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ASSESSMENT OF PHARMACEUTICAL SERVICE DISTRIBUTION USING GIS (A CASE STUDY OF KHARTOUM LOCALITY)

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Abstract - *Pharmaceutical service issue is one of important issues that affect different aspects of urban affairs. Its relation with health care make it necessity to be near and ease to access by all residents. The decision of locating health services such as health care services or pharmaceutical services not only in terms of costs to users but also determining the spatial distribution of demand for residential development in the city is important and has a noticeable effect.*
The aim of this research work was oriented to study the geographical distribution of pharmacies and their spatial coverage to identify how it is cover the study area and to what extent. Khartoum locality was selected to run this research work.
The data in this work was extracted from digital maps beside available descriptive data that obtained from authorized resources. Moreover, field visits also used to complete the necessary data.
GIS package used to created maps showing pharmacies locations, coverage area and determine shortage area for pharmacies by using analysis tools.
Results showed that pharmaceutical service does not cover all residential areas and it is not well distributed over the locality. Beside that a shortcoming of 94% of the required service was appeared. Moreover, existing pharmaceutical service coverage is one pharmacy for each 1,331 person, where it should be one pharmacy for each 78 person according to distribution standards.

Key Words: GIS, GPS, Khartoum locality, Pharmaceutical service, Spatial distribution.

1. INTRODUCTION

Pharmacies are among the most important centers that cater for quick, timely and cost-effective access to services in cities towards achieving the basic goals of development, namely social justice and fair development. Pharmacies also have significant effects on determining the pattern of urban development and spatial distribution of demands for residency in cities [3].

Hence, pharmacies can be employed as a tool for controlling and regulating the spatial distribution of population and facilities throughout cities as well as reducing the concentration of resources that have been the main cause of the growing loads of pollution, transportation, waste of time, and energy of the urban residents.

Support timely access to medicines and professional pharmacy services for all people is one of strategic goals and challenged for any developing society.

2. KHARTOUM STATE

The republic of Sudan includes eighteen states. Although Khartoum State is the smallest state in the country by area of 22,142 km^2, it is the most populated one. Its population approximated with 8,000,000 in 2019.

Khartoum state comprises three large cities; Khartoum, Khartoum North (Bahri) and Umdurman.

The city of Khartoum represents the capital of the state as well as the national capital of Sudan. The capital city contains offices of the state, governmental and non-governmental organizations, cultural institutions, and the main airport.

The city is located in the heart of Sudan at the confluence of the White Nile and the Blue Nile, where the two rivers unite to form the River Nile. The confluence of the two rivers creates a unique effect [3].

Khartoum state geographically extended between 31.5° to 34° E and 15° to 16° N. It is bounded by Northern state in the north, River Nile in the north east, Kassala in the east, and Gazira and White Nile in east south. Where, North Kurdufan state located at the West boundary of Khartoum [2]. Figure (1) below illustrates Sudan states distribution.

Fig -1: Distribution of Sudan states (After openaccesspub.org)

3. GEOGRAPHIC INFORMATION SYSTEM

Geographic Information System (GIS) is an Information System for creating, maintaining, managing and using geographic knowledge. It is an integrated platform for spatial data management and analysis.

GIS is used to produce maps from different data sources as imageries after the latter are digitally processed. In addition, it is used to overlay several map layers (Figure-2) for spatial visualization and analysis using vector or raster data or both.

In the past, GIS was used as a tool for individual projects and departments but in recent years, it has moved very fast from being a tool to become the framework for sharing information among organizations and across society.

There are many different GIS packages available around the world. These vary in their capabilities and features. The growth of the GIS industry, as a result of technological innovations has been exponential.

Today, hundreds of thousands of organizations are sharing their work and creating billions of maps every day to tell stories and reveal patterns, trends, and relationships about everything [5].

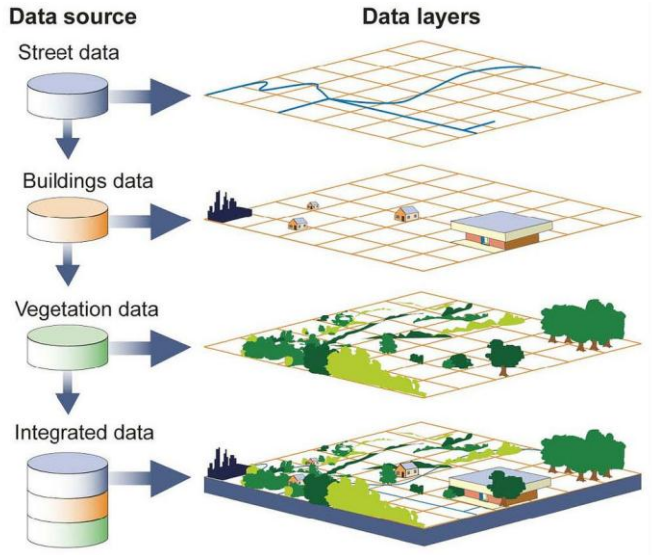

Fig -2: GIS layers

4. DATA COLLECTION

Ministry of health of Khartoum state government was the main source of data. Names and general locations of pharmacies in Khartoum locality provided by the ministry. A total number of 584 pharmacies were exist in Khartoum locality.

