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REGIONAL VULNERABILITY TO THE COVID-19 CASE IN PADANG CITY

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Abstract

Purpose: This study aims to analyze regional vulnerability to COVID-19 cases in Padang City. **Theoretical framework:** The COVID-19 pandemic is a health problem that has spread throughout the world, including the city of Padang. Padang City as the capital city of West Sumatra Province has high mobility and population distribution, as well as areas with high accessibility. This is a big potential in the spread of COVID-19. **Method/design/approach:** The type of data used is in the form of primary data and secondary data sourced from a questionnaire from district heads throughout Padang City, Padang City Health Office (https://dinkes.padang.go.id/) and Padang City BPS. The analytical method used is correlation analysis, regression and ANOVA with R studio. **Result and conclusion**: The results showed that the highest regional vulnerability to COVID-19 was in Nanggalo District, Lubuk Begalung District, North Padang District, and Koto Tangah District. These five sub-districts have high population density, comorbidities and elderly rates compared to other regions, as well as a low level of adherence to health protocols. Based on the results of the analysis conducted, it can be concluded that there is a strong correlation between regional vulnerability and COVID-19 cases and vice versa. **Research implication:** This research is intended to provide an overview of the mapping of Padang City areas that are vulnerable to COVID-19 transmission, so that policies can be adopted to prevent transmission to those at risk.

Keywords: COVID-19, Padang City, Vulnerability.

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1. INTRODUCTION

The SARS-CoV-2 virus, which is also called as COVID-19 virus, was first discovered in December 2019 in Wuhan, Hubei Province, China (Ghebreyesus, 2020), and has been declared as a pandemic by the World Health Organization on March 11, 2020.

It was recorded 494,587,638 was confirmed COVID-19 with 6,170,238 deaths worldwideon April 8, 2022. West Sumatra Province is the province with the highest number of confirmed positive cases of COVID-19 in Indonesia. Data on the spread of COVID-19 on Monday, April 11, 2022, there were 103,653 confirmed positive cases of COVID-19 with 2,328 cases of death in West Sumatra (Website Corona Sumbar, 2022). The city of Padang is the epicenter of the spread of COVID-19 in West Sumatra because it has the highest number of COVID-19 cases of all districts/cities in West Sumatra. Data on the spread of COVID-19 in Padang City as of April 3, 2022 totaled 7,305 people confirmed positive for COVID-19 with 42 deaths (DKK Kota Padang, 2022).

The COVID-19 pandemic is a health problem that has spread throughout the world, including Indonesia (Linardi et al., 2021). Several determining factors in the increase in COVID-19 cases are age, availability of health services, population density, and others (Sasidharan et al., 2020). For the prevention of COVID-19 is the application of health protocols. The community is expected to implement and comply with the 6M health protocol based on Surat Edaran No. 16 Tahun 2021, namely wearing masks, washing hands with soap in running water, maintaining distance, staying away from crowds, reducing mobility, avoiding eating together (Satgas Penanangan COVID-19, 2021).

An increase in the death rate of COVID-19 cases has a correlation with comorbidities in high-risk groups. People with comorbid diseases such as diabetes, cardiovascular disease, lung disease, hypertension, and cancer have a higher risk of being infected with the COVID-19 virus (Fang et al., 2020; Giannis et al., 2020; Huang et al., 2020). According to Wang et al., (2020), out of 138 cases of COVID-19 46.4% of them had comorbid diseases. Patients with comorbid diseases who are treated in the ICU are higher (72.2%) than those who are not treated in the ICU (37.3%). The great potential for the spread of COVID-19 is in areas with high mobility and population distribution, as well as areas with high accessibility (Yusup, 2020). Based on the total population, there is a chance of contact resulting in constant cases of COVID-19 in each province or different islands. Population density is used as an important factor in dealing with the spread of the COVID-19 virus. Population density will be directly proportional to the development of various sectors, both the economic sector and the health sector. In this theory, a high population density in an area has a higher vulnerability when compared to an area with a low population density. This becomes clearer because when an environment is denser by the community, then the more activities between humans will be carried out (Budiman et al., 2021).

