American Journal of Engineering Research (AJER) 2018
American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-7, Issue-2, pp-198-206
www.ajer.org
Research Paper Open Access

GIS As A Tool To Management The Government Services In Saudi Arabia: Case Study Of Health Services In Assir Region

Hala Ahmed Hamed Maala*
Public administrative department – Collage of business administrative King Saud University – Riyadh – Saudi Arabia
Corresponding author: Hala Ahmed Hamed Maala

ABSTRACT: Management of government services and GIS are two relevant fields that depend upon spatial data. Location of government services facilities, customers distribution and their characteristics are examples of spatial data that are dealt with during public services planning. Public services planners use such data to monitor and evaluate services on local areas. Such tasks can be better made using different GIS functions and models. This paper outlines the possibilities of using GIS in public services planning. Health care services in Assir region in Saudi Arabia is selected as a case study to show how GIS can help health planners and support their decisions. GIS is used to analyze the Governorates as well as studying the spatial pattern of some diseases. It shows that, Abha city and khamis Mushait city have high health facilities compared to the rest of Asir Region governors, while Tathlith city has less health services facilities despite the large area of Tathlith. It considered as a useful tool for health planners in defining how well patients are served by health services and anticipate demand for such services. The results of this application are very useful for government health services planners because they evaluate the level of service provision at the selected area.**Keywords:** Government services, management, GIS, health services, Assir region.

Date of Submission: 09-02-2018 Date of acceptance: 26-02-2018

I. INTRODUCTION:

Establishing a correlation between spatial location and health services will provide an efficient platform that assists in public health management. It helps in disease avoidance and primary healthcare service planning. However, various spatial locations on a certain geographical area are typically connected with varied factors such as environmental, biological, economic, social, and cultural. These factors are fully affected by health, disease, and healthcare (Boulos, *et. al*, 2001). An essential idea of health geography is that disease and health are unevenly allocated across space and time. Spatial patterns of disease have related to numerous elements such as healthcare services distribution, culture, climate, germs, experiences, and geography. Knowing spatial association of health and sickness is significant (Graves, 2008) and (Kandwal, *et.al*, 2009) stated that the illustration and exploration of disease maps incidence data are essential tools in the exploration of provincial difference in public health. Providing techniques for disease maps has increased noticeably in recent years. This progress has led to an extensive utilization of spatial statistical tools to analyze the data that collected for public health and ecological purposes to be linked with relating diseases. Geographers play significant roles in public health research, mainly in defining healthcare availability, utilization, and individual healthcare experiences (Timothy *et.al*, 2012). Many sophisticated tools have been developed for geographic information systems (GIS) which facilitate its applications in different sectors. Some studies have been improved with semi-structured detailed interviews to address individual experiences of people as they access healthcare. In recent years with the development and widespread of GIS software's, the representation, manipulation and storage of geographic information have experienced a revolution (Murad, 2004, 2005). Many health care planners and officers can gain many benefits from GIS tools and this will offer them the opportunity of manipulating the growth of health surveillance, environmental health assessment and the geographic allocation of health resources (Perdue, 2007).

1.2 Research Objectives:

The data of the Ministry of Health in Saudi Arabia about the health care is normally stored in separate databases which means no linked with any graphical representation (e.g. map) to represent that data (Moh.org). GIS system is aimed to accessing; retrieving, removing, representing and editing any data about any region by showing it in any graphic representation are taking long time. This problem can be solved by creating an interactive map for any region with a summarized data and special information. This way is the best way for the users or the decision makers in the health ministry to access and represent the data in easily and rapidly way. This method of view the information will saving the time of person who uses this map and give more professional way of showing information. The main objectives of this research are:

1- Construct a database containing the no. of hospitals, healthcare centres, doctors, nurses and patients.

2- Make use of GIS in studying, analysing and discussing the distribution of the healthcare services in general by knowing the areas that have (excellent – good – poor – non) service.

3- Using the graphical representations (Diagrams) to present the data to the decision makers to help them to get information easily and precisely.

4- Present the most common diseases in each area, and studying the factors affecting or causing these diseases.

5- Studying the effect of the environmental factors: weather, elevations and the water source and use.

