environmental, which means it is used to control pollution and climatic factors such as sunlight, rain, wind and temperature; And it also has physical and psycho-social functions for citizens and users of this use.

Fire stations: Proximity to the fire station is considered an important advantage due to the faster service facilities of this user in times of unexpected incidents and critical and sensitive situations such as fire, war, earthquake, etc. In the table number, the amount of distance of firefighting compatibility is mentioned, and the layer of the firefighting station is also prepared based on it.

Cemeteries: In creating cemeteries, their position in relation to the future expansion of the city should be considered and the location of collective facilities such as hospitals should not be adjacent to cemeteries. The compatibility distance of the cemetery is mentioned in table number (3) and the compatibility map of the cemetery was formed based on it.

Military Centers: Military centers should be at least 5 kilometers away from the city due to the fact that they cause noise and crowding and create psychological stress for the users of both uses. The suggested distance is shown in table number (3) and the military layer is obtained based on it.

Passenger Terminals: Today, with the growing urban population and the necessity of urban and intercity travel, the role of passenger terminals in regulating urban traffic and especially creating facilities and speeding up passenger services is becoming more and more apparent.

Slope: In urban planning and in creating a building in the city, paying attention to the proper slope is very important. Determining the appropriate slope of hospital spaces in Babol city by using the existing height points of the city, interpolation operation and then reducing the error coefficient was done in GIS and finally the slope of the city was modeled.

River: Respecting the privacy of the river due to long-term return periods is one of the necessities of establishing human activities in the city. In order to determine the proper exploitation and use of the lands along the rivers, it is necessary to evaluate and determine the flooding area of the rivers and to know the flooding regime for floods of different intensities, and then make decisions about the use of urban lands. Therefore, the location of the hospitals has been applied to the Babol River.

fault: The most vital urban facilities should be built in the safest place on the ground and built with high resistance against effective urban processes. Land use planning should be followed with sensitivity according to the geological situation in construction operations and especially in the construction of hospitals for this purpose, the distance of the hospital from the fault is mentioned in table number (3) and the fault layer is also obtained based on it.

Access to the communication network: quick and timely access to medical centers is one of the basic needs of families. Because timely delivery of patients to these centers is of vital importance, and in this case, the possibility of increasing the casualties of patients is reduced. Therefore, proximity to first-class access has been the best option.

Centrality: Proximity to urban centers is one of the most important factors that plays a role in determining the optimal location for building a hospital; This means that the hospital should be located in a place in the region that provides easy access for the residents of the region and the entire city.

Population density: The population is considered as the main factor in the land use arrangement of the city, and mainly any use is directed towards the needs of the population of that city, so that with the increase in the population of the region, its compatibility increases and naturally, its adaptability decreases as the population decreases. In this research, the weighting was based on five classes, according to which the density of people per hectare was determined.

Useful functional radius: In order to determine the useful functional radius of the hospital on the scale of the urban area, based on the urban land use planning book, a distance of 1000 meters to residential areas was considered. The main thing we considered for the analysis is that the greater the distance to the hospital, the greater its compatibility.

Compatibility of urban land use

According to the existing uses in Babol city, the degree of compatibility of the uses with each other was determined and classified based on the land use map of the city and in some cases with field observations which is mentioned in table number (3) and map number (6).

Table (2): compatibility matrix of urban uses with the hospital

Components	Applications

Fully compatible	1- Offices 2- Barren lands 3- Vacant lands 4- Telecommunications 5- Gardens 6- Forests 7- Open spaces 8- Public green spaces 9- Parking lots 10- Fire stations
Relatively compatible	1- Healthcare 2- Health 3- Hospitality 4- Middle school 5- Abandoned
indifferent	1- Higher education 2- Market 3- Commercial-residential 4- Commercial 5- Agricultural land 6- Barber shop 7- Tare Bar Square
Relatively inconsistent	1- Historical centers 2- Religious 3- Cultural 4- Residential complex 5- Ruined 6- Water sources 7- Residential (under construction) 8- Sports
Completely inconsistent	1- Educational 2- Urban facilities 3- Water centers 4- Repair shop 5- River 6- Industrial 7- Airport 8- Animal husbandry 9- Residential 10- Old houses 11- River border 12- Warehouse 13- Passenger terminal 14- Military 15- Exhibition

Source: (Jamali et al., 2013)

2. Entering influencing factors into the GIS environment

In the phase of entering the influencing factors into the geographic information system, data acquisition, format changes, ground referencing, setting and documenting of data have been done.

