Creating a GIS based data bank of health facilities in Mazandarn province

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Abstract: GIS is a computerized system that relates and displays data collected from a geographic entity in the form of a map. GIS have different functionality hence its possible use in the field of health is quite extensive**.** Yet in health service planning and provision it remains greatly underused**.** In phase one of a research project in Iran we have created a GIS based data bank of health facilities in Mazandaran province. A shape file of basic map from the region with 1/25000 scale was used for creating this data bank. In this basic map the roads and name of locations at village level were identified. Therefore in the created bank, the locations of health facilities are spotted at village level. For those rural health facilities that there were not possible to be found in the map or there were any inconsistency in determining their locations as well as for those health facilities and hospitals located at district level, we have used GPS for obtaining the geo-codes of these locations. There were 16 counties in Mazandaran province. Given the list of existing health facilities and obtained secondary data, it was possible to find the location of majority of rural primary health care units in the map but it was not possible for some rural health care unites and all of districts health care units**.** Using Arc GIS we have been able to create some of the maps that show the location of health facilities and their characteristics. Available secondary data of primary health care facilities at rural area in Iran are useful data that could be used in creating GIS based data bank. Using these data could accelerate the process of creating GIS map with especial saving in time and money. As such mapping system and data bank could be easily upgraded based on routinely collected data, therefore its advantage is quite evident not only in understanding the health issues of a given location but in studying the trend of change during the time. Accordingly health informatics should stop ignoring the use of GIS with its immense potential in improving the health of community through integrating available data and its update.
[Rouhani S, Hosseini SM. **Creating a GIS based data bank of health facilities in Mazandaran province**. *Life Sci J* 2013;10(9s):381-386] (ISSN:1097-8135). http://www.lifesciencesite.com. 54

Keywords: GIS; data bank; health facilities

1. Introduction

A Geographical Information System (GIS) is a "computerized system that relates and displays data collected from a geographic entity in the form of a map. The ability of GIS to overlay existing data with new information and display it in color on a computer screen is used primarily to conduct analyses and make decisions related to geology, ecology, land use, demographics, transportation, and other domains, most of which relate to the human use of the physical environment (1)."

As a modern, readily available and usable tool we can use it for different purposes particularly in public health field. The uses of GIS is possible for mapping where things are; mapping quantities; mapping densities; finding out what is inside; finding what is nearby; and mapping the change (2). GIS have different functionality including data storage, data capture, data retrieval and data display hence, its possible use in the field of health is quite extensive (3). When used to the full extent of its capability, GIS can "inform and educate (professionals and the public); empower decision making at all levels; help in planning and tweaking clinically and cost-effective actions, in predicting outcomes before making any financial commitments and ascribing priorities in a climate of finite resources; change practices; and continually monitor and analyze changes, as well as sentinel events (2)."

McLafferty in 2003 (4) has categorized the uses of GIS in health to four different area including: analyzing need to health care; analyzing access to health care (both access and inequality in access); geographic variation in utilization; and mapping health care delivery (locating health services, spatial decision support system; and GIS & disasters). WHO recommends investment in the development of public health mapping and monitoring system as the basis for appropriate response to the main health threats of 21st century. There are several major public health challenges that need to be addressed in a systematic way by developing a solid local, national and global information basis for the response. Such information is not only necessary for an early and effective

response but also to guide the reconstruction of the health system if needed. The scale of most important interventions in health sector also implies a much greater need for accurate, timely and complete information on health systems and implementation progress (5). Therefore a logical progression in the field of public health would be creation and application of GIS to health service planning & provision (2). Such information system should map and monitor public health risks, health resources and facilities, progress in program implementation, and general resources and infrastructures (3, 5, 6, 7).

Despite the incredible potential benefits of applying GIS technologies particularly in the field of public health, their use in health service planning and provision remains greatly underused (2). In phase one of a research project in Iran we have created a GIS based data bank of health facilities in Mazandaran province. In this paper we present some of the maps created from this data bank.

