

Multi-variable Analysis Applied to Evaluate the Primary Health Care Service, the case of the town of Hanoi

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Abstract: The system of primary health care service of Hanoi City has been established since 60-70's to cover the needs of a population of about only 0.8 million people in urban area. The context is changed especially when this population increased up to about 2 million. The city has considerably enlarged during the last two decades and consequently modified the health care needs of the population. It is important under this circumstance, to analyze the actual situation and to facilitate the decision making in terms of health care service. This paper deals with the analysis of the spatial relation existing between the population and the existing sanitary infrastructures and environment of the city. For this purpose, such indicators as health care service demand, accessibility and availability of hospitals are analyzed. The authors have used geomatic tools to integrate all this indicators in a multivariable analysis to evaluate the actual demand in relation with the service capacity of the Health Care Services in Hanoi city. To provide the possible amelioration of the spatial distribution of these services the spatial modeling has been carried out based on the results of the multivariable analysis. Through a simple study the authors aim to show that geomatic can be used to support the decision making even in a non-geosciences domain such as public health.

Keywords: health care, multi-variable analysis, spatial relation.

1. Introduction

1) Problems

Currently, the geomatic dispose tools allowing to observe the real world in different scale- spatial and temporal. The geomatic can be made profitable in applications whose major objective is to optimize the establishment of the infrastructures socio-sanitary according to the characteristics of a population and her environment [2].

In the urban zones, urban spreading out or the demographic packing are sources of dissatisfactions with respect to the public services [6]. In addition the development of a system of health must answer at the demand of medical care in a community. To plan new points of services or to improve the capacity of existing services, the appreciation of the relation offer/demand can be used.

In the town of Hanoi (Viet-Nam), the system of medical care was build in the Sixties and Seventies to answer a population of approximately 800 000 people. Today, with a population of more than 1,5 million, these infrastructures do not answer the request any more. Moreover, the urban development and the development of the peri-urban districts inevitably modified the distribution of the requirements in care for health for the community. At the political level, in its new plan on "the strategic orientation of tasks of care and protection of the health of population of 2000 to 2020", the Vietnamese Ministry of Health stressed that one of the most pressing work is to improve the performance of the hospitals. Research relating to the relation offer/demand of the medical departments with Hanoi thus becomes one requires for a better analysis of the situation. This research will facilitate the decision-makings for a better development of the system of health.

The offer of services in medical care can be evaluated under several aspects. Our study will relate to the space relations between the medical population and infrastructures. In this direction, a model of evaluation of the health services based on the existing space relations between the offer and the demand for service must integrate two major axes: determination of the demand for care of health of a community and the definition of the capacity to provide services by the system of health in force. In all cases, the evaluation of medical care must analyze qualitative and quantitative socio-economic and demographic data of nature [1] [3] [4] [5] [6]. The model of evaluation must indeed allow to amalgamate and integrate quantitative information or qualitative, spatial or not spatial, different scales and sources; the use of geomatic is probably the most adequate approach.

2) Zone of study

The town of Hanoi is the capital of Vietnam. It is located in the province of the same name which is localized in the north of the country between 20°53' -21°23 ' of Northern latitude and 105°44' -106°02 of longitude east. The

major part of the province is localized in the delta of the Red River, at an altitude ranging between 5 and 20 m. The province of Hanoi is in a wet tropical zone. Average precipitations are 1678 mm per year. Moisture is high there all the year.

Currently, the people of Hanoi practically gather in the seven districts adding up 1.5 million peoples. The urban population representing nearly 55% concentrates out of 9% of the provincial territory with the strongest average densities higher than 34 000 person/km². The population is well informed and young. The rate of increase in the population of the town of Hanoi varied from 2,7% in 1991 to 1% in 2000. Unemployment is estimated there between 10 and 15%.

As for the infrastructures, the roads account for against 8-10% of urban surface. However, the number of vehicles is raised; it contains 853.000 motor bikes, 30.000 cars and more 1 million bicycles.

Hanoi holds the second real park of the country with 12 million m² of built surfaces. Nevertheless, the capital misses residences. Livable average surface by one person is 6 m² in 1999. Moreover, the dilapidated houses represent slightly more than 60% of the park.