II. LITERATURE REVIEW

2.1. Wide view to health status

Health is a product of multiple elements. GIS is a technique and procedure that can address enquiries about the difficult web of causation of many health concerns. They can be vital in the incorporation and analysis of social, physical, and traditional environments (Graves, 2008). Health is crucial for all of us; the causes of diseases and their propagate among persons and communities have gained international attention. Differences in health outputs across geographical regions and populations are differences in access to healthcare services. Several researches have displayed the obstacles on healthcare service access and the effect of little access on health products. Studies that put attention to access, unequal health products are essential to address how, and where healthcare facilities are located (Kandwal, *et.al*, 2009).

2.2. GIS and Public health

GIS is a computerize scheme for incorporating and analyzing spatial data. GIS is able to represent, store, save, investigate, and show spatial data. GIS can be used to show the spatial distribution of health information. Mapping of health data can be beneficial in picturing shapes and brought questions that have not been addressed. GIS is a powerful tool that helps and assists in health communities in geographical context to monitor, control and eliminate certain life threatening diseases and epidemics (Boulos, *et.al*, 2001). As a form of IT, GISs are promising measure tools for the study of healthcare facility, health results, and the possible resulting health differences. Their capability to incorporate health's data with mapping meanings permits for picturing, examination, and modeling of health forms (Timothy *et.al*, 2012). It helps in labeling and clarifying differences in healthcare facility and health products (Kandwal, *et.al*, 2009). Certainly, GIS will quickly distribute in the areas of spatial environmental health sectors and public health. Accessibility of vast amount of environmental data amounts from remote sensing in addition to mixing of GIS into internet environment will provide significantly role to the developing acceptance of GIS within health sectors (T. Kistemann *et al*, 2002). GISs have been employed in land and natural resources management. They spread in many areas of health management and health research. They provide systematic tools for epidemiological study. The advantages of GIS tools are becoming powerful in the areas of public health and healthcare delivery. Lately, GISs have been used to precisely and briefly provide computerize assistant cartography of disease forms and epidemics as well as demographical and geographical data in health products (Kandwal, *et.al*, 2009). In the past GIS technology were used in environmental demonstrating, metropolitan planning, and public health. GIS applications have increased throughout natural resource management, services management, site analysis, sales area management, grid planning, transportation and route planning (Noon and Hankins, 2001). To support good public health results, GIS is used to connect the processes and products to inform health communication efforts and stand-in common thoughtful, cooperation and coordination among additional associates along with constituents (Ledsky *et.al*, 2013). GIS scheme was beneficial in the estimation of environmental conditions and Lyme disease. More studies have shown relationship to heart disease and stroke mortality to geographical location of healthcare services. Geographical plotting is used to display the relationships between teenagers and other social factors in addition to display geographical disparities in breast cancer among racial groups. GIS system could demonstrate both unequal access and unequal health outcome for many importance populations. GISs were effective

Table 1: Geographical and Demographical Data of Assir Governorates

Area	Area	Population	Latitude	Longitude
Abha	4,217 km2.	286,580	18°N	42°E
Tathleath	33,385 km²	48,765	19.57 °N	43.50 °E
Bishah	14,860 km²	188,668	20.01 °N	42.60 °E
Bulgarn	1,103 km²	41,362	19.20 °N	41.40 °E
Al-Numas	1,869 km²	47,783	19.12 °N	42.13 °E
Al-Majardah	1,284 km²	46,303	19.12 °N	41.91 °E
Muhail	4,605 km²	141,506	18.55 °N	42.05 °E
Rijal Alma'a	2,740 km²	96,288	18.32 °N	42.05 °E
Khamis Mushayt	1,652 km²	395,723	18.31 °N	42.73 °E
Sarat Abidah	2,664 km²	59,546	18.4 °N	43.48 °E
Dhahran Al-Janub	1,367 km²	31,162	17.66 °N	43.51 °E
Ahad Rafidah	769 km²	81,391	18.20 °N	42.80 °E

diagnostic tools for the evaluation and study of healthcare access and health products in the mentioned researches (Kandwal, *et.al*, 2009). The connection between GIS and health care has increased significantly in the past 10 years with the recognition that health observation practices and health service distributions need to become more sensitive to the needs of people in certain geographic areas (Murad, 2005).