3. preparation of new information layers;

In the stage of preparing a new layer of information according to the existing data and new information such as the distance from the densely populated centers of the city, the distance from the existing health centers and hospitals, the distance from the industrial centers, the suitable distance from the main roads and etc. conversion of land use mapping to raster map and creation of slope layer has been done.

4. Valuation of information layers based on distance and land use based on their economic value and appropriateness;

For the information layers of distance from green spaces, distance from fire stations, distance from the main communication network and distance from district centers, with increasing distance, less points have been awarded and with decreasing distance, more points have been awarded. for the layers of distance from industrial centers, distance from hospitals and health centers, the opposite of the above case is true, that is, with increasing distance, more points are awarded and with decreasing distance, less points are awarded.

Table (3): Layers used in the model and their priority

Components	Green space	Cemeteries	Fire stations	Military Centers	Terminals	Slope	River	fault	First class arterial	Useful functional radius	Centrality	Population density
Fully compatible	0-500	2000 upper	0-4000	4000 upper	1500 upper	0-3	300 upper	7000 upper	50-100	3000 upper	0-500	150 upper
Relatively compatible	500-1000	1500-2000	4000-8000	3000-4000	1000-1500	3-8	200-300	4000-7000	100-150	2000-3000	500-1000	100-150
Indifferent	1000-1500	1000-1500	8000-12000	2000-3000	500-1000	8-12	150-200	3000-4000	150-250	1500-2000	1000-1500	-------

Relatively inconsistent	1500-2000	300-1000	12000-16000	1000-2000	200-500	12-15	75-150	1000-3000	250-400	1000-1500	1500-2000	50-100
Completely inconsistent	2000 upper	0-300	16000 upper	0-1000	0-200	15-20	0-75	0-1000	400 upper 0-50	0-1000	Upper 2000	0-50

Source: (Jamali et al., 2013)

5. The final weighting of information layers based on the method of rating or proportional weighting and identification of prone areas for the establishment of medical centers.

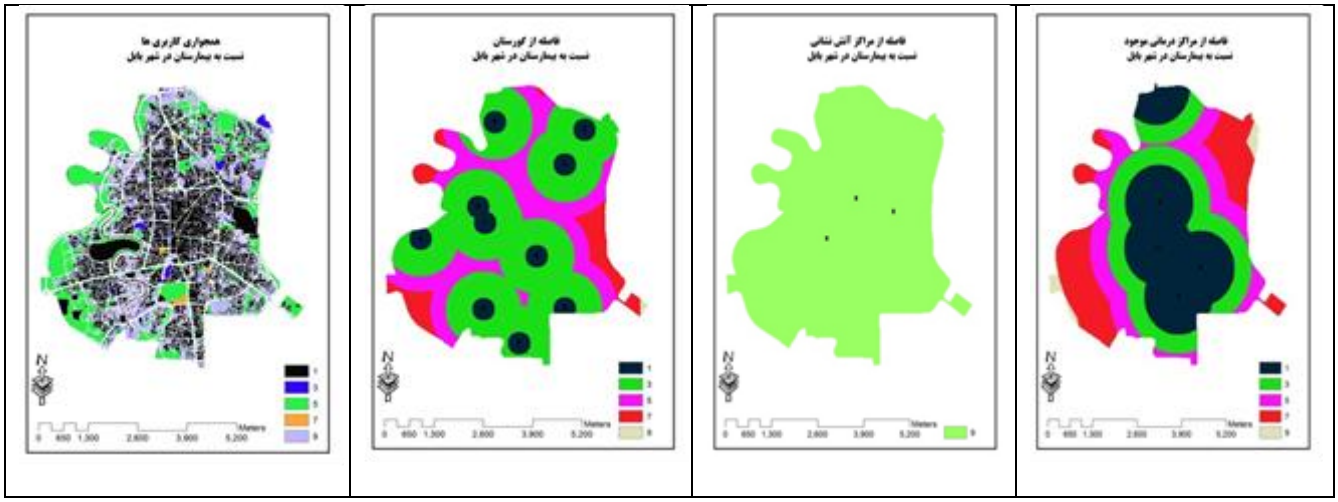
This step is to call the layers based on the level of influence. That is, based on the importance of each layer, they were weighted so that the total influence of the layers reaches 100. For weighting, the order of Table 3 and the opinion of experts have been used.