The Medical centers in Hanoi gather in three categories: federal hospitals, provincial hospitals and of the local centers of medical care. They were built in the Sixties and seventies.

According to statistical data's of the department of the health of Hanoi, the utilization ratio of beds was 144.2 % in 1998. Moreover human resources are insufficient.

The rate of doctor by 10.000 people with Hanoi being 2.24 in 1998 was much lower than that of the country, which was 4.7. As for the emergency services with Hanoi, in this large city there are one center of emergency services having 5 ambulances and 18 employees. This center is in the East of the city and it serves with difficulty the areas of South and West of Hanoi. This situation causes dissatisfactions at the population opposite the health services.

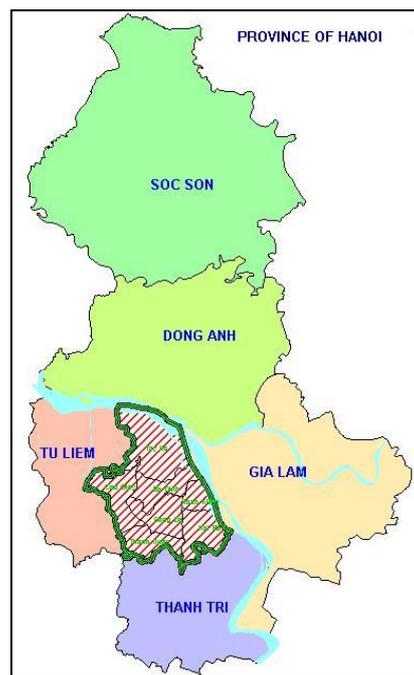


Fig. 1: Zone of study

3) Hypotheses

The analysis of the relations between the demand for medical care of the population and the offer of services of the system of health by using socio-economic and environmental parameters will allow to relatively estimating the situation of services in medical care of the town of Hanoi.

2. Methodology

[The various methodological steps are contained in the flow chart which follows.](#)

Our study relates to the relations spatial between the population, the infrastructures medical and the environment. In this direction, the evaluation of the health services based on the existing spatial relations between the offer and the

demand for services must integrate two major axes: determination of the request for care of health of a community and the definition of the hospital offer. In general, the step adopted in research is subdivided in 4 steps.

First of all, a review of the literature (step 1) enabled us to look further into knowledge on the methods used and to build the methodology of research. Concretely, it allow to direct the choice of the parameters, the model of integration of the data, as well as the method of treatments.

Starting from the data, indicators were chosen and calculated (step 2). These indicators were classified in two groups: indicators expressing the demand and the indicators related to the parameters of accessibility and availability of the hospital offer.

These indicators were formulated to be able to use them in multivariate analyses (step 3). This step made it possible to work out indices related at the demand of medical care and the capacity of the hospital offer. Multivariate integrations by methods of calculation of the scores using of the weights allow estimating results (the degree of the demand for medical care and the degree of capacity of offer of services) .These two estimates will enable us to evaluate the offer of the services of medical care in the zone of study. Lastly, the last step consisted of the development of scenarios connecting supply and demand of the services of care of health in the town of Hanoi. This step proposes orientations aiming at improving this offer of services.

Software ILWIS (Integrated Land and Water Information System) was used for modeling and the MapInfo software for the presentation of the results.