Research on COVID-19 in Padang City has been carried out by many other researchers, so that it can be used as a reference in research that focuses on regional vulnerability to COVID-19 in Padang City which has never been done, so that it can be an alternative for interested parties in breaking the chain of spread of COVID-19 in Padang City.

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2. TEORITICAL FRAMEWORK

COVID-19, caused by the SARS-CoV-2 virus, has diverse clinical manifestations. Symptoms that appear during COVID-19 infection can range from asymptomatic or presymptomatic, mild symptoms, moderate symptoms, severe symptoms, to critical symptoms (Salem et al., 2021). Asymptomatic or mild presymptomatic infection is characterized by positive results in diagnostic tests but without any symptoms. Mild symptoms include fever, mild cough, sore throat, dizziness, fatigue, nausea, vomiting, diarrhea, and loss of taste or smell. Moderate symptoms are characterized by confirmed lower respiratory tract infection with oxygen saturation above 94%, while severe symptoms involve moderate symptoms but with oxygen saturation below 94%. COVID-19 patients are categorized as critical if ther experience Acute Respiratory Disease Syndrome (ARDS) or septic shock. Typically, symptoms persist for approximately 14 days, with the most common initial symptoms being fever and dry cough, followed by other symptoms such as shortness of breath that typically appear four days afteer the onset of initial symptoms. Life-threatening conditions such as ARDS, sepsis, and Acute Kidney Injury Usually occur between days 7 and 19 (Byrne et al., 2020; Qiu et al., 2021).

The differences in clinical manifestations of COVID-19 are influenced by the interaction between individual vulnerability and the virus's ability to infect (Bajaj et al., 2021). Underlying comorbidities can increase an individual's susceptibility to more severe clinical manifestations. Some frequently associated comorbidities include cardiovascular disease, diabetes mellitus, and poor nutrition. Sars-CoV-2 primarily infect cells in the respiratory tract, particulary those lining the aveoli. The virus's ability to bind to the ACE2 celluar receptor plays a crucial role in this infection (Boutin et al., 2021; Lamers & Haagmans, 2022). After infecting the host cells, the virus encounters the host's innate immune response. To establish productive infection, SARS-CoV-2 must be able to evade or suppress the host's innate immune response. The immune system responds to viral infection by initiating inflamation and cellular antiviral activity to inhibit viral replication and spread within the body and protect from infection (Minkoff & tenOever, 2023).

COVID-19 is a disease that is currently causing a global pandemic (Calle-Ramírez et al., 2023). The rapid spread of the virus and the limited in-depth knowledge about it and the disease it causes have resulted in suboptimal patient management, leading to high mortality rate. Many factors influencing the severity of COVID-19 infection can be effectively addressed to prevent the development of severe clinical manifestations. Therefore, it is crucial to pay attention to these factors as they determine patient safety and raise awareness among clinicians about the necessary considerations, anticipations, and early management of COVID-19 patients before severe clinical manifestations occur. These factors include population density, the elderly population, underlying comorbidities, and healthcare service programs (MacLaren et al., 2020). Population density refers to the number of people living in a specific area. Areas with high population density tend to have closer social interactions, increasing the risk of COVID-19 transmission. Limited space and the difficulty of maintaining physical distancing can accelerate the spread of the virus. Therefore, areas with high population density have a higher vulnerability to the spread of COVID-19(Tammes, 2020). Elderly individuals, aged 65 and