2.3. Health Care in Assir Region

There are 12 governorates belong to Assir Region which are listed in Table 1 along with spatial data.

Table 2: Features of the integrated health areas in Assir [8]

Integrated health area	Number of PHCCs	Number of hospital beds	Population served	Total visits to PHCCs	Total referrals to hospitals
Abha	35	230	131,432	90,428	23,171
Khamis Mushayt	14	194	152,870	67,716	27,297
Muhayel	22	150	97,539	56,315	15,446
Majarda	17	126	59,413	34,411	10,710
Sarat Abeeda	22	100	50,964	39,096	13,831
Al-Namas	13	126	37,358	21,719	9,010
Rejal Alma'a	18	60	39,262	24,249	10,110
Dhran Al-Janoob	9	100	25,168	18,634	16,413
Ahad Rufeeda	9	40	47,112	27,101	8,200
Tathlith	5	90	28,944	17,626	7,787

The health care industry in Assir and all cities of Saudi Arabia is growing rapidly and will continue to provide excellent and challenging opportunities for providers. There are two main types of health facilities. They are called public and private health facilities. The former covers health centers and hospitals owned by the Ministry of Health. Health care in Assir region are provided by the Ministry of Health and by other governmental authorities including the Ministry of Defense and Aviation (MODA) and the Ministry of Interior (MOI) [8]. The principal objective of the Ministry of Health (MOH) is to provide primary health care to all Saudi Citizens. This is accomplished through hospitals and clinics established throughout the Region. The Ministry of Defense and Aviation (MODA) provides health care for military personnel (Army, Navy and Air Force), their dependents, MODA civilian employees and their dependents, at military bases and headquarters facilities throughout the Kingdom. So, in Assir region there are 227 health centers and 16 hospitals with a total capacity of 1890 beds. Public facilities provides medical, surgical, obstetric, emergency, and diagnostic as well as laboratory services Table 2 and Table 3 summarize the features of the integrated health areas and personnel in hospitals and primary health care center (PHCC). [8].

Table 3: Personnel in the integrated health area in Assir [8]

Integrated health area	Physicians	Dentists	Nurses	Pharmacists	Laboratory technicians	x-ray technicians	Sanitary workers	Administrative staff
Abha	65	17	144	21	14	6	23	34
Khamis Mushayt	44	9	101	14	8	3	12	17
Muhayel	38	8	76	16	6	1	8	9
Majarda	21	5	54	9	4	5	8	7
Sarat Abeeda	34	8	68	11	7	5	9	7
Al-Namas	20	6	37	12	3	4	3	15
Rejal Alma'a	28	4	64	11	8	4	2	17
Dhran Al-Janoob	15	2	30	4	1	1	3	4
Ahad Rufeeda	19	5	39	8	5	6	4	9
Tathlith	11	3	24	5	3	1	1	1

III. METHODOLOGY:

A general methodology is adopted in this study as shown in below figure. One of the major objectives of this project is to build a GIS application for health care system in Asir region which located in south Saudi Arabia. There are several types of health care facilities available and run by public or private authorities. These include local health care centres, general hospitals, specialized hospitals, and military hospitals. For this research, only public general hospitals and health centres that run by the Ministry of Health will selected. To build this application the following sets of data will be collected:

- Locations of public hospitals and health centers. This data is entered the GIS as a point coverage and each hospital/health center has got a unique ID number.
- Hospitals/Health centers beds capacity. To evaluate the information of hospitals/health centers, the maximum bed size of each hospital was collected directly from the Directorate of health affairs in Asir region.
- Population data. Every hospital is located within the city/governorate to serve several people. However, this data was built as polygon coverage where each polygon shows the boundary of the city/governorate District together with its total population. This data is obtained from the local health authority of the targeted region.
- Specific Diseases data. To evaluate the information about selected diseases, the number of patients for each disease in each city/governorate was collected.

After collecting the information, we analyze the system by finding the main scenario and drawing the structure diagrams. Then we designed the database by evaluating the main tables and the relationships between these tables and design the interface of the system.