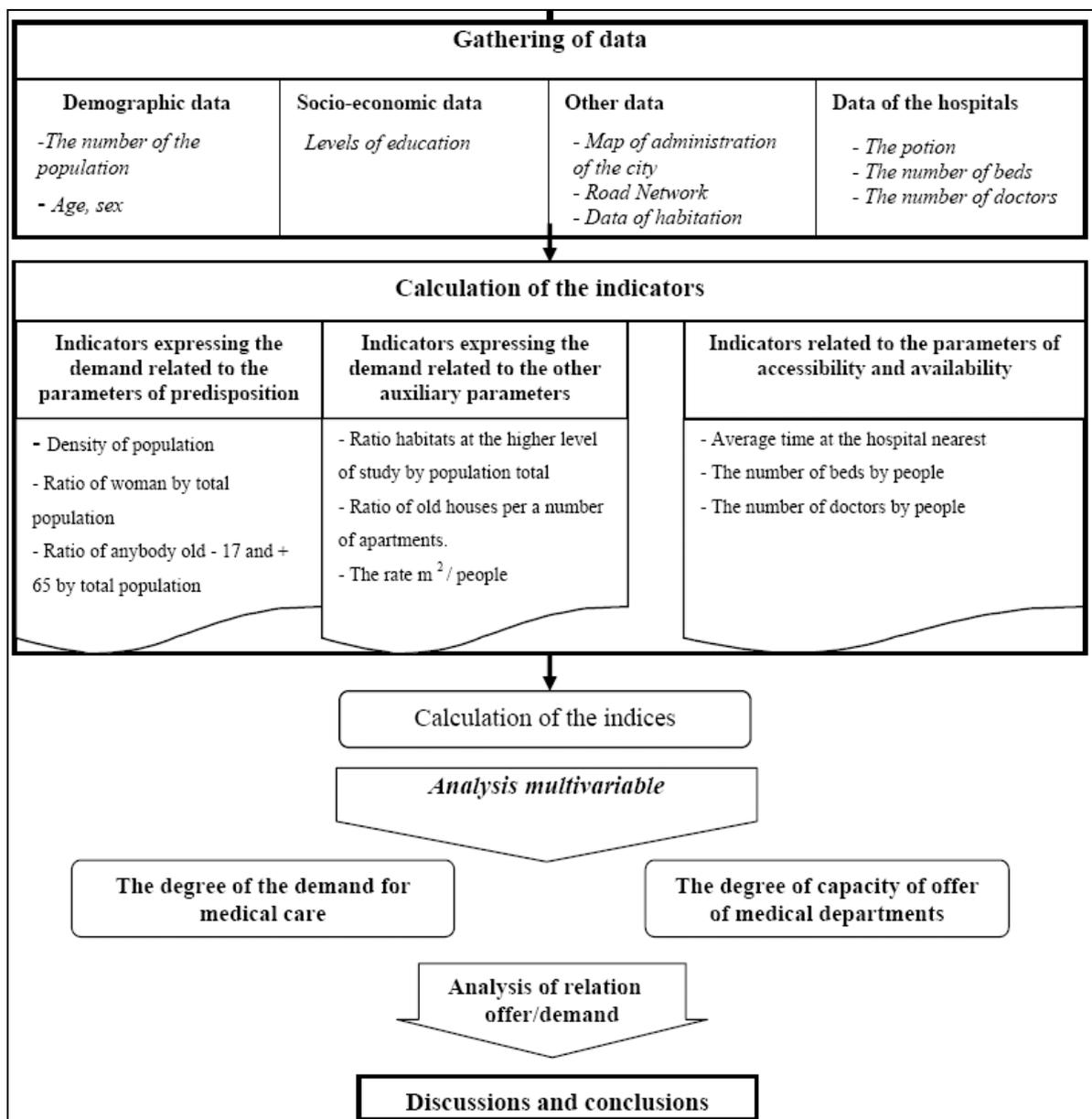


Fig. 2: Methodological step of the study

3. Results

1) The degree of the demand:

The multivariable integration of the indices of the demand of care of health related to these indicators, establish a total index, according to the following formula:

$$I = a_1 I'_1 + a_2 I'_2 + \dots + a_n I'_n \quad (1)$$

Where:

I is the total index of the demand for a ward unspecified K (k=1 with 102; 102 is the number of ward of the town of Hanoi)

I' is the index of the demand of indication N for each ward K, n=1 with 5 correspondent with the 5 indicators related to the demand.

a_n has is the balanced weight of indication N

This formula is allowed to establish a single index global relatively the degree of the demand for care of health for each ward.

The balanced weight was estimated according to the importance of the indicators (table 1).

Table1. Estimated weights of the indicators dependent at the demand of health care.

Indicateurs	Poids estimé
<i>la densité de population</i>	3
<i>personne ages +65ans ou -17ans</i>	2
<i>le nombre de femmes</i>	2
<i>personnes au niveau d'étude supérieur</i>	1
<i>Indices de logements</i>	1

A scale of 4 worth expressing 4 degrees of demand, which are *weak, average, high and very high*, was used to classify these total indices.