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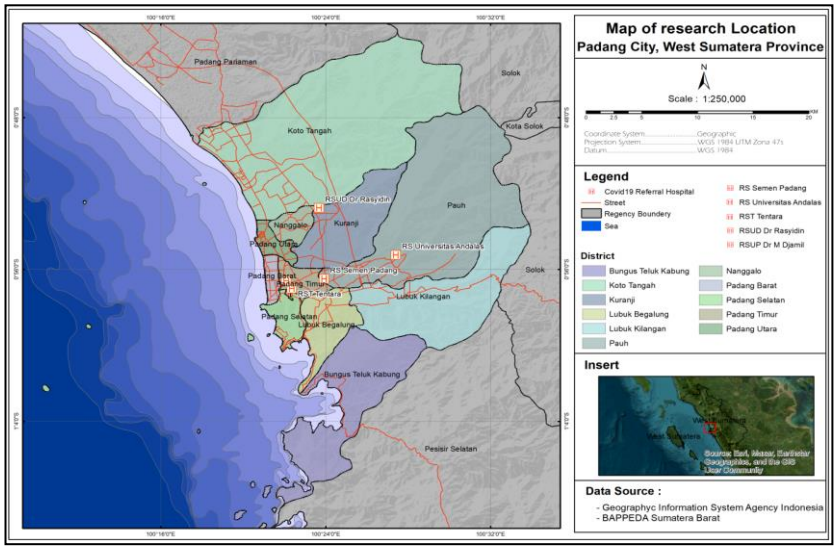
above, are considered vulnerable to COVID-19 (Lee, 2020). They have a higher risk of experiencing severe complications or death from the infection. Common health conditions among the elderly, such as heart disease, diabetes, or immunodeficiency, can worsen the symptoms of COVID-19. Areas with a higher proportion of elderly population may have a higher vulnerability to COVID-19 cases (Bajaj et al., 2021).

The presence of underlying helth conditions and comorbidities can increase the risk of individuals experiencing more severe COVID-19 symptoms. Some comorbidities associated with an increased risk include heart disease, diabetes, respiratory disorders, hypertension, and obesity. Areas with a high prevalence of underlying health conditions may have a higher vulnerability to COVID-19 cases (Sanyaolu et al., 2020). The vulnerability of an area to COVID-19 is also influenced by the availability and effectiveness of healthcare services. Factors such as healthcare facilities, testing capacity, healthcare workforce, testing policies, contract tracing, and vaccination can affect a region's ability to effectively detect, isolate, and treat COVID-19 cases. Areas with good healthcare programs and adequate infrastructure can reduce their vulnerability to COVID-19 by providing timely care and implementing effective prevention measures (Singh et al., 2021).

3. METHODS

The research was conducted in Padang City, with research locations covering all sub-districts in Padang City, namely Bungus Teluk Kabung District, Pauh District, Lubuk Kilangan District, Padang Selatan District, Padang Timur District, Padang Barat District, Nanggalo District, Lubuk Begalung District, Padang Utara District, Kuranji District, and Koto Tangah District (Badan Pusat Statistik Kota Padang, 2021). The astronomical position of the city of Padang is on the longitude 100 05'05"-100 34' 09" E and 00044'00" - 01'08" 35" South Latitude with an area of 69,496 ha. The research location can be seen in Figure 1.

Fig 1: Administrative map of the research location in the Padang City



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The research begins by collecting data from the required variables such as population density, elderly, comorbidities, and health care programs. Primary and secondary data were obtained from the Padang City BPS, the Padang City Health Office (https://dinkes.padang.go.id), and health protocol compliance questionnaires per district in Padang City.

The level of regional vulnerability to COVID-19 in Padang City is divided into 3 levels, namely low, medium and high. The level of vulnerability of the Padang City area to COVID-19 in each sub-district has a different level of vulnerability. Research data processing is using the method of analysis of correlation, regression and ANOVA with R studio. The vulnerability of the Padang City area to COVID-19 cases is described by the Geography Information System (GIS), namely by overlaying a map of the vulnerability of COVID-19 cases with an administrative map of the research location, as well as paying attention to the parameters of vulnerability.

4. RESULTS AND DISCUSSION

The vulnerability of the Padang City area to COVID-19 cases was obtained based on vulnerability parameters which include population density, elderly, comorbidities, and health care programs. Total population density, number of elderly people, comorbidity rates and health protocol levels in the study locations are presented in Table 1 below.

