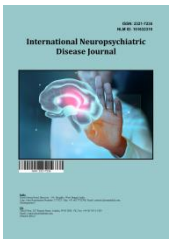

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Simple Geographic Distribution of Patients with Stroke According to their Medical Care Financing System in a Private University Hospital

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Authors' contributions

This work was carried out in collaboration between both authors. Author ED designed the study, performed the statistical analysis, wrote the protocol, managed the analyses of the study and wrote the first draft of the manuscript. Author NW managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Aims: To reveal the geographical distribution of stroke patients in a private university hospital in Jakarta, Indonesia according to their address and further divide them into three sub group of using universal health coverage (UHC) vs other type of insurance ((OTI) vs private non insurance patient (private)
Study Design: simple retrospective cross-sectional study.
Place and Duration of Study: Sample: Medical record from patients of the Department of Neurology, *Rumah Sakit* Universitas Kristen Indonesia, Jakarta Indonesia; a private university hospital located in Jakarta Indonesia, between January 2021 and December 2023.

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Methodology: We analyzed medical record of 162 patients (90 men, 72 women; age range 15-87 years (mean age 61.12 SE± .82) with history of stroke and at the present routinely underwent routine medical control (outpatient) or with current diagnosis of stroke (inpatient in our hospital). We further divided them based on their medical care financing system (UHC vs OTI vs private) and using the help from GPS service made available by Google Maps™ we simply try to make a geographical distribution of those patients based on their address/residence location
Results: Geographical distribution of patients using UHC were closer to the hospital compared to the other 2 non UHC medical care financing users.
Conclusion: Our analysis regarding stroke patients in our hospital (2021-2023), we found that 55.6% male patients, 42% were in the range of age between 55-64 years old, most of the patient (94.4%) using BPJS as their medical care financing system, with 27.7% came from sub district Makkasar which is near from our hospital. Further analysis using the help of Google maps™ we can show that the UHC or BPJS health referral system has facilitated patients receiving health services at the health facility closest to their residence.

Keywords: Referral; social security agency for health; chronic; rehabilitation; ischemic; hemorrhagic.

1. INTRODUCTION

Badan Penyelenggara Jaminan Sosial Kesehatan (BPJS Kesehatan, or 'Social Security Agency on Health') is a social security agency of Indonesia, Social Security Fund as a Form of Constitutional Responsibility for the Right to Health [1], and was aimed at providing universal health care to all of its citizens [2] which launched in January 2014. The Indonesian government launched a universal health care system called the Jaminan Kesehatan Nasional (JKN, "National Health Insurance"). Covering around 95.77% or 268 million of people by February, 2024 [3], it is the world's second most extensive insurance system or to be more precisely called publicly funded health insurance (PFHI) program, after the programme in India with population coverage of 500 million [4].

As part of the implementation of JKN, on the first day of 2014, PT Askes (Persero) was shifted from a state-owned company into BPJS Kesehatan, a state appointed public agency, which becomes the sole provider of JKN [5]. It is hoped that the entire citizen of Indonesia will be covered in the year 2019 [6]. In 2016, the BPJS program suffered from a horrible deficit of more than six trillion IDR. However, the deficit expanded up to 32 trillion in only three years [7]. In response, the government issued a policy that increases the monthly premium for access using system dynamics method [8]. Expert opinion regarding the government policy saw that the move as adding more burden on low to middle-income citizens [9].

BPJS Kesehatan, or Badan Penyelenggara Jaminan Sosial Kesehatan, is a state/government-managed health insurance program established in Indonesia that offers protection for its members, as long as the pay [8,9], and it provides equal access to health facilities for everyone [1,2], with no exception to those who live in rural, remote and even poor areas [10]. BPJS covers hundreds of diseases [11], including chronic conditions like stroke [12] and Indonesia is the leading country in the number of stroke patients throughout Asia with a stroke rate of 3,382.2/100,000 people and stroke-related mortality in the south east Asian Region was the highest in Indonesia [13]. Since the launching of BPJS, the early detection of stroke has become more effective and efficient [14].