The result is presented in figure3.

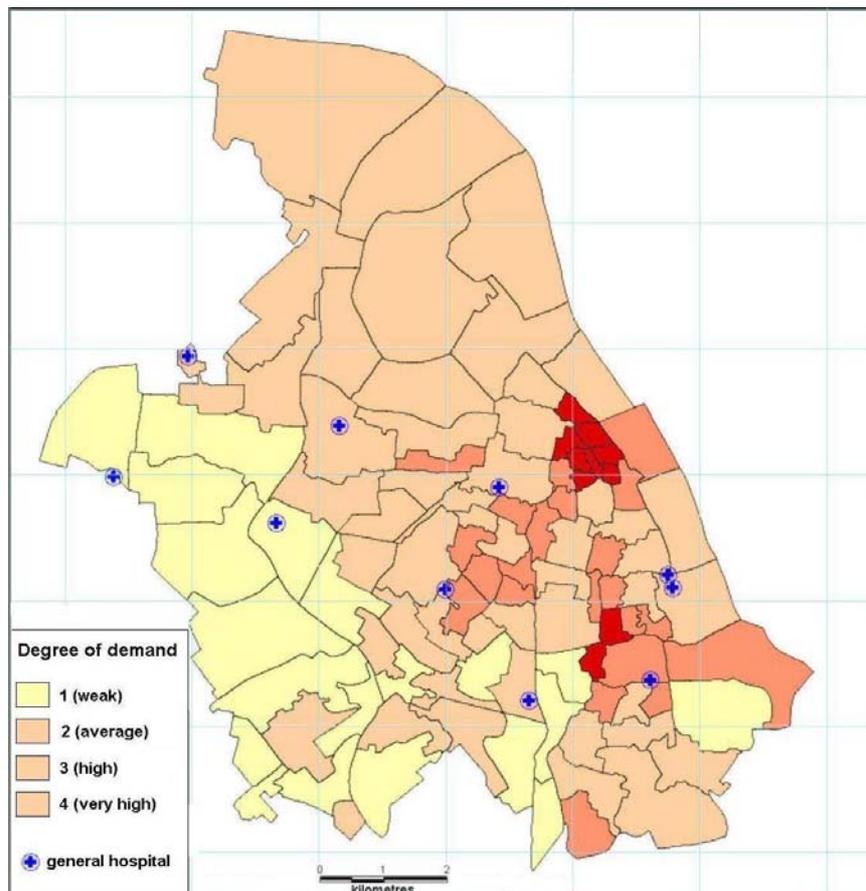


Fig. 3: Degrees of the demand for medical care

Generally, it is noted that:

- The wards having a top and very high degree of demand are located at the center of the city where the population is very dense. The residences old and are dilapidated there. The livable surface is very low there.

- The degree of the request in the western and south-western zone of the city is lowest. The low density of population, best housing conditions and the high educational level of the people cause a drop in the degree of demand for medical care of the ward in these zones.

2) The offer of health care services

Time to the hospital

The results are presented in figure 4.

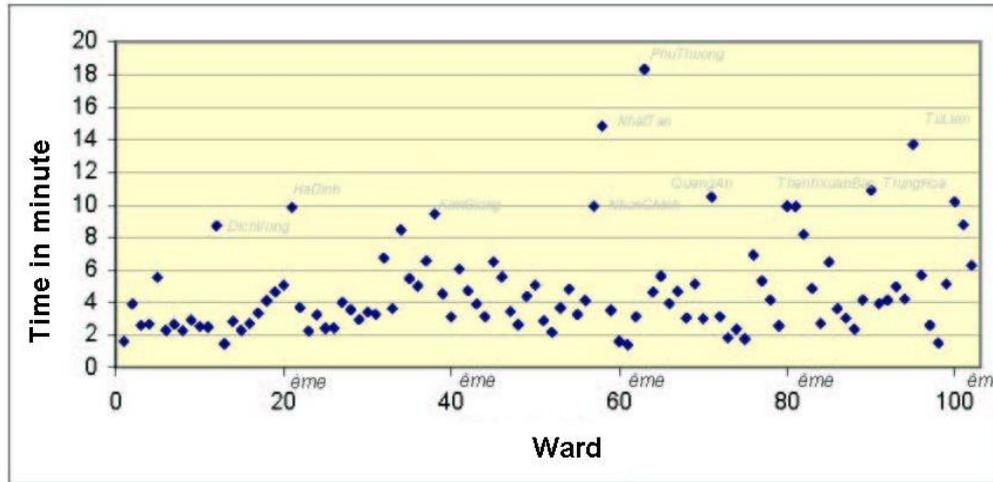


Fig. 4: Time in minute towards the hospital nearest.