Table 1: Level of vulnerability of the COVID-19 case area

Subdistrict	Density	Elderly	Comorbid	Health Protocol	Level
Bungus Teluk Kabung	275	697	4855	35	Low
Pauh	425	1467	12815	35	Low
Lubuk Kilangan	675	919	10432	25	Medium
South Padang	6079	3121	12056	30	Medium
East Padang	9485	2272	16151	35	Medium
West Padang	6101	3185	9196	20	Medium
Nanggalo	7227	2600	12074	25	High
Lubuk Begalung	3998	2627	22718	25	High
North Padang	6789	5268	14422	25	High
Kuranji	2565	3297	27165	20	High
Koto Tangah	852	6040	34615	20	High

It can be seen that areas with a high level of vulnerability are in the Districts of Nanggalo, Lubuk Begalung, North Padang, Koto Tangah, and Kuranji. Areas with a medium level of vulnerability are in the sub-districts of Lubuk Kilangan, South Padang, East Padang and West Padang. Meanwhile, areas with a low level of vulnerability are in Bungus Teluk Kabung and Pauh Districts. An overview of the level of vulnerability in each area of Padang City can be seen in Figure 2.

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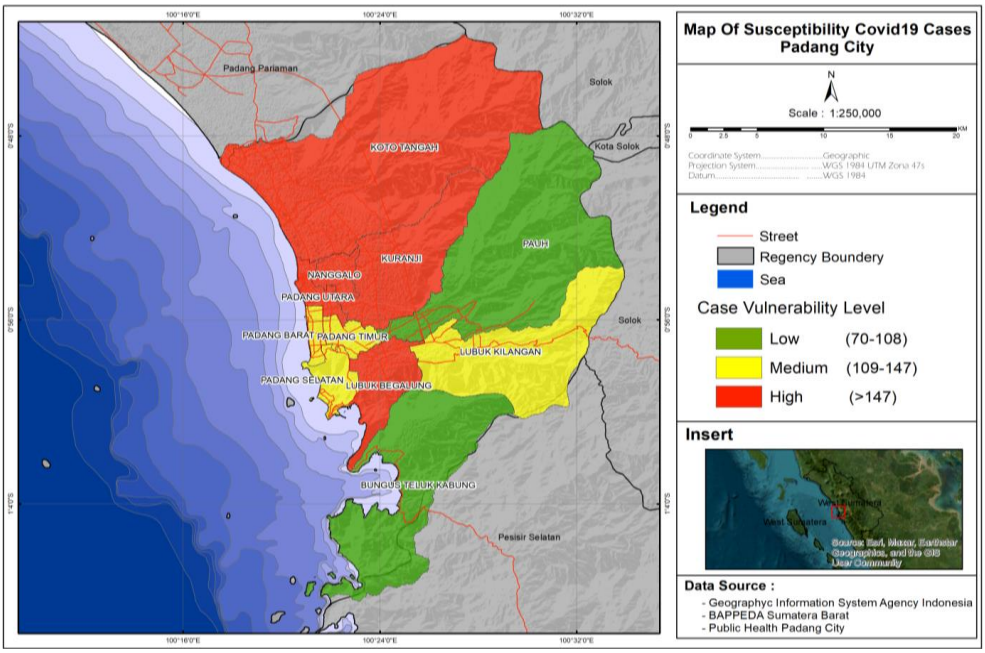
Fig 2: Map of the vulnerability of the Padang City COVID-19 case



Based on the results of a simple linear regression analysis of the relationship between regional vulnerability to COVID-19 cases, a simple linear regression model was obtained which obtained $Y = 0.7353X + 0.1471$ and $R^2 = 0.4377$ presented in Figure 3 below.

Fig 3: A simple linear regression model of the regional vulnerability relationship to the Padang City COVID-19 case