In 2022, it estimated that healthcare costs for stroke patients in Indonesia, covered by BPJS Kesehatan, ranging from the smallest Rp 1,937,400 to the highest Rp 207,675,700, averaging Rp 8,487,531 per patient [15,16]. BPJS Kesehatan's actual total spending on stroke treatment and in combination with patient's rehabilitation in 2022 estimated as much as Rp 2,883,269,825,972. The biggest group benefiting from this were those receiving Beneficiary Contribution Assistance (PBI) from the government, which in 2019 estimated reached >96 million or roughly 46.5% of all National Health Insurance participants.

The aim of this simple preliminary study is to reveal the geographical distribution of stroke patients in a private university hospital in Jakarta, Indonesia according to their address and further divide them based on their medical care financing system.

2. METHODOLOGY

During June to July 2024 at the dept. of Community Medicine, we cross sectionally analyzed medical record of 162 patients (90 men, 72 women) with history of stroke and at the present routinely underwent routine medical control (outpatient) or having current diagnosis of stroke (inpatient in hospital) in a private university hospital located in Jakarta, Indonesia; all 162 patients were patients from January 2021 to December 2023. We further divided them based on their medical care financing system (BPJS vs OTI vs private) and using the GPS service made available by Google Maps™ we simply try to make a geographical distribution of those patients based on their address/residence location.

3. RESULTS AND DISCUSSION

This simple retrospective cross sectional study of 162 patients of stroke revealed an interesting phenomenon. First lets started with demographic conditions of these patients.

Within three years (2021-2023) there were gradual reduction on the number of patients with stroke, and this perhaps due to the tiered hospital/health facility referral system. within those three years, there are more and more primary health care facilities, whose service levels are actually below hospitals, but are actually become more capable to handle stroke patients themselves, so they no longer need referrals to higher hospitals.

Based on the sizes and medical services coverage, the health facilities in Indonesia are divided into two tiers: primary care providers and secondary care providers [17,18]. Primary care providers consist of private physicians, community clinics, primary health care facilities/centers (Puskesmas), and class D-hospitals [19,20], whilst secondary care providers categorized as specialized or even sub-specialized service (which cannot have conducted in primary care providers) and consists of classes A to C-hospitals with class A as the highest tier [21]. The higher the hospital "tier", the more coverage of health services are provided.

Table 1. Demographic characteristics

Characteristics		N (162)	%
Year	2021	71	43.8
	2022	55	34.0
	2023	36	22.2
Gender	Men	90	55.6
	Women	72	44.4
Age	15 – 24	1	0.6
	25 – 34	0	0
	35 – 44	4	2.5
	45 – 54	29	17.9
	55 – 64	68	42
	65 – 74	49	30.2
	>75	11	6.8
Medical care financing system	BPJS	153	94.4
	Private	8	4.9
	OTI	1	0.7
The patient comes from the sub-district (*kecamatan*)			
Cakung		2	1.2
Cipayung		7	4.3
Ciracas		4	2.5
Duren sawit		10	6.2
Jatinegara		17	10.5
Kramat Jati (where the hospital exists)		36	22.2
Makkasar		44	27.2
Matraman		0	0
Pasar Rebo		1	0.6
Pulogadung		1	0.6
Area outside east Jakarta		40	24.7

Real efforts from all stakeholder are needed to organize better health promotion programs down to the community level with a more rational and a better distribution of neurologists and neurointerventionalists which is needed in order to tackle this preventable disease [22]. All community based hospitals should have a ready to use CT scan machine and stroke units to minimize in-hospital mortality rate [23]. Intensifying telemedicine for stroke patients [24] is a very promising effort as an addition to the improvement of integrated acute stroke management system [25].

Regarding the gender of the patient with stroke in our hospital, there are more male patient than female patient (55.6 % Vs 44.4%). Our findings also in line with the findings of Zamzam et al [26] where those researchers found out the incidence of stroke higher in male gender (OR=1.48; 95% CI= 1.07 to 2.03 *p*=0.017).