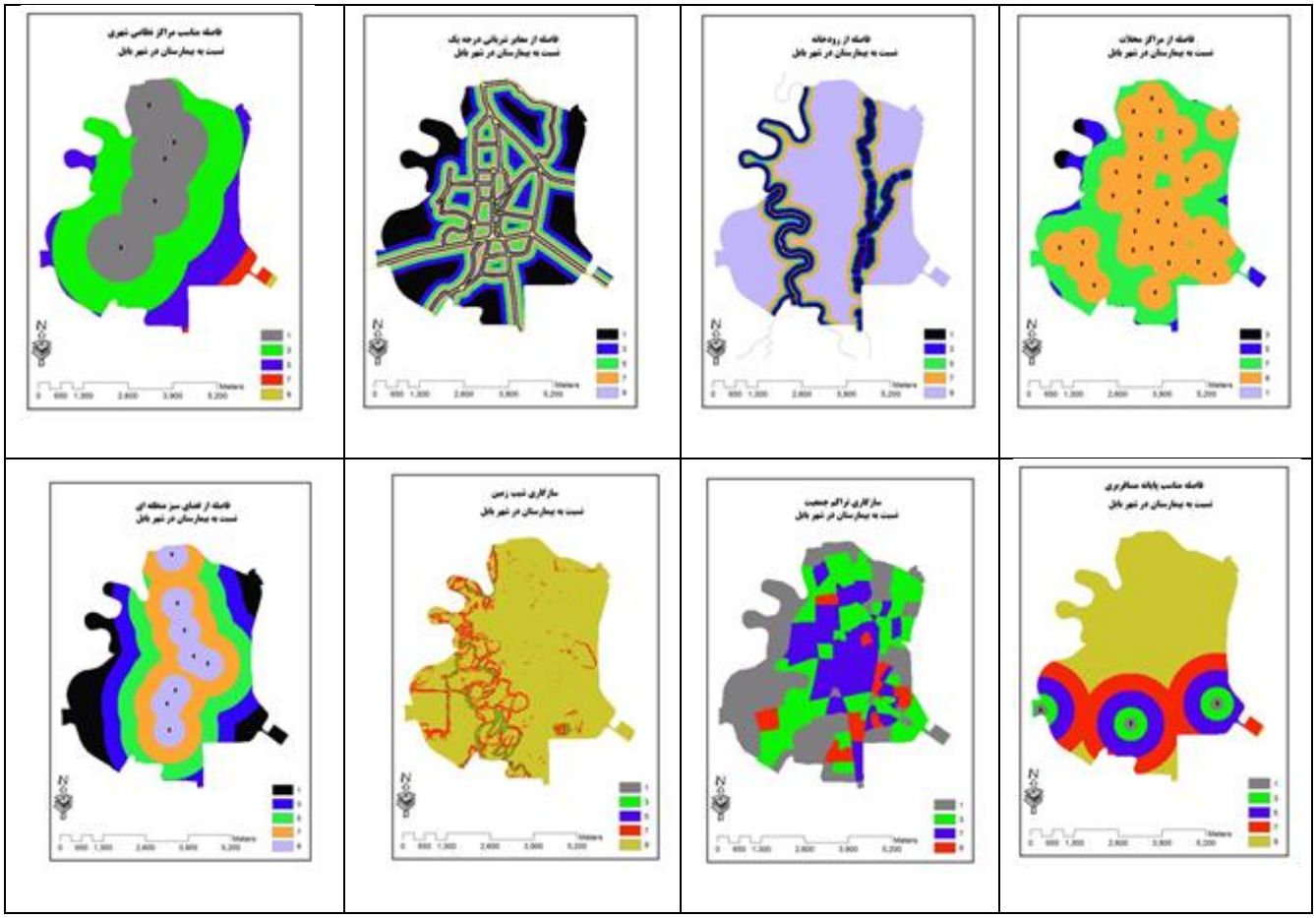
Table (4): The weight of the layers used in the overlap index method