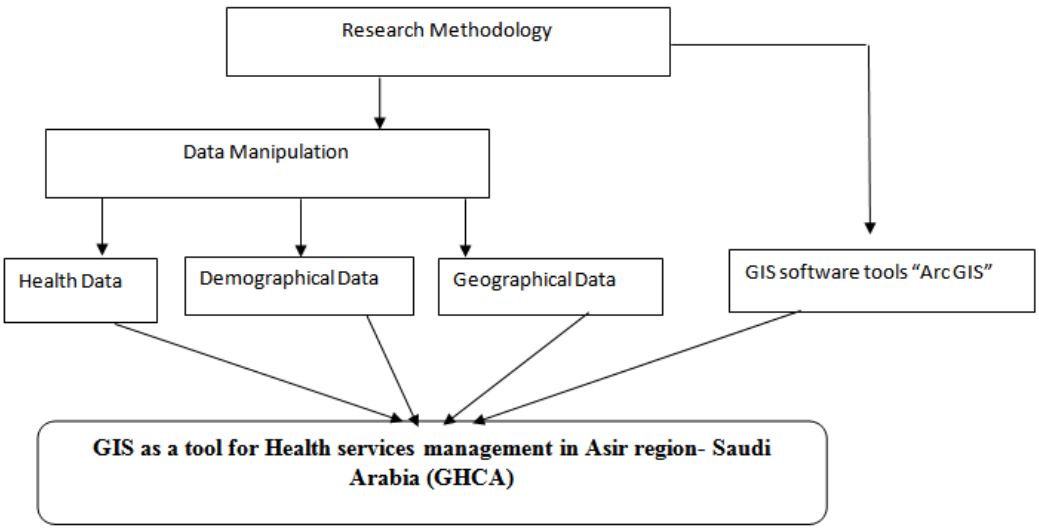

Fig. 1: Research Methodology of GHCA

Based on Fig. 1 and Tables 1,2 and 3, different types of tables have been used to store the information about Assir district, cities and governorates, hospitals, health centers, hospital departments and diseases. The following figure illustrate the tables with the databases:

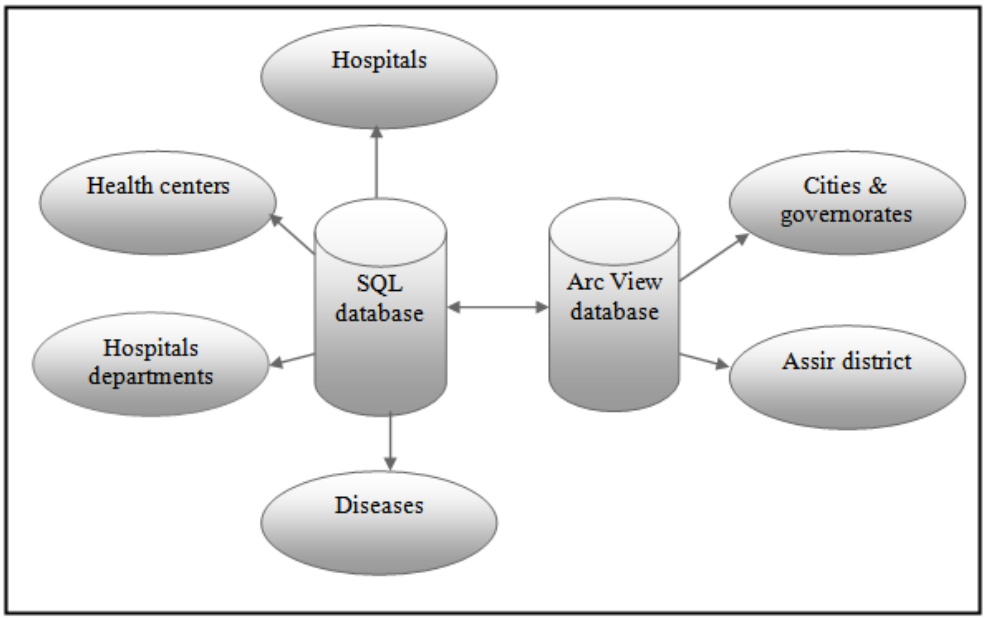

Fig. 2: Data bases of GHCA system

IV. RESULTS & DISCUSSION

GIS can help in generating thematic maps - ranged color maps or proportional symbol maps to denote the intensity of any type of data. Fig. 2 shows the map of Asir region where the geographic data are provided. From this figure, we can observe that there are 12 governorates belong to Assir Region. It has an area of 81,000 square kilometers and an estimated population of 2,190,000. Thathleth is the biggest governate in terms of area which holding around 33,385 km^2 while Ahad Rafidah is the smallest governate in terms of area which holding around 769 km^2. The rest of governates are falling between these two Thathleth and Ahad Rafidah.

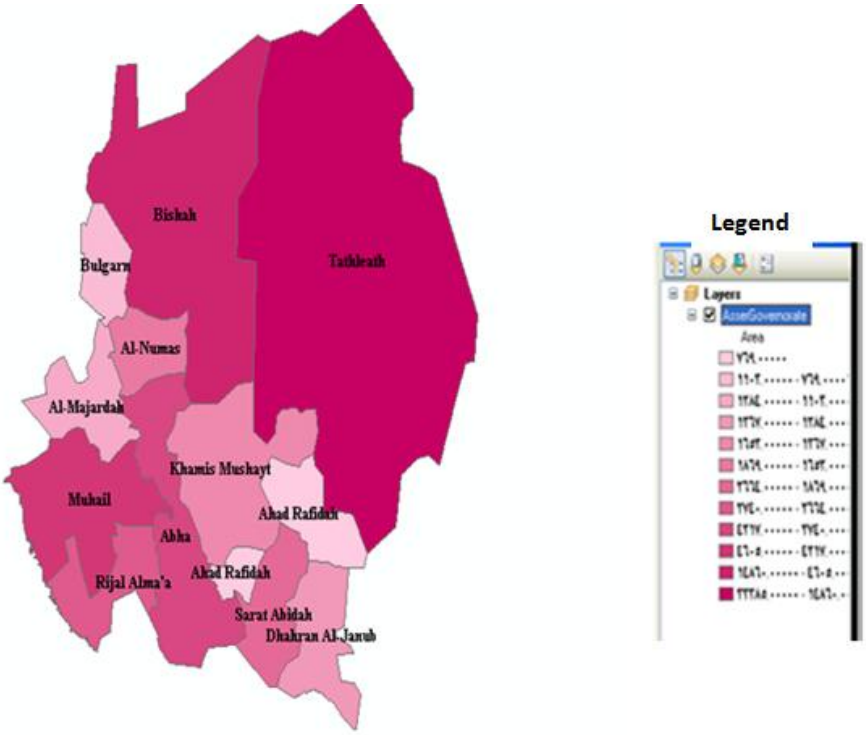

Fig. 3: Assir Governorates

Usually, maps that illustrate the locations of health facilities are very beneficial for health managerials. For instance, these maps help planners to swiftly classify the spatial delivery of health facilities within a certain area. In addition, these maps give planners to decide which areas have shortage in health utilization. In Fig. 4, the health care facilities in Abha were mapped based on different classes (i.e., general hospitals and public health centers) and disease contagion. Presently, there are 38 health care facilities in Abha, of which 7% are general hospitals and 93% are primary health care center (PHCC). We can conclude that the first defense line of health facilities are went to PHCC and the emergency and chronic cases went to general hospitals. Most of these facilities are located in the northern eastern of Abha city which means most are underserved.

