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RESEARCH ARTICLE

Mapping of pharmaceutical service facilities (pharmacy) based on geographic information in Surabaya

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Abstract

Background: The need for accessibility to health facilities, including pharmacies, hospitals, health centres, health clinics, and others, increases due to population growth in Indonesia. The approach to mapping the geographic location of health facilities needs to be used as a policy reference in determining the achievement of national health care coverage. **Objective:** This study aims to see the distribution of pharmacy locations in Surabaya and its relationship with the population and epidemiological parameters. **Method:** Geographic information of pharmacies in Surabaya was collected from a database provided by the Indonesian Ministry of Health. Population data in 2019, including the number of district residents in the Surabaya area, the number of hospitals and clinics, and the number of disease cases, were obtained from the Central Statistics Agency of Surabaya. **Result:** A total of 791 pharmacies are spread across 31 districts in the city of Surabaya. The ratio of pharmacies number to the population per district varies from 1:1426.7 to 1:49806.0. The number of pharmacies per district significantly correlates with the number of hospitals and clinics in each district of Surabaya ($r = 0.784$). **Conclusion:** The distribution of pharmaceutical service facilities (pharmacies) in Surabaya is still uneven and centralised, following hospitals and clinics distribution in each district.

Introduction

Pharmaceutical services have changed very rapidly. It started with the discovery of drugs derived from plants and developed synthetic drugs with therapeutic properties. In the era of pharmaceutical services that focus on drugs as products, the direct approach pursued by pharmacists is to produce and sell as many drugs as possible. This phenomenon makes pharmacies the only place where the process of buying and selling drugs and prescription services occurs. Furthermore, it creates many potential drug-related problems that patients will experience. In the patient-focused pharmaceutical services era, the therapeutic needs of individual patients are a concern and consideration in pharmacist services. Identification of drug-related problems through the assessment process is essential, complemented by a counselling and monitoring

process to ensure that patients achieve the therapeutic goals that have been set (Cipolle, Strand & Morley, 2012). Although most pharmacists consider that value-added pharmaceutical services are essential, several obstacles exist, so their implementation is not optimal. These constraints include time, pharmacist competence, limited counselling space, lack of consumer demand, and limited access to pharmacies, leading to a lack of optimal pharmaceutical services. Pharmacies have not yet become health facilities based on location-based community services, thus hampering value-added comprehensive pharmaceutical services (Eades, Ferguson & O'Carroll, 2011; Todd *et al.*, 2014).

Geographical location plays an essential role in the success of health services and is a significant factor in determining patient decisions in choosing health facilities. Healthcare providers, including pharmacies,

must be easily accessible to consumers. In Indonesia, regulations governing the distribution of pharmacies are left to each local government. Article 5 of the Regulation No. 9 of 2017 of the Ministry of Health of the Republic of Indonesia (Kemenkes RI) concerning pharmacies states that "Regency/City Governments can regulate the distribution of pharmacies in their territory by ensuring access to pharmaceutical services to the public " (Menteri Kesehatan Republik Indonesia, 2017).

However, the implementation is still not optimal. Several studies on access to pharmacies in Indonesia reported that pharmacies are still not evenly distributed. In Banjarbaru City, pharmacies are grouped in specific locations near hospital locations. The number of pharmacies is still not directly proportional to the population of Banjarbaru City (Zaini, Satibi & Lazuardi, 2016). Another study reported that pharmacies in Jogjakarta are only concentrated on main roads and usually centred on the location of the district border. The ratio of the number of pharmacies to the population in Jogjakarta is 1:3,967 (Sukamdi, Lazuardi & Sumarni, 2015).

In East Java, the city of Surabaya is the city with the highest number of pharmacies, with 791 pharmacies (in 2019) spread over 31 districts covering a total area of 326.81 km². These pharmacies serve 3,094,732 people of Surabaya (1:3,912). Therefore, regulating the distribution of pharmacy locations in the Surabaya area is crucial. This study aims to evaluate the distribution of pharmacy locations in Surabaya and its relationship with the population and epidemiological parameters.

Methods

Study design

This non-experimental descriptive study used secondary data in the form of pharmacy locations in Surabaya, population attributes data on the boundary map of the district of Surabaya, and the hospital's location in Surabaya.