2. Material and Methods

The purpose of this research project at phase one was to show the applicability of GIS based data bank and the possibility of its use in public health system In Iran. The data of all primary health care units and hospitals in 16 counties in Mazandaran province in north of Iran were gathered. In creating this data bank we have included those variables that their data were mostly readily available as secondary data. A shape file of basic map from the region of study project with 1/25000 scale was used for creating this data bank. In this basic map the roads and name of locations at village level were identified. Therefore in the created data bank, the locations of health facilities are spotted at village level. For those rural health facilities that there were not possible to find out their locations or there were any inconsistency in determining their locations as well as for those health facilities and hospitals located at district level, we have used GPS for obtaining the geo-codes of these locations. For these cases the created geo-codes were uploaded in the map electronically. We have created an excel file with all health facilities and their predetermined variables included. The descriptive data of all health facilities were entered to this file. The data of health facilities at rural area were uploaded in the map after finding its place among the existing locations of the map. The created data bank has the possibility to include more variables and be updated in the future by linking with any electronic files or by adding the data in the aforementioned excel file manually. Using the Arc GIS we have created different maps that some of them are presented in this paper.

3. Results

There were 16 counties in Mazandaran province each with an independent health authority. The health facilities including hospitals and primary health care unites and their affiliation are presented in table 1.

Table 1: Health facilities and their affiliation in Mazandaran province

County	Primary health care units							Hospi-tals	
	Health houses	Health posts	Rural health centers	Urban health centers	Urban-rural health centers	Behvarz training centers	Policlinics	Governmental	Private
Amol	152	11	25	7	1	-	-	3	-
Babol-sar	45	4	7	1	-	1	-	3	-
Behs-hahr	46	4	13	1	1	1	-	2	2
Tone-kabon	105	9	9	-	1	1	-	1	-
Joybar	35	1	5	-	3	1	-	1	-
Chalos	55	5	6	1	2	1	-	3	-
Ramsar	26	-	3	-	-	-	-	1	-
Sari	198	9	38	11	12	1	1	5	3
Savad-kooh	48	6	9	1	3	1	-	1	-
Ferido-nkenar	17	2	3	-	-	-	-	1	-
Ghaem-shahr	89	19	18	4	-	1	-	2	-
Galogah	17	1	2	6	-	-	-	1	-
Mahmou-dabad	45	-	9	-	3	1	-	1	-
Nekah	74	-	14	3	1	-	-	2	-
Noor	75	11	9	1	5	1	-	2	-
Noshahr	76	5	10	1	3	1	-	1	-
Total	1103	87	180	37	35	11	1	30	5

As table 1 shows the majority of primary health care facilities (health houses and rural health centers) are distributed at rural area.

Given the list of existing health facilities and obtained secondary data, it was possible to find the location of majority of rural primary health care units in the map but it was not possible for some rural health care unites and all of districts health care units therefore, requiring finding geo-codes by GPS. Table 2 shows the characteristics of these health care units.

Table 2: Health facilities and their affiliation in Mazandaran province that their Geo-code were measured by GIS

County	Primary health care units							Hospi-tals	
	Health houses	Health posts	Rural health centers	Urban health centers	Urban-rural health centers	Behvarz training centers	Policlinics	Governmental	Private
Amol	41	11	4	8	1	-	-	3	-
Babol-sar	12	4	3	1	-	1	-	3	-
Behs-hahr	13	5	5	1	1	1	-	2	2
Tone-kabon	54	9	-	-	1	1	-	1	-
Joybar	3	1	-	-	3	1	-	1	-
Chalos	6	5	-	1	2	1	-	3	-
Ramsar	-	-	-	-	-	-	-	1	-
Sari	40	9	7	11	12	1	1	5	3
Savad-kooh	7	6	1	1	3	1	-	1	-
Ferido-nkenar	1	2	-	-	-	-	-	1	-
Ghaem-shahr	17	19	4	4	-	1	-	2	-
Galogah	2	1	1	1	-	-	-	1	-
Mahmou-dabad	4	-	1	-	3	1	-	1	-
Nekah	6	-	8	3	1	-	-	2	-
Noor	3	11	-	-	5	1	-	2	-
Noshahr	9	5	2	1	3	1	-	1	-
Total	218	88	36	32	35	11	1	30	5

Table 2 also shows that the majority of health facilities that based on available secondary data finding their position in the map were not possible then required geo-code measurement by GPS are located at rural area.