It is noticed that average time put to go to a hospital varies between 1.4 and 18.3 minutes. The areas having a time of longer transport towards a hospital are in the north and the south-west of the city. The sparse road network and its bad condition are the cause of the increase in the time of circulation in these zones.

The results showed that the majority of the wards have a time of transport towards the hospital nearest lower than 6 minutes. It there only 22 wards on 102 which have a time of transport higher than 6 minutes. In reality, the time of transport is increasingly higher than these values. The influence of the unverifiable elements like the congestions or the absence of adequate means of transport increased.

The availability of the hospital resources

The data concerning the ratios of lits/1000 habitats and médecins/1000 habitats can be found in figures 5 and 6.

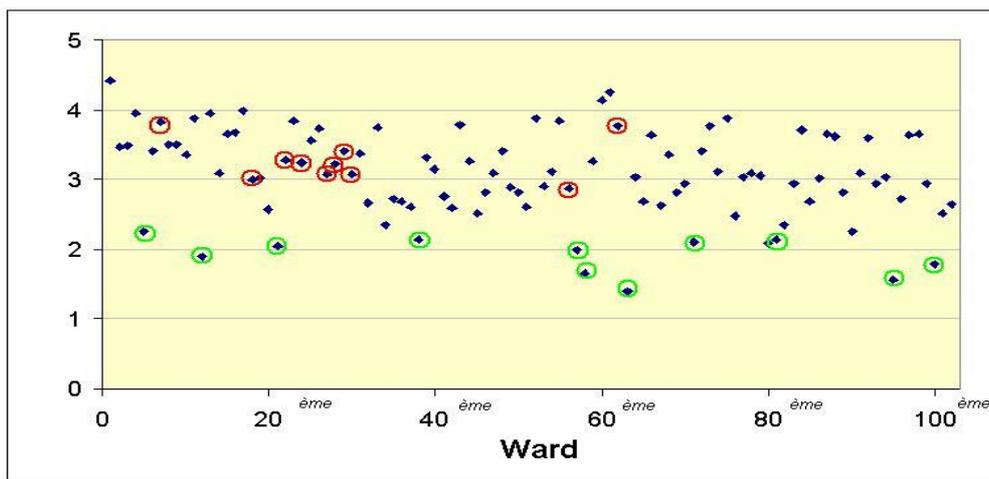


Fig. 5: The number of beds for 1000 people.

By observing these data, one notices that the number of lits/1000 people varies between 1.4 and 4.4.

The north of the city presents a fall of availability in beds. In this zone of 5 units of vicinity, the rate of lits/1000 people does not exceed 1,8.

On the other hand, in the centre town, this rate is high is more than 3.0. However, the wards, having the highest degrees of demand, are in the area where the rate of lits/1000 habitats is not highest.