Many study justified that age-adjusted burden of stroke is greater in men compared to women (4.4 vs 3.9 per 1,000 person-years) [27]. Nonetheless, the lifetime risk of stroke is higher in women than in men [28] and furthermore, women are at increased risk of stroke in the very old age group [29]. Since overall, women always have a higher life expectancy than men, the overall stroke burden is therefore higher in women [30]. This give us insight to analyze further in our future study regarding the impact of stroke on individual burden post hospitalization, psychologically, economically and also clinically.

Age is an essential non-modifiable risk factor for stroke [31,32]. The age distribution in our patient are as follow. The youngest patient is 15 years old and the oldest 87 years old with mean age 61.12 years (SE±.825, SD± 10.59). previous report from Kusuma in 2009 stated that the mean age of stroke patients found in Indonesia is 58.8 years [33]. According to the INTERSTROKE study, the mean age of stroke was 62.2 years overall compared to 59.6 and 56.6 in South and Southeast Asia, respectively [34]. In other part of the world, the risk of stroke among European populations in 6 countries study revealed that median age was 73 years and the distribution based on gender was varied more than 2-fold in men and women. On average, higher rates of stroke were observed in eastern and lower rates in southern European countries [35]. while in the United States, according to a 2012 study, the mean age of stroke in the United States is 74.3 years, with a standard deviation of 13.6. Men tend to have strokes at a younger age than women, with a mean age of 71.4 years for men and 76.9 years for women [36]. The mean age of stroke patients in Africa varies by study and location: In Sub Saharan Africa region, including Somalia, stroke represents a significant portion of the chronic disease burden in previous studies veiling the whole region (not including data from Somalia), the overall pooled prevalence of ischemic stroke among all strokes was 61.4%, with a mean age range of 55 – 62.8 [37] while a study from South Africa revealed the mean age of the patients was 57.7 years [38].

The relative risk definitely increases with age, the incidence doubling with each decade after the age of 45 years and over 70% of all strokes occur above the age of 65. Of the estimated 795, 000 new or recurring strokes that occur in the United States each year, approximately 145, 000 will result in death [39]. Pathobiologically, aging is associated with shifts in the cerebral arteries's anatomy and physiology that actually can be used to predict the relative risk of stroke [40]. These patho-bio-anatomical shifts include:

(1) Endothelial dysfunction which release inflammatory mediators [41] that facilitates chronic neuro-inflammation [42],
(2) Impaired cerebral blood flow autoregulation [43] that lead to microvascular injury [44] which further lead to brain dysfunction and permanent cognitive or other higher brain function impairment [45] and
(3) Impaired neurovascular coupling, even reaching the zone outside the affected area [46], which definitely lead to a decline in cortical function and connectivity to other part of the brain [47].

The three factors above showed us how keeping a stable blood supply to the brain is essential for survival because it supplies the brain with sufficient oxygen, glucose and nutrients, which are necessary for the brain's homeostasis and to keep its function properly.

Based on their financing system, most of stroke patients in our hospital using BPJS as their primary funding source for their medical expenses (94.4%) in comparison with 4.9% that uses their own pocket money/private patient and only 0.7% considered as patient using other type of insurances. Other literature regarding the percentage of stroke patients in Indonesia who use BPJS compared to other insurance or private costs is difficult to find on the internet. Most of the available literature is regarding studies on the

use of BPJS in various types of chronic diseases, such as cancer [48], diabetes [49] and including stroke [14,15]. This shows that BPJS has been used widely in Indonesia and the coverage includes many types of diseases, various medical procedures/treatments as well as various types of health services from the first level (primary care) to the most advanced level (secondary or tertiary care in tier hospital) [16-20].