Central statistical organization assisted in providing Khartoum locality population that estimated by 777,381 inhabitants in 2019.

A digital map representing Khartoum locality obtained from Khartoum ministry of physical planning as shown in figure (3) hereunder.

Fig -3: Khartoum locality map

In order to represent pharmacies locations in digital map, their coordinates are required. A hand-held GPS receiver used to collect locational data (X, Y) of each pharmacy. This spatial data assists the process of analyzing the distribution of pharmacies over the study area. Figure (4) below represents sample of collected data.

A	B	C
X	Y	إسم الصيدلية
454969.7804	1717348.294	صيدلية دكتورة وداد
449639.9566	1722959.265	صيدلية التسامح
451488.1347	1723135.161	صيدلية رنا كير
451387.5094	1723119.382	صيدلية مستشفي أفريقيا
451904.9538	1721276.256	صيدلية الملك نمر
451624.2996	1721383.481	صيدلية رواج
451465.8817	1721350.982	صيدليه ابا يزيد فارما
451742.6925	1721024.67	صيدليه القمه التخصصي
451890.1046	1720837.426	صيدلة المركز العلاجي
451778.6204	1720900.543	صيدلية المني العالميه
451167.1827	1720723.024	صيدليه العمارات الجديده
451675.0269	1720293.452	صيدلية يونيفيرسي
450317.9778	1723657.243	صيدلية الخرطوم 2
449802.8096	1723591.151	صيدلية نور
453032.2746	1722887.261	صيدلية عمليون
453924.2195	1723323.743	صيدلية بايونير
454007.2135	1723185.093	صيدلية زون
454363.4335	1723321.818	صيدلية علياء
453148.4339	1722149.765	صيدليه علياء
453403.5387	1722243.517	صيدليه ريفان
453009.3801	1722457.205	صيدليه كاف
454087.6649	1722618.041	صيدليه ابن الملك
454368.3318	1722336.298	صيدليه السرنجس

Fig -4: Sample of pharmacies and their coordinates

5. ANALYSIS AND RESULTS

According to the collected data, the number of pharmacies in Khartoum locality was found to be 584 pharmacies. This number should have to serve 777,381 inhabitants. On the other word, analysis of the pharmacies compared with the population yields, one pharmacy for each 1,331 persons. Table (1) below shows pharmaceutical service coverage ratio.

Table -1: Pharmaceutical service coverage ratio

Population	No. of pharmacies	Coverage Ratio
777381	584	1/1,331

In order to take an idea about locations and distribution of pharmacies service in Khartoum, the collected spatial data of pharmacies entered in ArcGIS 10.5 package as points coordinates. As a result, Khartoum map showing pharmaceutical service distribution was obtained as illustrated in figure (5) below.

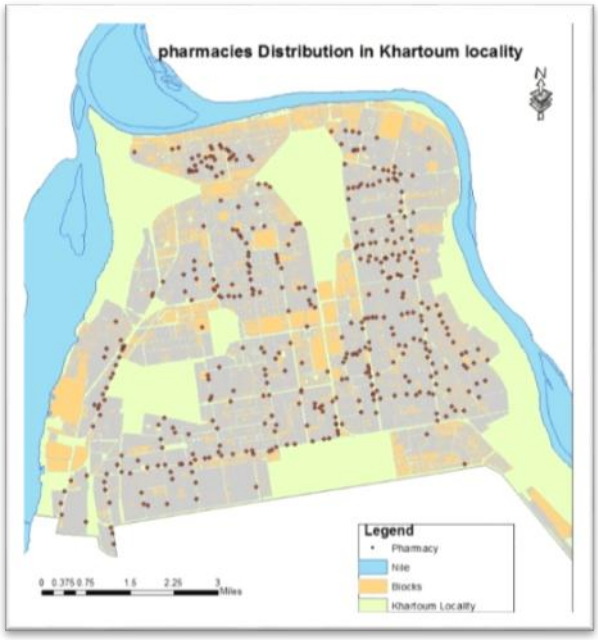

Fig -5: Pharmaceutical service distribution

From the figure above, it can obviously be noted that, pharmaceutical service does not cover all residential areas. It is not well distributed since it is slightly concentrated in some place and scattered in another.

According to pharmaceutical service distribution standards, each pharmacy should be 100 meters far from another. Satisfaction of this criteria reflects an ideal distribution of the service.

To examine satisfaction of 100m criteria, GIS analysis tools was used. For each pharmacy, a buffer of 100m was applied accordingly. Thus, the resultant map of Khartoum locality was obtained as shown in the below figure.