Fig. 4: Abha Map for health facilities

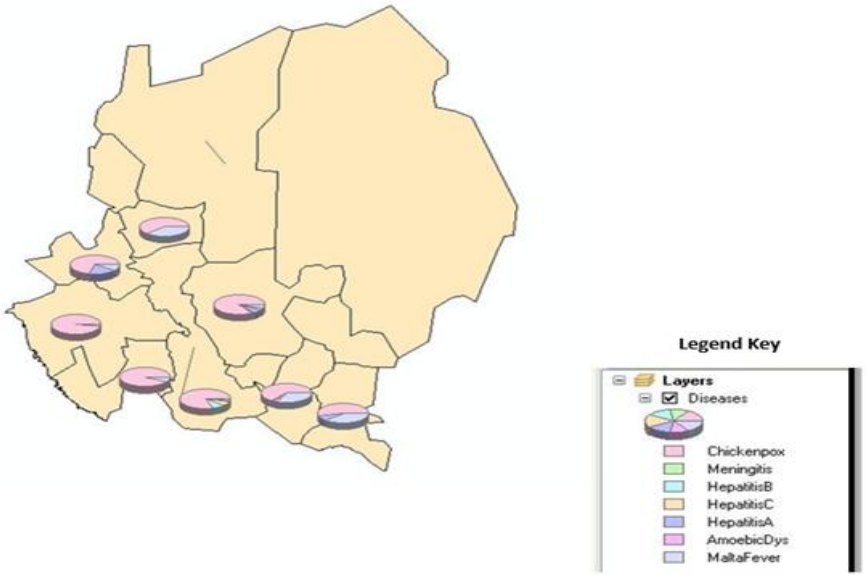

Fig. 5: Disease Map for Asir Region

Fig.5 shows a disease map of Asir Region. The diseases are Chicken pox, meningitis, hepatitis B, hepatitis C, hepatitis A, Amoebic dys, and Malta fever. It shows Chicken pox are high in all governates except Tathleth governate while the highest rate in Muhail Asir since Chicken pox is the primary systemic infection with Varicella-Zoster virus (VZV) and the climate represent good environment to this virus.

In Fig. 6, the health care facilities in Asir Region were mapped based on different classes (i.e., governates, general hospitals, primary health care centers, and diseases contagion. Currently, there are 227 health centers and 16 hospitals with a total capacity of 1890 beds. These facilities provide medical, surgical, obstetric, emergency, and diagnostic as well as laboratory services to an estimated population of 2,190,000. The high population density in Abha and Khamis Mushait cities which proportional with health facilities. We can conclude that the first defense line of health facilities is went to PHCC and the emergency and chronic cases went to general hospitals. Most of these facilities are located in the northern eastern of Abha city and southern of Khamis Mushait, which means most are underserved.

The graph below (Fig. 7) shows the key indicators of staff versus health facilities in Asir Region from statistical point of view. Although 60% of health care facilities are located in Khamis Mushait and Abha, Abha city has a higher density of physicians. This distribution pattern is attributed to two factors. First, Abha is a tourism city has a larger number of physicians, and then its surrounding areas would have a higher provider density to tourists. The second reason is the climate of Abha.

Fig. 8 represents the number of hospitals and PHCCs with their activities in Asir Region. It concludes that Khamis Mushait underserved the majority of population (131,432) in hospitals while Abha city is leading in terms of services provided by PHCCs.