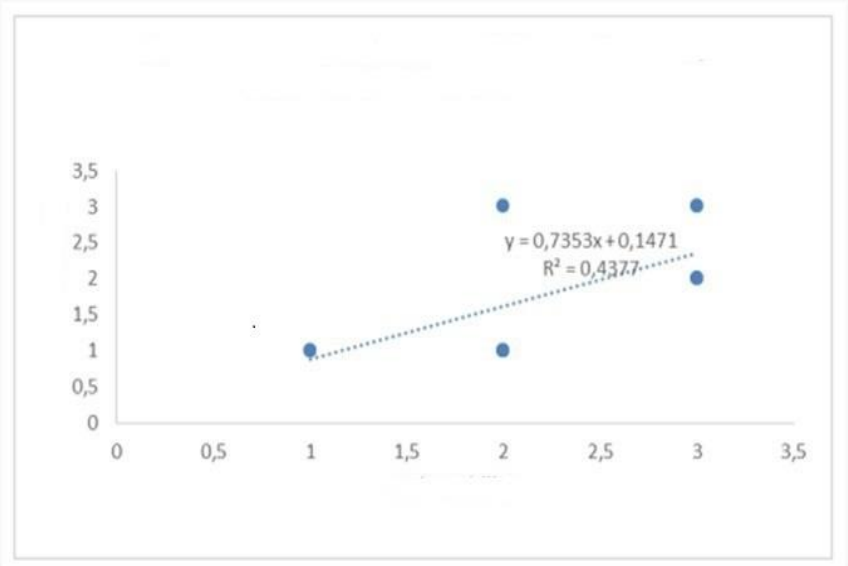


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Table 2: The results of the ANOVA test for the vulnerability of the Padang City area to COVID-19 cases

ANOVA					
	Df	*SS*	*MS*	*F*	*Significance F*
Regression	1	3,342	3,342	7,005	0,027
Residual	9	4,294	0,477		
Total	10	7,636			

Based on the results of the ANOVA test, the significance section F is in Table 2. The results of the analysis that has been carried out obtained a significance value of 0.027. When compared with the 5% alpha significance level, the resulting value is less than the alpha significance level. So, it can be concluded that the model which states the effect of vulnerability to COVID-19 cases is significant.

The influence of regional vulnerability to COVID-19 in Padang City was tested using correlation analysis with the results of the correlation analysis which can be seen in Table 3 below.

Table 3: The correlation analysis result of the level of regional vulnerability to the Padang City COVID-19 case

	Regional Vulnerability	*COVID-19*
Vulnerability	1	
COVID-19	0.662	1

Based on the results of the correlation analysis, a correlation coefficient was obtained between COVID-19 cases with a susceptibility level of 0.662. The resulting correlation coefficient is in a range with a strong category. This means that there is a strong correlation between regional vulnerability and COVID-19 cases and vice versa. In this correlation test, it was found that the correlation level was 0.662, which means that the relationship is strong.

Based on the research results, it was found that areas with a high level of vulnerability were in the Districts of Nanggalo, Lubuk Begalung, North Padang, Koto Tangah, and Kuranji. High-risk areas in areas with high vulnerability have a population density of more than 6142 people, comorbidities of more than 19841 people, elderly people of more than 3563, and adherence to health protocols of more than 25%.

Areas with a medium level of vulnerability are in the sub-districts of Lubuk Kilangan, South Padang, East Padang and West Padang. Moderate risk level with population density reaching 3071-6142 people, comorbid 9921-19841 people, elderly 1782-3563 people, and health protocol compliance 25-29%.

Meanwhile, areas with a low level of vulnerability are in the Bungus Teluk Kabung and Pauh sub-districts. Low risk level with a population density of less than 3070 people, comorbidities of less than 9921 people, elderly less than 1781 people, and adherence to health protocols of less than 30%. Population density can cause interactions between communities to occur more frequently. Regions with high population density allow for higher susceptibility to transmission

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(Ikbar et al., 2021; Nugroho et al., 2020). Thus, increasing the risk of transmission of COVID-19 (Izati & Choiruddin, 2022). Apart from population density, there are other factors in accordance with the Decree of the Menteri Kesehatan Republik Indonesia, (2019) HK.01.07/MENKES/413/2019 states that several public facilities and transportation centers, for example markets, shops, places of worship, educational institutions, train stations or bus. Strategic locations for the spread of COVID-19, namely data obtained based on information on locations that allow the gathering of a number or groups of people, which are considered as strategic location zones for the spread of COVID-19 which can trigger the growth of new clusters or trigger high cases of COVID-19 because it causes crowd of people (Poli et al., 2021).

In addition to population density, the spread of COVID-19 in the population is also influenced by age and gender, where the elderly population is more susceptible to exposure because elderly people experience decreased tissue function (Acharya & Porwal, 2020; Pratiwi et al., 2021), organs are more susceptible to disease. Vulnerability parameters such as the elderly and co-morbidities also increase the risk of transmission of COVID-19. Comorbid or comorbid diseases that increase the population's risk of exposure to COVID-19 such as hypertension, diabetes mellitus and so on (Susilo et al., 2020).