Row	Information layers used in land suitability analysis	relative weight (percentage)	Row	Information layers used in land suitability analysis	relative weight (percentage)
1	Fire stations	5	8	Military Centers	5
2	Cemeteries	3	9	slope of the land	3
3	Fault	9	10	First class arterial communication network	11
4	Land use	25	11	river	2
5	Useful functional radius	10	12	terminal	4
6	The factor of urban centrality	7	13	Regional green space	8
7	Population density	8			

Source: authors

Figure 1: Layers used in the hospital location model

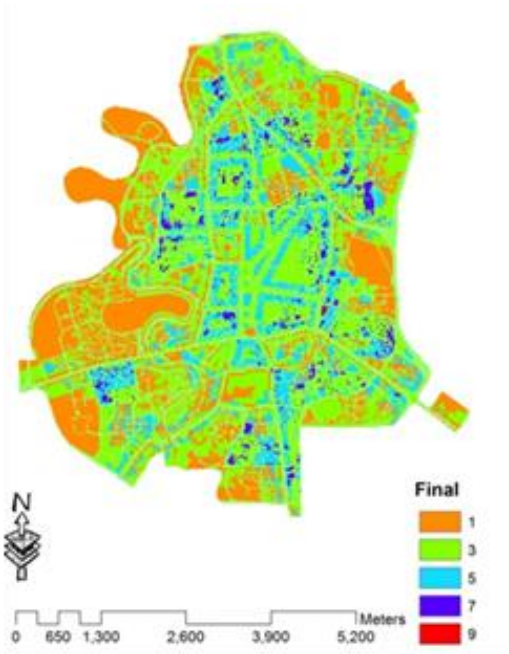




Source: authors

After that, all layers of information effective in positioning should be combined. In combining layers, the new or output layer is obtained by combining two or more input layers. thus, the attribute layer assigned to each position in the output layer is a function of the values of the input layer. This practice, which is at the heart of GIS analysis, combines different spatial data to create a new spatial element. This practice can be defined as a spatial practice that combines several geographic layers to produce new information. Finally, from the raster layers, by applying their importance factor, the final location map in raster format is obtained, and the areas with higher scores are more desirable for location. (figure 2)

Figure 2. final valuation and prioritization of urban land for building a hospital



source: authors

Conclusion

In this research, after finding out the problems of the Babol city hospital, using the geographic information system and the overlap index model, we have done the location for the establishment of the hospital, taking into account the passive defense, and finally, the land available in the city is divided into five categories: very excellent, excellent, good, medium and poor. In this division of land whose degree of suitability was very high and excellent, we have selected for the establishment of a hospital, then we have compared the selected places with the land use map. After the comparison, it was found that the suitable lands for establishing a hospital are very compatible with the land use. These lands are located near residential centers, green spaces, and main roads, and are far from other parameters such as existing health centers and industrial workshops.

In the end, it is better to pay attention to the following:

1. General revision in the preparation and implementation of comprehensive and detailed plans regarding the optimal location of health and treatment centers
2. The necessity of establishing special regulations for locating hospitals and monitoring their implementation;
3. Not requiring permission to establish incompatible uses in the vicinity of therapeutic activities;
4. Considering that urban services and infrastructure facilities are considered to be the most important factors for the development of the city and its future population, it is necessary to identify and preserve the lands needed for allocation to these resources

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