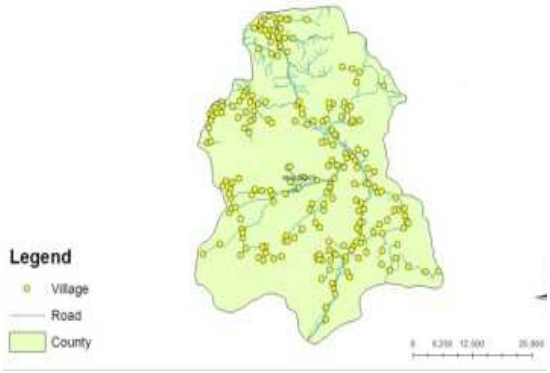
Using Arc GIS we have been able to create some of the maps that show the location of health facilities and their characteristics. Such map could be created for all 16 counties in Mazandaran province. We have chosen Savadkooh county for presenting created maps. This county has a range of health facilities that their characteristics could be found in table 1 and 2 above. For indicating the location of health facilities in this county we have used the basic map of the county that is shown in map 1.

As map 1 shows, we had access to the map of selected county with smallest entity that is village and their spatial distribution across the county. Using the above basic map we tried to show different characteristics of health facilities and their distribution in the county. The extent in which different health facilities are equitably distributed across a region might be a basic question of regional health managers. This is shown in map 1.

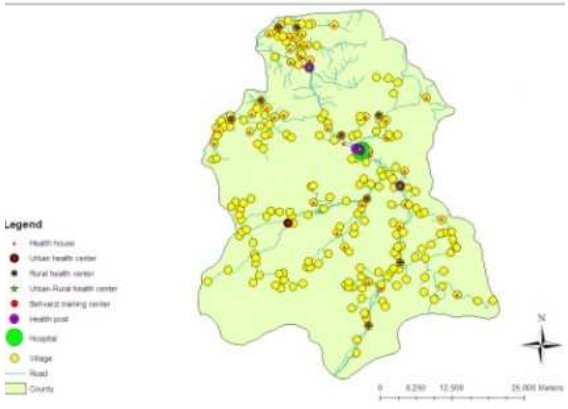
As map 2 indicates all health facilities and their spatial distribution across the county of Savadkooh and their position among the entities are evident.

The operation of health facilities and their readiness in providing services is also important for health mangers in terms of their planning for the expansion of services. We had access to the current situation of health facilities in terms of their state of operation. Using this data we have created map 3.

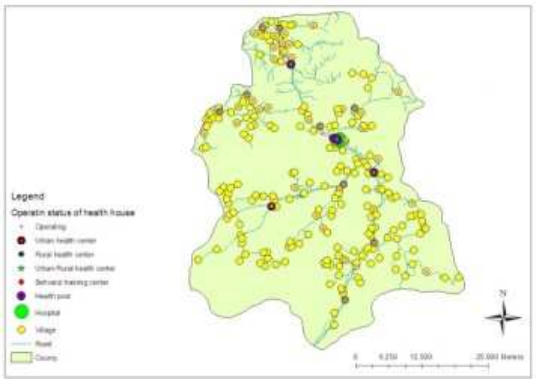
Map 1. The basic map of Savadkooh-Iran and its geographical entities



Map 2. Spatial distribution of different health facilities in Savadkooh-Iran



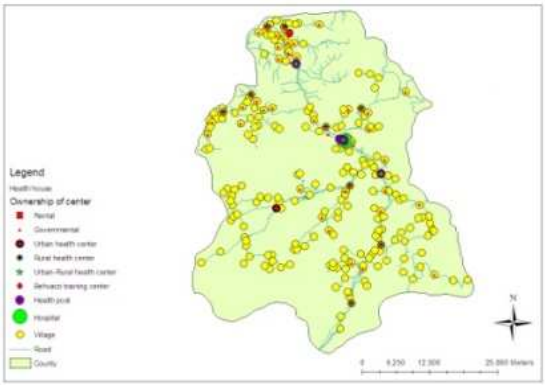
Map 3. Map of health facilities in the county of Savadkooh-Iran and their current position of operation



As the above map indicates the current state of operation and their spatial distribution could be found in the map.