In 2022, healthcare costs for stroke patients in Indonesia, covered by BPJS Kesehatan, varied widely from Rp 1,937,400 to Rp 207,675,700, averaging Rp 8,487,531 per person. BPJS Kesehatan's total spending on stroke treatment and rehab in 2022 was reaching Rp 2,883,269,825,972, [15] one of the disadvantage is, as revealed by Rachmawati et al that the hospital costs exceeded the BPJS health insurance tariff leading to financial losses [50].

Most of our patient comes from the sub-district (*kecamatan*) Makkasar (27.2%) followed by Kramat Jati (22.2%), Jatinegara (10.5%), Duren sawit (6.2%), Cipayung (4.3%), Ciracas (2.5%), Cakung (1.2%), with Pasar Rebo and Pulogadung each 0.6%. These are sub district located in east Jakarta. There are 40 patients (24.7%) came from outside east Jakarta. This shows us that patient's referral system is organized with the aim of providing good quality healthcare, so that the purpose of service is achieved without having to use expensive costs [51], including in the context of distance.

Implementing this type of referral system makes health services in primary health facilities must be strengthened because First Level Health Facilities (FKTP) act as the first contact and filter for referrals to health services. FKTP is required to handle 144 disease diagnoses entirely according to the Indonesian Doctor Competency Standard (SKDI), which follows the Clinical Practice Guidelines.

We further evaluate the distance from the patient's address to out hospital. In order to estimate the distance (km) from the home address to the hospital, we used the directions feature from Google Maps and then entered the home address as the place of origin and the hospital address as the destination. The total distance shown by Google Maps is then recorded for further analysis to determine the distribution of distance from house to hospital based on the financing scheme. Mean distance of patient's address which use BPJS was 6.41km (Median 4.0km). On the other hand, for private patients, the mean distance from their home to our hospital was 12.87km (median 8.85km) and for OTI, there was only one patient and the distance from his/her house to our hospital was 11.4km. Data showed in the following box plot diagram presented in Fig. 1.

Distance to a health facility can affect how common or to which extent people use health services. [52] Delays in care-seeking for life threatening illness such as stroke may lead to more severe or even fatal outcomes [53]. a relationship between travelling further and having worse health outcomes cannot be ruled out and should be considered within the healthcare services location debate [54].

The result of our evaluation showed that the distance from a primary healthcare facility, based on the patient care financing system, was significantly different between group of BPJS vs private vs OTI (using Kruskall Wallis non parametric test, p=0.022). in general, BPJS patient's home were closer to our hospital compared to private patients and OTI patient.

This simple study actually is part of our student's thesis. By incorporating Google Maps™ with the patient's address and the hospital, we can develop simple health related geographic information system (GIS) by using data that is attached to a unique location, and it can be used to help people understand spatial patterns and relationships; in this context is the distribution of the patient in relation our hospital location. Post-covid pandemic, Medical education is become rapidly changing. Everyone in the business realize that COVID pandemic, globally and in Indonesia, had changed and forced the *civitas academica*, including lecturers, staffs and students, to make so many adjustments in order to make sure that learning is held in a proper manner, as best as possible [55]. During their educational process, medical students usually developed their own style of reading and learning in order to address those issue (pile of textbooks / papers / lecture notes they must read). Those style of reading and learning also supported by advancement of information and communication technologies [56]. The educational goals of using technology in medical education include facilitating basic knowledge acquisition, improving decision making, enhancement of perceptual variation, improving skill coordination, practicing for rare or critical events, learning team training, and improving psychomotor skills. Different technologies can address these goals [57].

This simple study showed us that the incorporation of information technology into existing data and combine it with other tools, e.g., maps, can make the data more informative to all stakeholder. Geographic Information System (GIS) is actually a trusted computer system that collects, stores, analyzes, and displays real time any kind of data (including health related data) in relation to the Earth's surface [58]. GIS is used in many industries and sciences, including health sector, to help stakeholder acknowledge spatial patterns and relationships [59]. GIS can also be used to inspect disease distribution (mapping, routing and even clustering) [60] and pinpoint areas with improving priority resource requirements [61], identifying communities, e.g., poor and underserved prone sub-population [62], or gaps in healthcare access [63], helping in prioritizing in strategic planning and effective-efficient response of local authorities [64]. GIS take part in an important role in governing the exact point where and when stakeholder start to surveillance [65], spatially mapping the risk pattern [66], the accessibility of health service and arbitrating health equity [67], increasing the quality of care [68], and even finding more cost-effective approach of health intervention in accordance to distance [69]. Our findings justify the previous last statement.