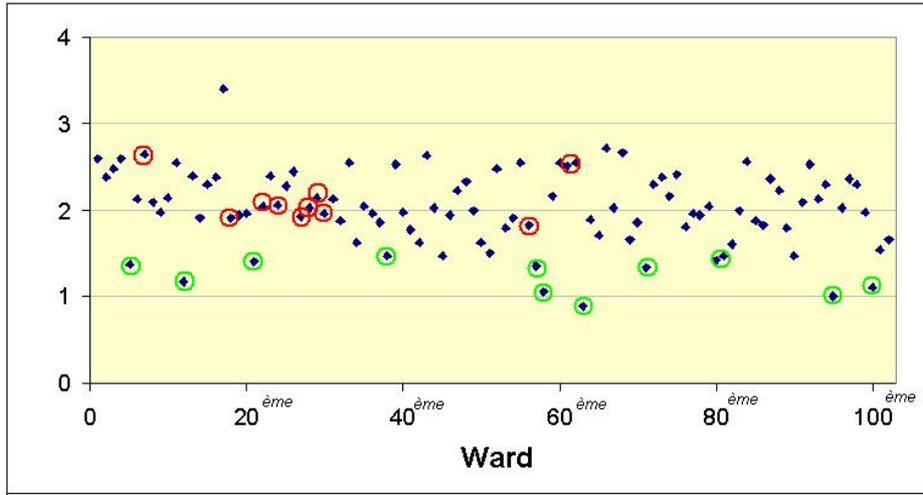


Fig. 6 : The number of doctors for 1000 people.

Concerning the availability as doctors, the rate of médecins/1000 habitats varies from 0.8 to 3.4. The availability as doctors is low in north but high in the center of the city. The majority of the ward in very high degree of request is in the average zone of availability as doctors.

3) Scenarios of analysis

A scenario of analysis is a multivariate integration of the several factors. It is noted that the capacity of offer of care service depends on the availability of hospital resources and thus on accessibility at these hospitals. But the influence as of these factors is obviously different.

Several scenarios were established to give approaches different of evaluation and managements of medical departments in the town of Hanoi.

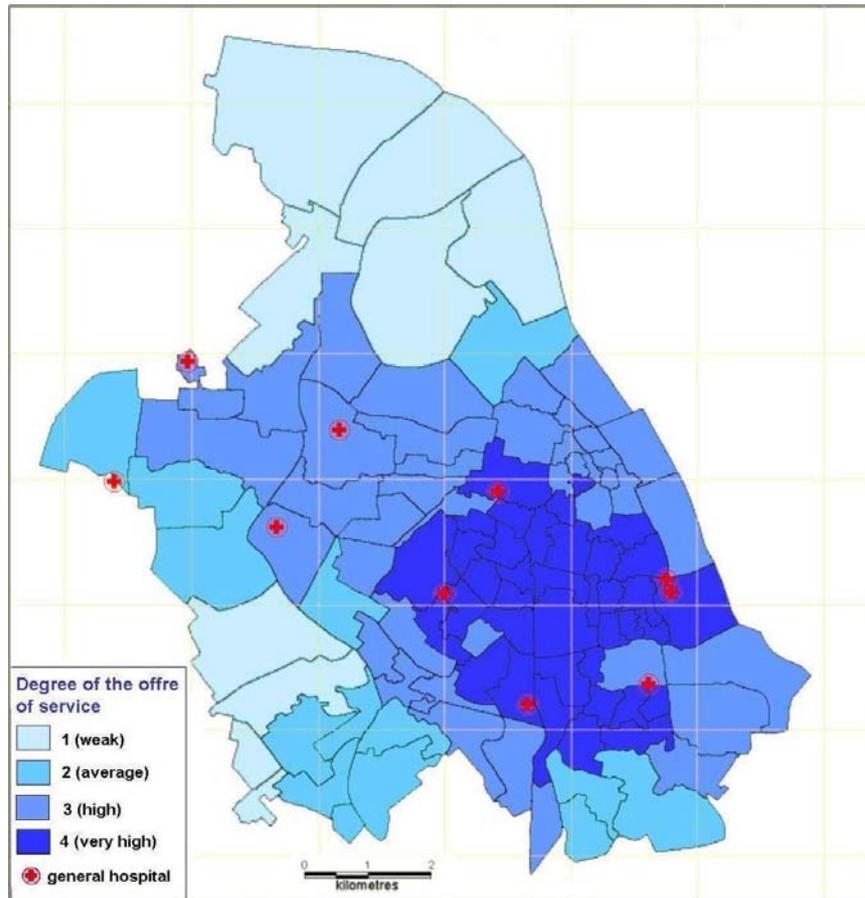


Fig. 7: Scenario 1

In *the first scenario*, the importance of time of transport towards a hospital is increased. By calculating the scores related to the capacity of offer, a weight of 2 was assigned with the variable "time". The effect of the time of

transport on the capacity of offer of services is thus twice more significant than that of the other parameters. The change of offer of services depends strictly on the variation of the time of transport towards a hospital.