Data collection

Pharmacy and hospital locations in Surabaya were obtained from the Ministry of Health of the Republic of Indonesia publication in 2019. The address data is then converted into spatial data and separated into every 31 districts in Surabaya. Attribute data for the district of Surabaya city, such as population data and the number

of visits to the Public Health Centre (*Puskesmas*), was obtained from the Surabaya City Central Statistics Agency publication in 2019. Meanwhile, data on the administrative boundaries of the districts in Surabaya were obtained from the Indonesian Geospatial Information Agency.

Data analysis

The thematic map of the ratio of the number of pharmacies to the number of residents in each district was prepared using Q-Geographic Information System (QGIS). The relationship between the number of pharmacies, total population number, the number of hospitals, and the number of visits to the *Puskesmas* in each district in Surabaya were analysed using the Spearman correlation due to data normality.

Results

As per the Ministry of Health 2019 data, 791 pharmacies were distributed across Surabaya, ranging from 1 to 70 pharmacies per district (Table I). *Asem Rowo* had the smallest number of pharmacies and *Gubeng* the highest number. The number of hospitals and clinics spread across Surabaya varies from 1 hospital/clinic to 40 hospitals/clinics per district. In 2019, the total number of hospital visits per year ranged between 4,331 (Bulak district) and 345,006 (Wonokromo district).

After calculation, the number of pharmacies to the number of residents per district varied from 1:1,426 to 1:49,806. *Asem Rowo*, *Bulak*, *Krembangan*, and *Semampir* were among the districts with a ratio above 1:10,000. In comparison, *Mulyorejo* and *Tenggiling* Mejoyo were the two districts where the number of pharmacies to the population was below 1:2,000 (Figure 1).

Correlation analysis between the number of pharmacies vs district population, number of hospitals and clinics, number of hospital visits shows that the distribution of pharmacies in each district is strongly correlated with that of hospitals ($p = 0.000$ with $R_s = 0.784$). The correlation between the number of pharmacies and the total population per district was significant with $p = 0.004$ and $R_s = 0.499$. Also, the correlation between the number of pharmacies and hospital visits was significant with $p = 0.000$ and $R_s = 0.615$ (Table II).

Table I: Pharmacy and hospital distribution in Surabaya districts

District	Number of pharmacies in 2019	Population number in 2019	Number of pharmacy vs population ratio	Number of hospital/ clinic	Number of hospital vs pharmacy ratio	Hospital visit (outpatient & inpatient) in 2019	Number of pharmacy vs hospital visit ratio
Asem Rowo	1	49,806	1:49,806.00	1	1:1.00	8,554	1:8,554.00
Benowo	16	68,351	1:4,271.94	3	1:5.33	90,937	1:5,683.56
Bubutan	16	107,823	1:6,738.94	3	1:5.33	17,007	1:1,062.94
Bulak	2	46,164	1:23,082.00	1	1:2.00	4,331	1:2,165.50
Dukuh Pakis	25	62,786	1:2,511.44	21	1:1.19	27,300	1:1,092.00
Gayungan	23	47,819	1:2,079.09	9	1:2.56	71,905	1:3,126.30
Genteng	20	63,153	1:3,157.65	21	1:0.95	136,409	1:6,820.45
Gubeng	70	143,853	1:2,055.04	40	1:1.75	291,522	1:4,164.60
Gunung anyar	19	60,500	1:3,184.21	10	1:1.90	15,381	1:809.53
Jambangan	12	54,099	1:4,508.25	2	1:6.00	13,956	1:1,163.00
Karang Pilang	10	77,554	1:7,755.40	5	1:2.00	12,192	1:1,219.20
Kenjeran	25	179,197	1:7,167.88	3	1:8.33	49,046	1:1,961.84
Krembangan	9	126,732	1:14,081.33	8	1:1.13	27,195	1:3,021.67
Lakarsantri	10	61,854	1:6,185.40	9	1:1.11	20,672	1:2,067.20
Mulyorejo	64	91,310	1:1,426.72	35	1:1.83	81,371	1:1,271.42
Pabean Cantian	20	85,850	1:4,292.50	9	1:2.22	117,601	1:5,880.05
Pakal	4	58,593	1:14,648.25	3	1:1.33	33,915	1:8,478.75
Rungkut	41	121,234	1:2,956.93	17	1:2.41	45,796	1:1,116.98
Sambikerep	26	66,782	1:2,568.54	8	1:3.25	18,075	1:695.19
Sawahan	48	216,393	1:4,508.19	12	1:4.00	36,997	1:770.77
Semampir	15	206,438	1:13,762.53	5	1:3.00	32,838	1:2,189.20
Simokerto	12	104,135	1:8,677.92	4	1:3.00	55,648	1:4,637.33
Sukolilo	50	116,893	1:2,337.86	20	1:2.50	149,889	1:2,997.78
Sukomanunggal	21	108,221	1:5,153.38	11	1:1.91	36,990	1:1,761.43
Tambaksari	43	239,251	1:5,563.98	21	1:2.05	55,705	1:1,295.47
Tandes	22	96,583	1:4,390.14	11	1:2.00	55,115	1:2,505.23
Tegalsari	24	108,079	1:4,503.29	29	1:0.83	34,941	1:1,455.88
Tenggilis	40	60,262	1:1,506.55	14	1:2.86	28,736	1:718.40
Mejoyo							
Wiyung	22	73,963	1:3,361.95	11	1:2.00	91,931	1:4,178.68
Wonocolo	17	85,278	1:5,016.35	18	1:0.94	40,741	1:2,396.53
Wonokromo	65	169,987	1:2,615.18	36	1:1.81	345,006	1:5,307.78
Mean	25.55	101,901.39	1:7,221.77	12.90	1:2.53	66,054.90	1:2,921.57