The elderly is a vulnerable group that is very at risk of morbidity and mortality due to COVID-19, because the majority of the elderly have chronic/degenerative diseases as comorbid diseases and have low body immunity. Therefore, elderly health services at the community level and in health facilities must be a priority. The elderly needs easy access and security in obtaining quality health services and in accordance with the needs and conditions of the elderly (Purwanto et al., 2021; Supartini et al., 2020).

West Sumatra is one of the provinces with high comorbidity rates. The highest cases of COVID-19 and comorbidities in West Sumatra were in Padang City with details of 65,550 elderly people, 203,787 hypertension, and 22,538 diabetes mellitus (Yuniarti et al., 2020). This indicates that Padang City is a high-risk area for COVID-19 in West Sumatra Province. People or children with comorbid diseases such as diabetes, cardiovascular disease, and chronic lung or even high blood pressure and cancer have a higher risk of being infected with the corona virus (Fang et al., 2020; Giannis et al., 2020; Huang et al., 2020). A meta-analysis reported that the likelihood of a high risk of developing severe COVID-19 for people with hypertension, respiratory disease, and cardiovascular disease was between 2.4 and 3.5 times (Yanga et al., 2020).

Based on data from the results of research that has been conducted with many sub-districts in Padang City with high vulnerability, there is a need for awareness of the importance of following health protocols. However, from research data, the percentage for health protocols has a low value, which is <25%. The low level of public awareness in implementing health protocols has resulted in a high rate of spread of COVID-19. The majority of individuals find it very easy to avoid corona virus infection if they implement health protocols required by the government, this will affect compliance in implementing health protocols (Afro et al., 2020; Arroyo et al., 2023).

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If the perceived benefits of an action to prevent the disease are low, then the possibility of action to be taken for prevention will be even lower. So, if the perceived benefits are high, then the person will carry out the health protocol so that it will have an impact on the high level of adherence to the health protocol (Wright et al., 2021). Population density, elderly population, comorbidities, and health service programs are important variables that affect the vulnerability of an area to COVID-19 cases (Alam et al., 2022).

In the city of Padang, these variables are the main consideration for understanding the level of vulnerability to the spread of the virus. The high population density in Padang City, with a population of up to 1.2 million people, can increase the risk of spreading COVID-19 in Padang City. The city of Padang has a significant level of population density. High population density causes crowds in public places, such as traditional markets and shopping centers, which makes it a potential place for the spread of the virus. The elderly is at a higher risk of contracting COVID-19 because their immune systems weaken with age (Bajaj et al., 2021).

The proportion of the elderly in the population needs to be the main focus in assessing the level of vulnerability of an area. In facing a pandemic, special protection and attention must be given to the elderly to reduce the risk of infection and further complications (Vieira et al., 2020).

Comorbidities, such as heart disease, diabetes, hypertension, and chronic respiratory disease, can increase the susceptibility of individual sufferers during the COVID-19 period (Ejaz et al., 2020; Gasmi et al., 2021). In the city of Padang, it is necessary to monitor and manage comorbidities to prevent more severe complications if infected with COVID-19 (Thevarajan et al., 2020).

The availability of an effective and adequate health service program is very important in dealing with COVID-19 cases in the city of Padang. Good health infrastructure, including health care facilities, sufficient medical personnel, and accessibility of health services, can assist in early detection, testing, contact tracing, and appropriate care for COVID-19 patients (Pratiwi et al., 2021).

5. CONCLUSION

The level of vulnerability of the Padang City area to COVID-19 with high levels of vulnerability is in the Districts of Nanggalo, Lubuk Begalung, North Padang, Koto Tangah, and Kuranji. From the correlation analysis test, a strong relationship between regional vulnerability and COVID-19 cases in Padang City is 0.662. The simple linear regression model for the relationship between regional vulnerability and COVID-19 in the city of Padang is Y=0.7353X+0.1471.

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