In other words, in this case, the influence of time on the offer of services is analyzed by considering that the whole of the current hospitals can provide sufficient resources to satisfy the demand for population. The results are presented in figures 7

On the other hand, in *the second scenario*, by considering that all the needs easily have an access to a hospital resource, the offer of health care service in according to a change in the availability of the resources is analyzed. A weight of 2 was assigned with the variables of the parameters of the availability of resources.

The results are presented in figures 8.

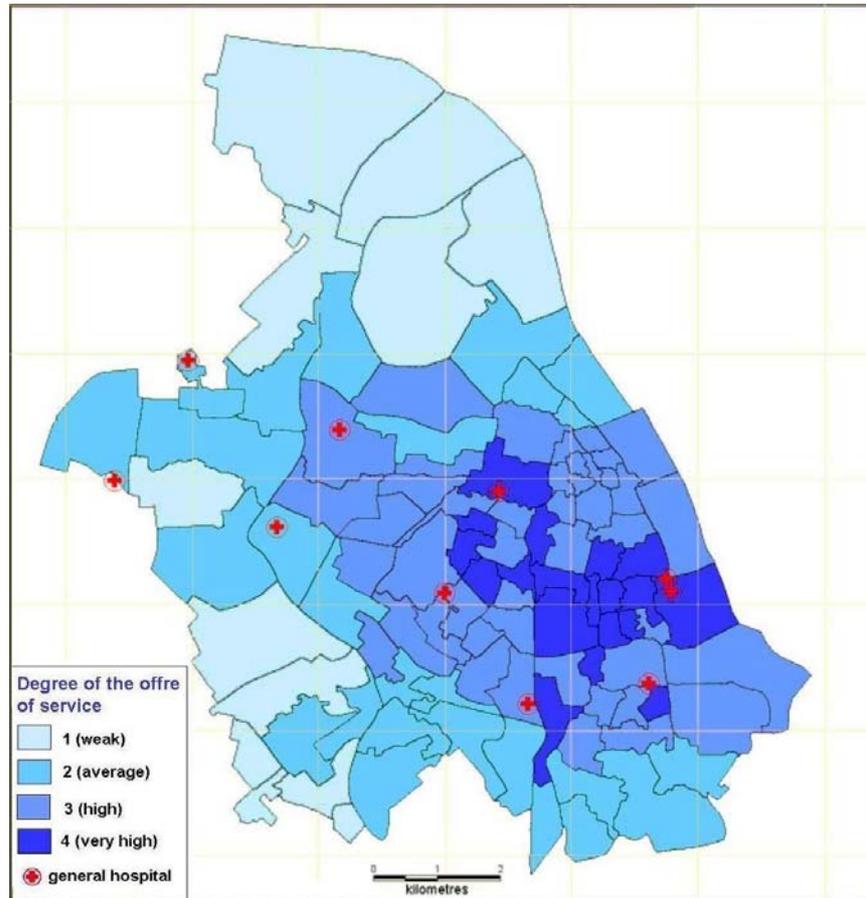


Fig. 8: Scenario 2

The results show that:

- In scenario 1, the majority of the people of the city are found in the zones in high degree and very high of offer of services.
- With scenario 2, the zones of high degree and very high of offer of services are fewer.

In comparison with the degree of the demand, in the two scenarios, the northern part of the city is the area in small degree of offer of services of care. Two other wards in south-west present the same situation.

4. Discussion

The simultaneous analysis of the demand, the accessibility and the availability of the hospital resource allow to estimate the state of services of care of health in the town of Hanoi. It is noted that:

- The hospitals are, in the very high majority of the cases, far from the zones in top and in degree of the demand. There are only 3 hospitals which are beside these zones. The minimal distance from the zones having a degree of very high demand at a hospital nearest can one is 1,558km. Conclude that the hospitals are not best localised?

- The high demand for services of health care concentrates in the center of the city. The results obtained show a deficiency. There are a shift between the zones of the high level demand and that of the offer. Is this established fact perhaps caused by the inadequate distribution of system of offer of medical department?

- In the zones of urban development, the demand for care is enough bases, but the capacity to have access is also low. An improvement must be made to the level of the capacity of offer of the adequate medical care and quality in these various zones.