Table II: Correlation analysis

Correlation between number of pharmacy vs	Significance (p)	Coefficient of correlation (Rs)
Number of population	0.04 [†]	0.499
Number of hospital	0.0001 [†]	0.784
Hospital visit (outpatient & inpatient)	0.0001 [†]	0.615

[†]Significant at $\alpha=0,05$

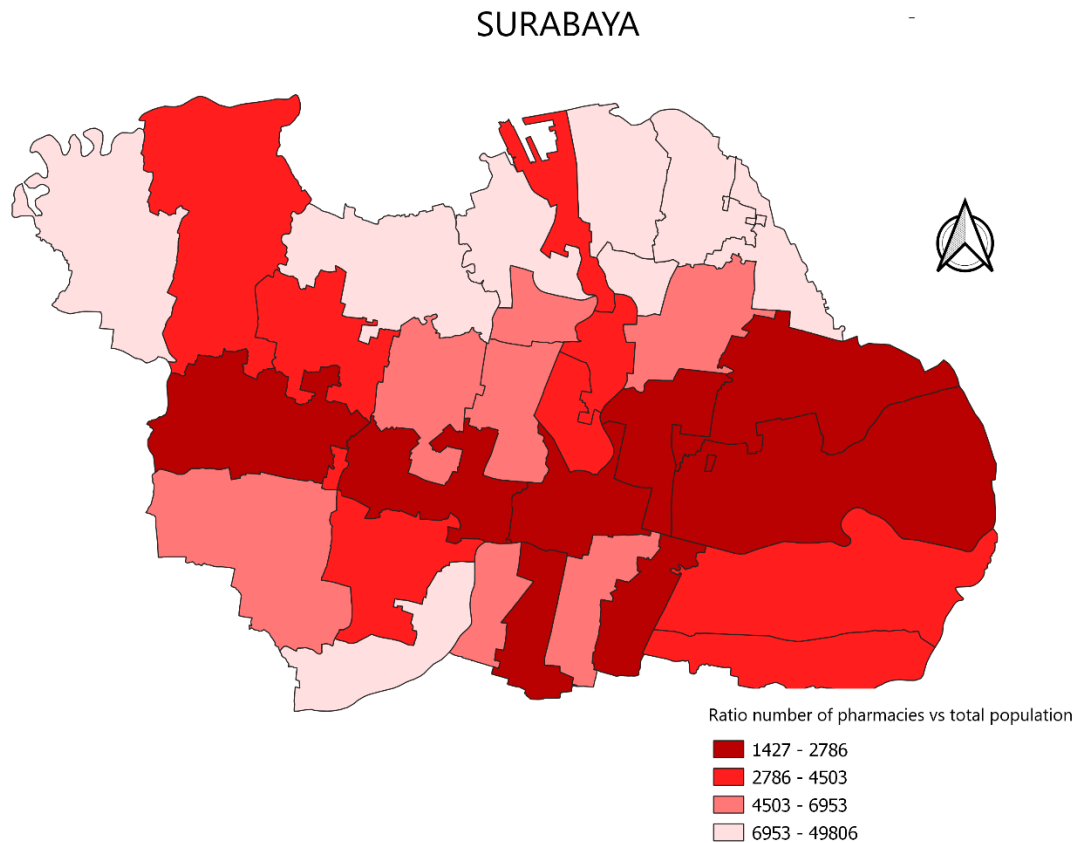


Figure 1: Pharmacy vs population number distribution map in Surabaya

Discussion

Based on article 51 of 2009 concerning pharmaceutical work, a pharmacy is where pharmacists practise pharmaceutical services. Pharmaceutical service is a direct and responsible service to patients related to pharmaceutical preparations to achieve definite results to improve patient quality of life (RI, 2009).