Geographical information systems (GIS) can be very helpful in the healthrelated domain, but unfortunately there are some unsolved problems which limits its use, including:

1) Its dependencies on the amount of data quality and availability, especially when doing field survey [70]. e.g., when preparing accurate data on disease transmission, then data regarding certain environmental condition and specific demographic information become a pre-requisition;
2) its vulnerability regarding data security and confidentiality because it usually deals with large and open source data [71], sometimes security devices become too prone for the potency of skimming, hacking and penetration. There is always concerns about data security and confidentiality;
3) its weaknesses in data interoperability and integration especially in emergency setting [72]; which include different type of data within the same file or handling the metadata, especially when the data needed in a short time;
4) its inconsistencies and even unwanted errors in the spatial scales of the data [73]; this condition can be produced by a number of unexpected factors, such as different nomenclature conventions, various data formats/programme, or even non-identical scales used by different sources. These discrepancies and even inconsistencies can make it hard to integrate or overlay datasets, and can lead to errors in analysis;
5) during its early year of application, its limitation in operating statistical functions needed was obvious; e.g., in order to emphasize analysis or even to withdraw any conclusion based on numerous data available, so in order to overcome the limitations to understanding spatial change between two time periods, spatial data may be collected at multiple time and then the data tested using newer version of statistical test (raster GIS) [74],
6) its expensive cost and complexity which prevent single end user to buy the software product, e.g., Software costs: GIS software can cost between $600 and $17,000 per year, depending on the type and quality of the software, and the size of the project. For the hardware costs: Implementing GIS can involve additional hardware costs [75];
7) its lacking in quality and consistency of input addresses which in turn can be a source of error in the geocoding process [76];
8) its time consuming: The process of collecting, storing, and analyzing information using GIS can be time consuming. It may need a long time to obtain complete information regarding a certain specific set of data due to the vastness of the data availability and its related infrastructure [77];
9) as lesson learned from COVID-10 pandemic, GIS have limitation regarding disease outbreak detection [78]: GIS may not be able to detect rapidly evolving disease outbreaks due to challenges still continue in data aggregation, knowledge discovery, and dynamic expression.
10) its limitation in health disparities: GIS may not be able to directly identify localized health disparities; further careful assessment of the data and applications were required to properly interpret the findings in understanding the relationship between vulnerable populations and environmental burden [79].