The ownership of health facilities in terms of the building is governmental or rental could be a concern of decision makers and mangers when they think for long term planning of service provision. This has shown in map 4.

Map 4. Map of health facilities in Savadkooh county and their ownership



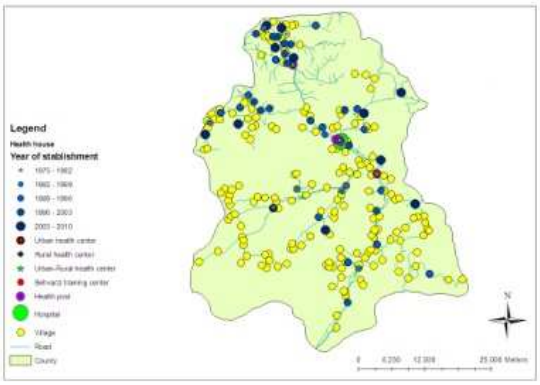
As map 4 depicts governmental and non-governmental health facilities and their distribution could be found in this picture.

The time in which the health facilities are being established and then their oldness, was another variable that its data was available to us. Such data might be important for mangers of the health system when they think about the maintenance of building and renewal of equipment. This characteristic of health facilities is depicted in map 5 below.

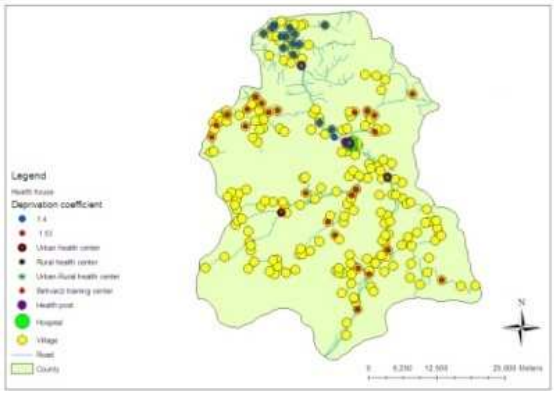
As map 5 indicates the oldness of health facilities can be found in that map that are established in different decades.

Deprivation is an important factor and has quite extensive impact on the health situation therefore it is very important to know about local area deprivation. Using the deprivation coefficient of the area that health facilities are located we have created a map with this characteristic that is presented in map 6.

Map 5. Map of health facilities in Savadkooh county and the year of their establishment



Map 6 . Distribution of health facilities in locations with different deprivation coefficient.



As the above picture indicates health facilities based on their deprivation coefficient are mapped.

4. Discussions

GIS is a new technology that can visualize the current situation and that assist professionals and managers in the understanding and comparing the situation (8). In this regard where the possibility in the use of this technique in the field of health dated back to more than half century ago (9); it is not used until recently even in developed countries. For instance in the country of Canada as a developed nation, GIS was not fully used in the health field until 2003 (2). As WHO pointed out in a developing country such as India, without using computer and internet, people are fighting with problems of 21st century with the techniques of 19th century (10). This certainly will limit the productivity of system in many ways.

Health of people is a matter that is in relation with different local factors as determinants of health.

Also there are different separate resources in different regions that could be linked for appropriate use in resolving health problems. As highlighted by Boulos 2004 (11) creating a GIS based map could simply empower managers and decision-makers in better doing their job.