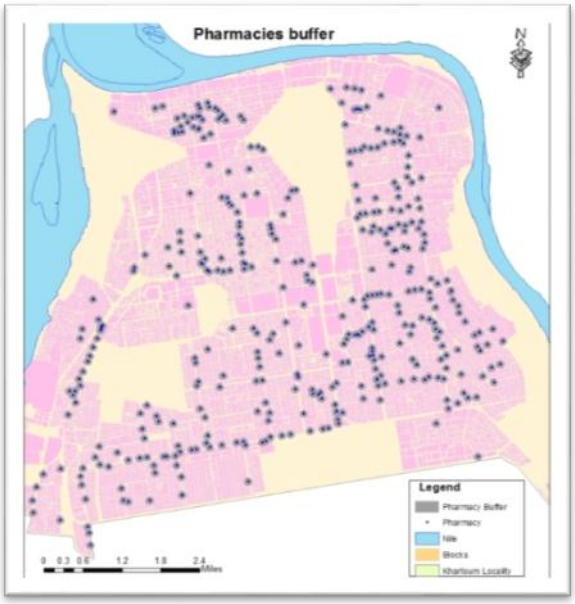

Fig -6: Pharmacies buffers of 100m

From the above figure, it can easily be remarked that the existing pharmacies do not meet 100m distribution criteria in most areas of Khartoum locality. Not only this, but also some areas did not covered by pharmaceutical service at all.

Now, by calculating number of pharmacies required to satisfy the 100m criteria it can be found that about 10,015 pharmacies are required to fulfil this standard.

On the other hand, assuming well distribution of the existing pharmacies will yield about 414m part between each adjacent pharmacies.

This result leads to say that the existing pharmaceutical service covers only about 6% from the required one. i.e shortcoming of 94% is exists.

Thereafter, instead of 100m criteria, 200m, 300m, and 400m, assumed. Then, the number of pharmacies required and shortage in services were calculated. Results of assumed buffer and shortage expected are tabulated as shown in table (2) below.

Table -2: Shortage in service via buffer and number of pharmacies

Buffer	No. of pharmacies	Shortage In service %
100	10,015	00
200	2,504	75
300	1,113	89
400	626	93
414	584*	94

*Number of existing pharmacies

6. CONCLUSIONS AND RECOMMENDATIONS

Pharmaceutical services as a complementary part of medical service should necessary be near and easy to access by inhabitants. This research concentrated on existence and locations of such service. Therefore, its spatial coverage and its distribution compared with the number of population were analyzed.

From the data collected, analysis carried out and results obtained, one can conclude with the following points:

- Pharmaceutical service does not cover all residential areas of Khartoum locality.
- Pharmacies do not meet the 100m distribution criteria. The average distribution of existing pharmacies estimated to be 414m.
- Existing pharmaceutical service coverage is 1 pharmacy for each 1,331 persons.
- According to the 100m standards, pharmaceutical service coverage should be raised to be one pharmacy for each 78 person. i.e a shortcoming of 9431 pharmacy is exist. This shortcoming represents about 94% of the required service.
- Changing to 200m, 300m and 400m part between each adjacent pharmacies, shortcoming of 75%, 89%, and 93% arise successively.
- There are some disparities in the spatial distribution of pharmacies at the locality level. So GIS can efficiently be used to redistribute pharmacies locations and selecting suitable location of new ones.
- The shortcoming among pharmaceutical services may also open a good chance for service provider to invest in this sector.

Further studies of pharmaceutical services and their quality are recommended to better identify local needs and develop public health strategies.

It is also recommended to make a reverse study starting from the ideal number of persons for each pharmacy then, calculating backward to find the number of pharmacy and redistribute them over the study area using GIS.

REFERENCES

[1] Cristiana Vîlcea, Sorin Avram(2019),Using GIS methods to analyse the spatial distribution and public accessibility of pharmacies in Craiova city, Romania, Bulletin of Geography. Socio-economic Series, No. 45.

[2] Eiman Eisa Ahmed Elhaj, Nagi Zomrawi Mohammad, A Rahim Elhag (2017), Recent Development of Secondary School Coverage in Khartoum, International Journal of Trend in Research and Development (IJTRD), Volume-4, Issue-3.

[3] http://apps.who.int/medicinedocs/documents/s18006en/s18006en.pdf

[4] https://en.wikipedia.org/wiki/Khartoum.

[5] https://www.esri.com.

[6] https://openaccesspub.org/jar/article/875

[7] Nagi Zomrawi Mohammad and Eiman Eisa Ahmed Elhaj, (2017), Analysis of Basic Education Extension in Khartoum State Using GIS, International Journal of Trend in Research and Development, Volume 4(3)

[8] Nagi Zomrawi Mohammad and Eiman Eisa Ahmed Elhaj, (2017), A Study of Health Services Coverage in Khartoum State Using GIS, International Journal of Trend in Research and Development, Volume 4(1).

[9] Sohyla Reshadat, Alireza Zangeneh, Shahram Saeidi, Arash Ziapour, Fariba Saeidi, Maryam Choobtashani (2018), A Study of the Application of Geographic Information Systems (GIS) in Children Access to Pharmacies: A Case Study of Kermanshah, West of Iran, inter Journal Pediat, Vol.6.

[10] yaghfouri h., fotouhi s., beheshtifar j. (2013), application of gis in the analysis of the spatial distribution and localization of pharmacies (case study: pharmacies of jahrom city), Research and Urban Planning volume 4, number 14.