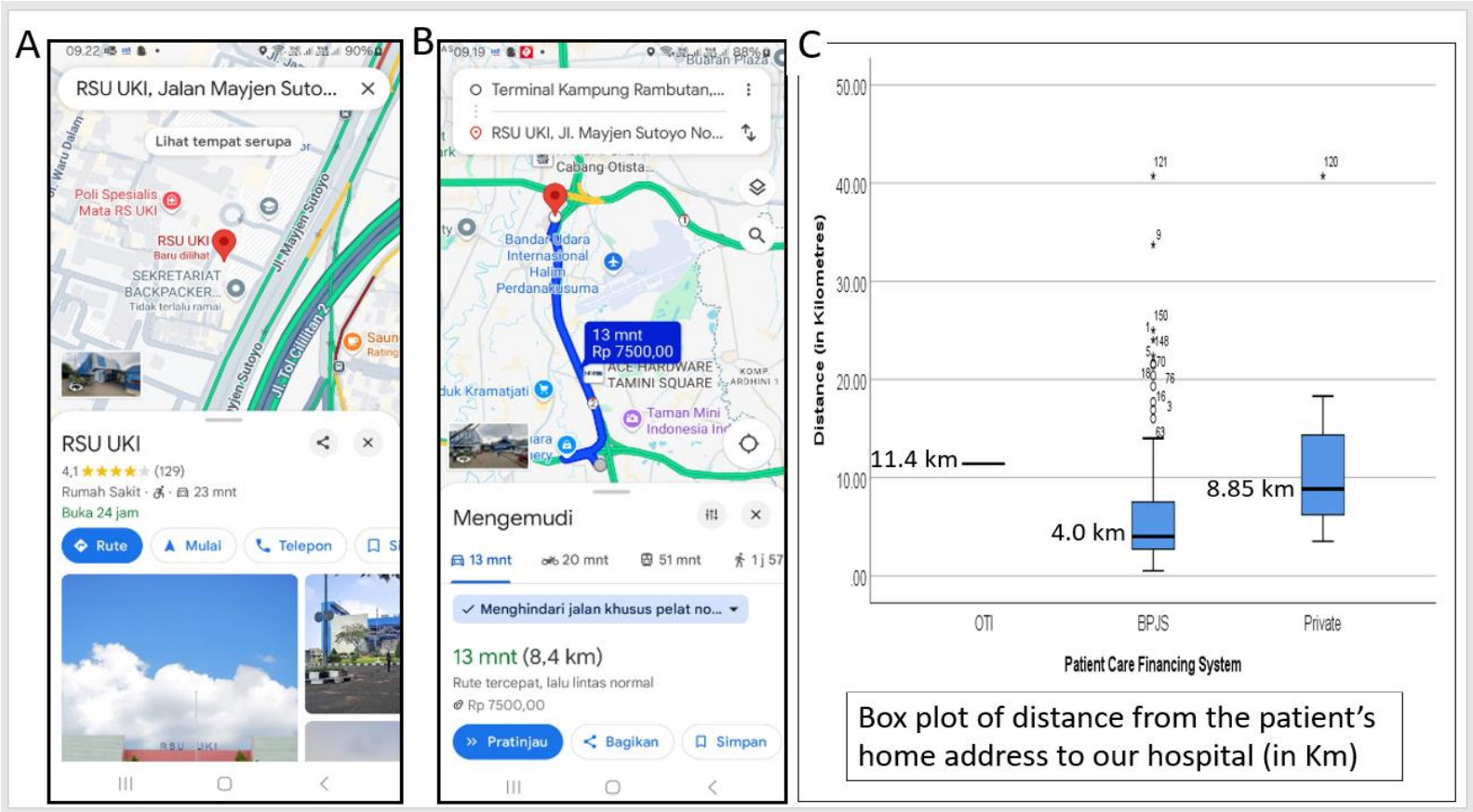

Fig. 1. (A) To estimate the distance between patient's house to the hospital, we use Route feature available in Google Maps™.(B) We put the patient's address as complete as possible in the place of origin and put our hospital (RSU UKI) in the destination. we chose to simulate using a vehicle/driving and the results showed in kilometres. All data regarding distance were put in Microsoft Excel™ and then further exported to SPSS for further processing. (C) Box plot diagram of distance distribution of stroke patients, from their home to the hospital (in Km), based on their medical care financial system (BPJS, OTI or private)