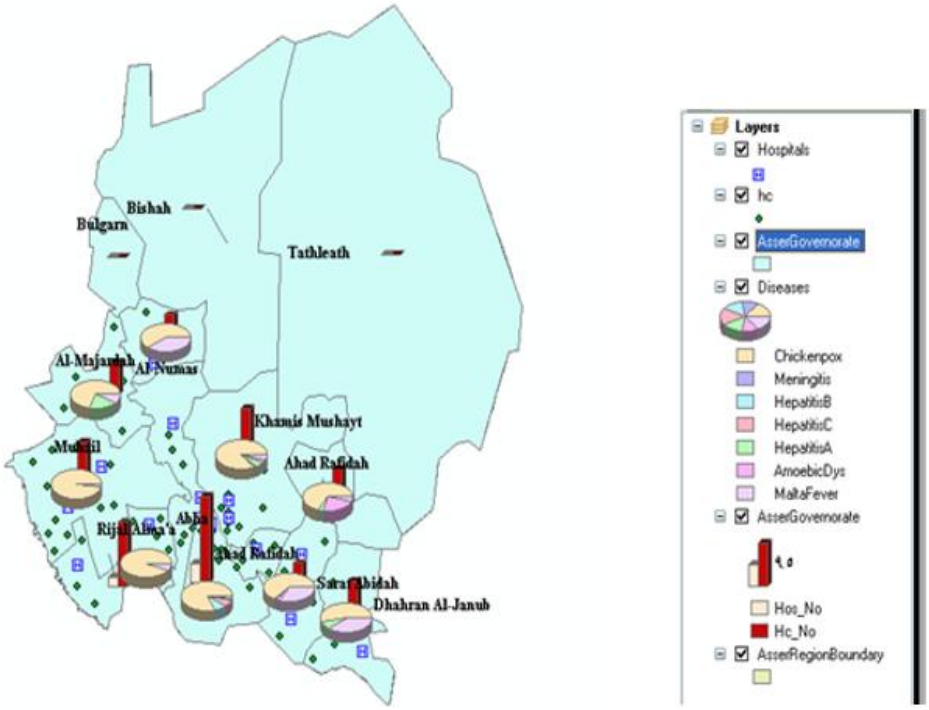

Fig. 6: Asir Map for health facilities

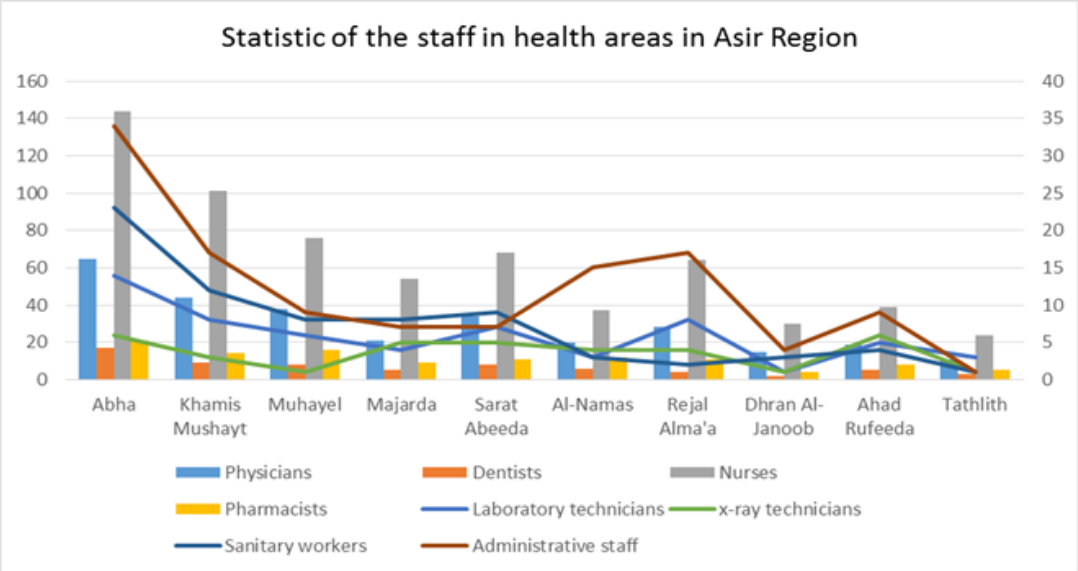

Fig. 7: Statistic of the staff in health areas in Asir Region – source Ministry of Health 2017