In this initial GIS based data bank for Mazandaran province we have created different maps with possible use for local health authority. In creating these maps, as could be found in tables 1 and 2, we mainly employed secondary data that were available for majority of rural health facilities in this province. Such useful data is similarly available for all rural health facilities in the whole country. As internationally recognized, health information system in Iran particularly at primary health care level is well developed (12) and in recent years a huge investment has been putted to employ a Health Information System (HIT) at national level (13). Furthermore there are many routinely collected data such as five year national census, insurance data, economic data, socio-demographic data, ecological data, vital registration data and so on that could have meaningful correlation with health situation of population in different area. If we integrate all these data and add the health situation of population in any given area together with potential existing and attainable resources, surely we will reach to a better position of planning and assisting people in promoting their health.

Given the different source of routinely collected data and lack of an information system to model such data for appropriate use in health sector, experts in Iran urge the use of GIS based system to combine these data (13, 14, 15). Using secondary data could save lots of time and financial resources without need to attend in all local units in creating a national GIS based data bank of health facilities. It is why others considered GIS technology as cost-effective action in the field of health planning and provision (11, 2). As the scale of basic map used in this project is 1/25000 and the locations of all villages are predetermined, therefore creating a GIS based data bank for peripheral health care units that are a single governmental health care unit among several villages known as health house will easily and economically be possible for majority of remote health care facilities. We brought this idea to practice and have shown in maps 1 to 6 using available secondary data. In these maps, we can simply understand the accessibility of local population to different health facilities (map 2); status quo of their operation (map 3); the ownership of them (map 4); the oldness of health facilities (map 5); the economic situation of the area in terms of its deprivation level (map 6). As mentioned earlier there are loads of such timely data now available inside and outside of health care system in Iran and could be used for the creation or development of such maps at local, provincial and national level. Maps presented are examples of indicating the possibility of creation and use of GIS for health in Iran and are important in decision-making for the planning and provision of health care (2). Any development of this initiative need an additional program that based on literature identify the possible use of GIS in health and develop a checklist of appropriate variables and then select the data for updating this data bank.

5. Conclusion

Where there is a vast majority of routinely collected data in health system and social care system of Iran they are not integrated and linked together (13). In this study project we have shown that it is quite possible to integrate theses valuable data to create a visual map in assisting managers and decision makers in doing their activities. The creation of such data bank can be expanded for all regions at national level as the health system at all provinces has the same category and content. The use of this technology is more recommended where in the case of Iran and particularly in health sector there is an ongoing reform in health information system with special emphasis on the use of information technology. Currently the health system is greatly computerized and many electronic data banks have been created or their creation is in the top agenda of health system in Iran. Other sectors are moving in this way with the same trend. Applying GIS techniques for these data banks and linking between them can provide appropriate and timely information for policy-makers, decision-makers and managers to do their duty appropriately.

Based on our experience in this study we are in the position that can assert that available secondary data of primary health care facilities at rural area are useful data that could be used in creating GIS based data bank. Using these data could accelerate the process of creating GIS map with especial saving in time and money (16). As such mapping system and data bank could be easily upgraded based on routinely collected data therefore its advantage is quite evident not only in understanding the health issues of a given location but in studying the trend of change during the time (2). Based on the findings of this study and the same as other authors we conclude that health informatics should stop ignoring the use of GIS with its immense potential in improving the health of community through integrating available data and its update (2).

Applying GIS in health is quite new in Iran therefore the same as other authors (3, 17, 18, 19) it is recommended that more attention is needed to show the potential of this technique to managers and

decision-makers. In this regard a better communication with stakeholders and their involvement as emphasized by (20) is very important. Given the availability of different source of electronically collected data at the local and national level, a link between information across different sectors as recommended by (4, 21) is also very appropriate in the case of Iran. With the possibility of this technique as has shown in this study and in accordance with others (2, 7, 20), using GIS based data bank is recommended for further understanding of the relationship between specific health situation of populations and their unique geographical contexts.

Acknowledgements:

Authors are grateful to the Deputy for Research and Technology- Mazandaran university of medical sciences for approval and financial support to carry out this work. Also we thank department of statistics in provincial health authority of Mazandaran.

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8/12/2013