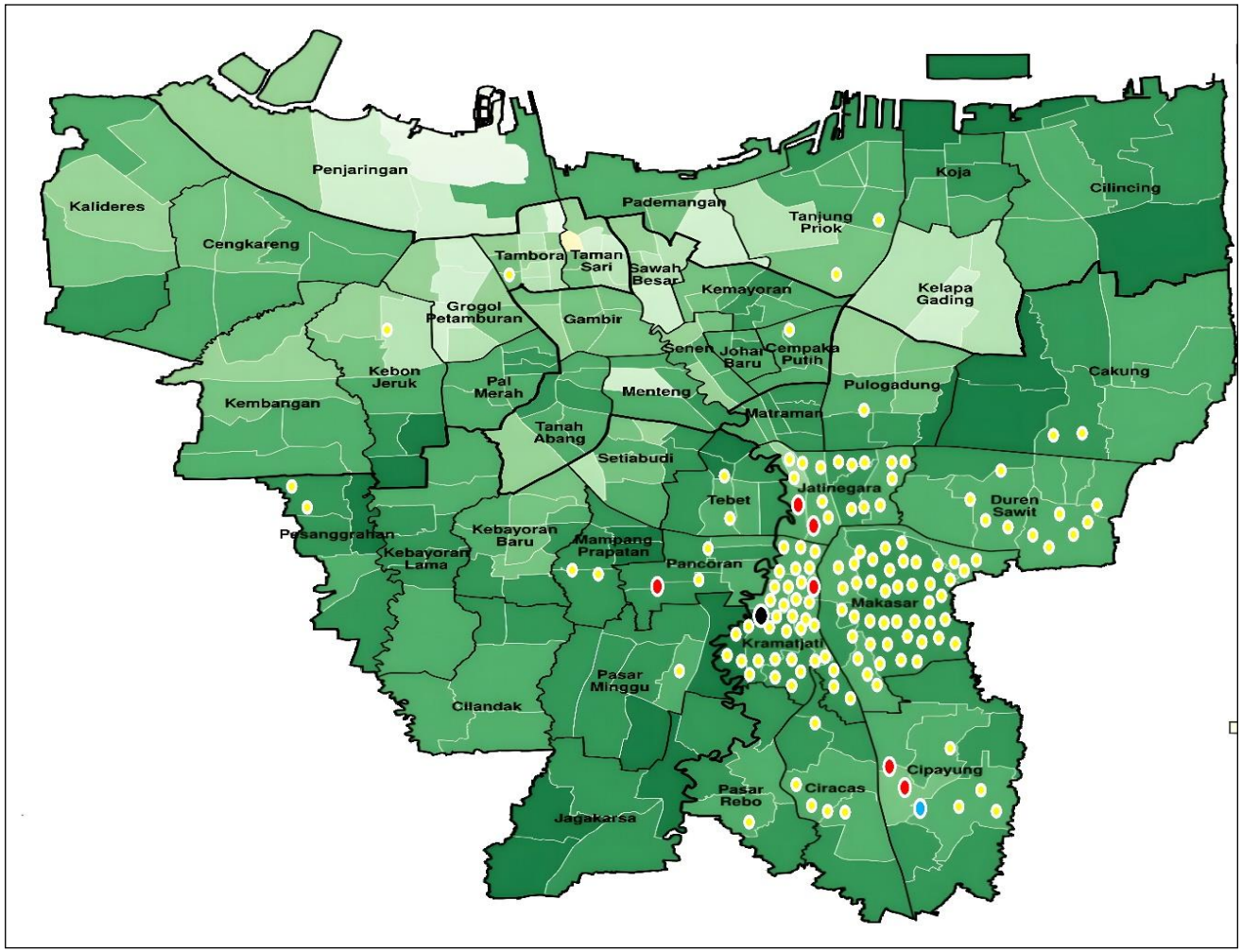

Fig. 2. Geographic distribution of patient's residence based on their medical care financing system. (Legend as follow: Yellow: BPJS, blue:OTI, red: private, black: hospital)

4. CONCLUSION

From three years of stroke patient's analysis, we found that more male patients (55.6%), with 42% were in the range of age between 55-64 years old, most of the patient (94.4%) using BPJS as their medical care financing system, with 27.7% came from sub district Makkasar which is near from our hospital. Further analysis using the help of Google maps™ we can show that the UHC or BPJS health referral system has facilitated patients receiving health services at the health facility closest to their residence.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

CONSENT

It is not applicable.

ETHICAL APPROVAL

We only dealing with data of medical record, ethical approval obtained from the director of the hospital (no. 378/DIRUT/RSU.UKI/06.2024) with cover letter from the dean to the faculty of Medicine (no, 0623/UKI.F5.D/PPM.00.01/2024) prior to data collection.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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