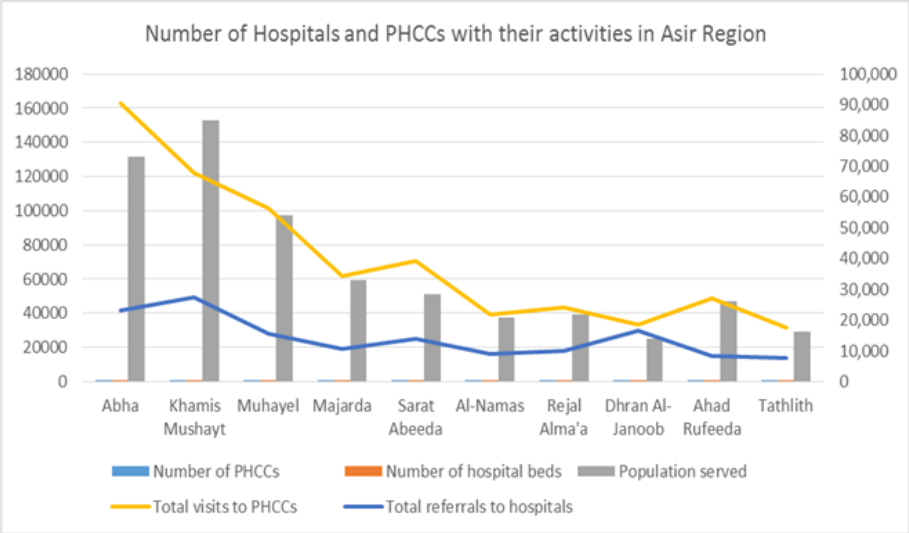

Fig. 8: Number of Hospitals and PHCCs with their activities in Asir Region - source Ministry of Health 2017

V. CONCLUSION:

GIS helps in faster and better health dynamic mapping and analysis than the conventional methods. It gives health professionals quick and easy access to large capacities of data. It provides a variety of dynamic analysis tools and display techniques for monitoring and management of health facilities. GIS has a vital role to play in the future. It concluded that Abha and khamis Mushait have high health facilities compared to the rest of Asir Region governates. Tathlith has less health facilities despite the large area of Tathlith. Chicken pox disease is the most breakthrough in all gevernates especially in Muhail Asir. The results of this study are very useful for health planners because they evaluate the level of service provision at the selected area.

REFERENCES:

[1]. M. N. Kamel Boulos,1 A. V. Roudsari, and E. R. Carson, Health Geomatics: An Enabling Suite of Technologies in Health and Healthcare, Journal of Biomedical Informatics, vol. 34, pp.195–219, 2001.
[2]. Barbara Ann Graves, Integrative Literature Review: A Review of Literature Related to Geographical Information Systems, Healthcare Access, and Health Outcomes, journal of Perspectives in Health Information Management, vol 5, pp. 1-11, 2008.
[3]. Rashmi Kandwal, P.K. Garg, R.D. Garg, Health GIS and HIV/AIDS studies: Perspective and retrospective, Journal of Biomedical Informatics vol. 42, pp. 748–755, 2009.
[4]. Timothy L. Hawthorne and Mei-Po Kwan, Using GIS and perceived distance to understand the unequal geographies of healthcare in lower-income urban neighborhood**,** *The Geographical Journal*, vol. **178**, pp. 18–30, 2012.
[5]. Abdulkader A. Murad, Creating a GIS application for local health care planning in Saudi Arabia, International Journal Of Environmental Research, Vol.14, No. 3, pp. 185-199, 2004.
[6]. Abdulkader A. Murad , Using GIS for Planning Public General Hospitals at Jeddah City, Journal of King Abdulaziz University-Environmental Design Sciences, Vol.3, pp. 3-22, 2005.
[7]. Bryan L. Perdue, Introduction to Geographic Information Systems ,CADD/GIS Technology Center ,3909 Halls Ferry Road.Vicksburg, 2007.
[8]. http://www.moh.gov.sa/ (*access date 2/3/2017*)
[9]. Thomas Kistemanna, Friederike Dangendorfa, J¸rgen Schweikartb, new prospective on the use of geographical information system (GIS) in environmental health science, international journal of hygiene and environmental health, vol. 205, pp. 169-181, 2002.
[10]. Charles E. Noon, Charles T. Hankins, Spatial Data Visualization in Healthcare: Supporting a Facility Location Decision via GIS-based Market Analysis, Proceedings of the 34th Hawaii International Conference on System Sciences IEEE, 2001.
[11]. Rebecca Ledsky,, Caleb Parker, Alexandria Smith, Andre Weldy, Thomas Lehman, Lisa Tensuan, Jane Bittner, and Kristina Olson, Geographical Information Systems (GIS) Tools: Fostering Healthcare, Health Communication Activities and Materials, National conference on health communication marketing and media , August 20, Atlanta, 2013.

Hala Ahmed Hamed Maala "GIS As A Tool To Management The Government Services In Saudi Arabia: Case Study Of Health Services In Assir Region" American Journal of Engineering Research (AJER), vol. 7, no. 2, 2018, pp. 198-206.