The pharmacy's location must be easily accessible to the public to provide good services. Geographical location plays an essential role in the success of health services and is a significant factor in determining patient decisions in choosing health facilities. Health care providers, including pharmacies, must be easily accessible to consumers. One measure of affordability is the proximity of the pharmacy to the patient's house. In the concept of access approach, patients who need health services will seek the nearest health service. Therefore, determining the location of health services must consider the demographic conditions of the area (Pechansky & Thomas, 1981; Levesque, Harri, & Russell, 2013; Kelling, 2015). Several previous studies reported that the community chooses pharmaceutical services

(pharmacies) because it is closest to their homes (Sasanti Handayani & Gitawati, 2009).

This study found that the 791 pharmacies in Surabaya were distributed unequally across 31 districts. *Asem Rowo* District, with 49,806 people, is only supported by one pharmacy in the area. This condition makes the service burden very high in that region. People in *Asem Rowo* have to visit pharmacies in other areas to redeem the medicines they need. Another potential problem is related to the time of getting the drugs needed by patients. The proximity of the pharmacy is essential in supporting the success of therapy for certain diseases. Previous research found a significant relationship between the success of asthma management and the distance between the pharmacy and the patient's house. Patients living at an average distance of 3.2 miles from the pharmacy had different therapeutic success profiles than those living at an average distance of 1.9 miles from the pharmacy. This condition is related to the speed of redeeming asthma drugs when the patient has an attack (Deshpande *et al.*, 2018).

On the contrary, in *Mulyorejo*, the ratio of pharmacies vs population was below 1:1,500. Pharmacies were grouped according to the number of hospitals widely

available in the area. This result is similar to the findings of several other countries around the world. A follow-up study in 2018 found that the distribution of pharmacies in the United Kingdom is clustered, where 75% are located in clusters (10 minutes walking from the nearest pharmacy). There is a significant difference that the pharmacies that make up the group are in areas with a high social environment and income, while areas with a low social income had a more even distribution of pharmacies (Todd *et al.*, 2018).

Grouping pharmacies in an area would increase competition, making pharmacies engage in a price war strategy, where service quality is no longer a top priority. The pharmacist's decision determines the distribution of pharmacy locations as the pharmaceutical facility owner chooses the site. The behavioural approach can be used where selecting the pharmacy location is the behaviour itself (Michie, Stralen & West, 2011).

The average number of pharmacies to the population in the Surabaya area is 1:7,221, indicating the need for new pharmacies in the future to reach the ideal ratio of 1:3000. But the distribution of locations needs to be improved in a structured policy. In other countries such as Iran, public access to pharmaceutical services is also regulated by local governments. A study conducted in 2014 showed that 88% of households in Iran could easily access pharmacies that provide 24-hour pharmaceutical services the whole week, either through private vehicles or on foot (Hashemi Meshkini *et al.*, 2014).

In the future, pharmacy licensing regulations based on geographic location need to be applied in the Surabaya area. The Surabaya City Health Office and the Indonesian Pharmacists Association must make special rules regarding this matter. Location aspects, including building permits and waste management planning, must be added with location determination based on the geographic location of the pharmacy. Furthermore, regional demographic parameters such as population size and the epidemiological profile of each region also need to be used as a basis for policy determination.

Study limitation

In this study, all data are secondary data provided by related parties; therefore, further research is needed to clarify the distribution map of pharmacies in Surabaya.

Conclusion

The distribution of pharmacies in the Surabaya area is still uneven and clustered in the downtown area,

following the location of the hospital. New pharmacies in Surabaya are still needed to achieve the ideal ratio of one pharmacy serving 3000 residents. However, it is necessary to rearrange the licensing of new pharmacies for an even distribution of pharmacies in the Surabaya area based on geographic location.

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