It is noted that the relation between supply and demand of health services can be approximate according to several angles. The common point between these two elements is their variation from one sector to another on a territory. Therefore, an analysis based on the spatial relation between the offer and the demand can offer additional data elements to the manager of health.

The approach using of the indicators has much interest because it can be used to explain and synthesize a complex phenomenon by simple elements. Selected approach in this work is not only interesting to study the care of health, but also to evaluate several aspects connected to the urban life, such as the quality of life. Although applied to the town of Hanoi, this method can be used for all the managers who would like to concentrate on this phenomenon. Indeed, the implementation of a system of indicators makes it possible to compare very different areas.

Although the procedure of calculation of the indices is subjective, this method is an obligatory solution to integrate factors of various sources.

The variation of weighting allows to extend the range of the study and to evaluate the effect of the various weights allotted to each category of indicators. In spite of the subjectivity of part of the method, the results are interesting and encouraging because they can show the importance of each indicator. The result is that the scenarios of evaluation become open and elastic to meet various needs.

It is necessary to notice here the importance of the availability of the data. We had to face the lack of data, which directed work towards relative and qualitative analyses of the parameters available. It from of results whereas the results so obtained are partial. For example, according to Thouez [7], the indicators of mortality and morbidity express directly and clearly the requirements in care for health for a population. These data are not available, accordingly there is an insufficiency from information and consequently an inaccuracy in the results.

5. Conclusions and Recommendations

In spite of certain difficulties, we can conclude that the objective to evaluate the services of medical care for the 102 ward of the town of Hanoi was finally achieved. By the production of indices derived from certain indicators, it was possible to analyze the spatial relation between supply and demand and to evaluate the situation of the services of medical care. The implementation of an easy methodology of access made it possible to undertake work well. The availability and the detail of the data were significant elements in the realization of this project.

The town of Hanoi currently undergoes a very fast development. It needs to optimize its planning. This study comprises several originalities at the scientific level as much that methodology. That it is the implementation of the relative qualitative indices composed of various indicators or the use the space relation between supply and demand of services, this research is added to rare work on the subject. In addition to evaluating levels of services in care of health on the territory being studied, this work offers tracks for future work.

We had to face a lack of data, which directed work towards relative and qualitative analyses of the parameters available. It from of results whereas the results so obtained are imperfect. New parameters directly dependent at the demand of services of care, that it is mortality and morbidity or others, are essential.

The estimate of the weights was rather subjective. Ideally, these weights must be calculated by statistical methods using of samplings on the ground. This would require the installation of a suitable structure to be ensured of the validity of the data.

Concerning the improvement of the services in care of health, we propose to install a new hospital in the center of the northern part of the city and to add human and material resources in the hospitals located to the south and south-west. The localization of the new hospital and the determination of the new hospital resources will be the object of future research.

6. References

[1] Allen, P.M., Grant, I.T. et Michael, A. (1992) Siting hospitals to provide cost-effective health care. *Geo info systems*, Septembre, pp58-64.

[2] Béné, G.B., Muller-Poitevien, C. et Hieu, H.N. (2000) La géomatique de la santé : tendances actuelles. *Documents électroniques*, http://xxi.ac-reims.fr/fig-st-die/actes/actes_2000/goze/article.htm.

[3] Love, D., et Lindquist, P. (1995) The geographical accessibility of hospitals to the aged : A geographic information systems analysis within Illinois. *Health services research*, vol. 29, n. 6, pp629-641.

[4] Piché, J. et Coté, H. (1997) Développement et validation d'un indicateur d'accessibilité géographique aux ressources hospitalières. *Ministère de la Santé et des services sociaux*. 29 pages.

[5] Ruben A., et Miriam, R. (1993) Evaluating public services and health assistance : delimitation and application in a GIS. *ITC journal*, 1993-4, pp 205-210.

[6] Tabibzadeh, I., Rossi-Espagnet, A. et Maxwell, R. (1991) Pleins feux sur les villes - Améliorer la santé dans les villes du tiers monde. *Organisation mondiale de la Santé*, Genève, 183 pages.

[7] Thouez, J-P. (1987) *Organisation spatiale des systèmes de soins*. Les presses de l'Université de Montréal, 166 pages.