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Analysis of Community Perception to Mass COVID-19 Vaccination Plan in Indonesia Using ContingencyTables

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Abstract*: The COVID-19 pandemic has changed the patterns of life for people around the world. The World Health Organization (WHO) states that COVID -19 pandemic is a global health emergency. For this reason, various countries have implemented some policies to cut the spread of the COVID-19 pandemic. One of the efforts to break the chain of pandemic spread is mass vaccination. In Indonesia, the government is accelerating vaccine development and establishing a mass vaccination plan for the community. The plan gave rise to various perceptions of society. For this reason, research is needed to analyze public perceptions of the vaccination plan so that the policy can run appropriately and accordingly. In this study, a statistical analysis was used using the b x k contingency table based on Chi-square statistics and the odds ratio. Community perceptions are viewed from various aspects, such as development areas, latest education level, gender, income range, and age which are traced by survey methods. The results of the analysis show that people's perceptions are not influenced by gender, income range, and age, but are influenced by the development area and the level of final education. People who disagree with the plan are dominated by people who live in development areas C and D and have the latest education level, namely senior high school or lower. Thus, the socialization of the importance of this mass vaccination plan can be carried out to these community groups so that this plan can be implemented and get approval and support from the entire community.*

Keywords—Contingency Tables, COVID-19, Odds Ratio, Public Perceptions, Vaccines.

1. INTRODUCTION

In a short period of time, the COVID-19 pandemic has rapidly hit the entire world, including Indonesia. This pandemic started in Wuhan, China, and it quickly spread throughout the entire country and to near 50 others all over the world. This virus attacks the respiratory tract [1]. There are a few types of corona viruses that can also cause more serious illness for some people, such as Middle East Respiratory Syndrome (MERS-COW), Severe Acute Respiratory Syndrome (SARS-COW), and Pneumonia [2].

Indonesian government officially announced the discovery of positive cases of COVID-19 in Indonesia on March 2, 2020. Since then, the increase in positive cases in Indonesia has tended to increase due to the spread that is difficult to control. In order to break the chain of spread of COVID-19, the government has implemented various policies such as The Government Regulation No 21 of 31 March 2020 on Social Distancing on a Large Scale, evacuate 237 of its nationals and 1 foreigner living in Wuhan, Provide protective equipment for medical staff in hospitals including the purchase of personal protective equipment, the closure of schools and workplaces encouraging work from home; restrictions related to religious activities; limitation of activities in public areas; limitation of socio-cultural activities; restrictions on modes of transport; restrictions on other activities related to defence and security aspects [3].

The World Health Organization (WHO) has declared that COVID-19 is a global health emergency [4]. Researchers around the world continue to strive to develop and deploy safe and effective vaccines [5]. The WHO believed that vaccines could solve the COVID-19 problem around the world and save millions of lives. vaccines work by training and preparing the body's natural defences (the immune system) to recognize and fight off the viruses and bacteria they target. If the body is exposed to those disease-causing germs later, the body is immediately ready to destroy them, preventing illness. It hope to be the effective way to provide protection for the wider community to reduce the spread of the COVID-19 Virus and protect people in all countries.

In Indonesia, the president formed a national team to accelerate the development of a possible COVID-19 vaccine and to improve the country's resilience in responding to the pandemic [6]. The team was established through Presidential Decree No. 18/2020 on the national team for the acceleration of COVID-19 vaccine development, which was signed by the President on September 3 2020. First, the team formation aims to accelerate the development of COVID-19 vaccine [7]. Second, it aims to improve the country's resilience and independence in responding to the pandemic, particularly in regard to vaccine. Third, it seeks to improve synergy among research institutions.

This research will be analyzed using an approach with the b x k contingency table and then processed with the Odds Ratio. The relationship between the variables to be analyzed is the public perception of the mass COVID-19 vaccination plan based on differences in the background of the

development area, final education, gender, income range, and community age. With this method, the relationship between community perceptions about the mass COVID-19 vaccination plan based on differences in the background of the development area, final education, gender, income range, and community age will be analyzed more specifically. Basically, the analysis of people's perceptions of something has been carried out by many researchers [8-11]. In addition, statistical analysis using odds ratios can provide a more in-depth interpretation [12-13].

The use of various variables in analyzing community perceptions is a novelty in this study. In addition, the mass vaccination plan to stop the spread of the COVID-19 pandemic is actual and widely discussed in various countries. Thus, this research is very important to do so that the government can further improve the perceptions of the Indonesian people about the COVID-19 mass vaccination plan. In addition, this research can be useful as a reference in determining further policies related to COVID-19 vaccination.

2. Literature Review

2.1 Public Perception

Basically, a process that is preceded by sensing in the form of receiving a stimulus by an individual through the senses is known as perception [14]. In general, the perception results can be divided into 2, namely positive perceptions and negative perceptions. Perceptions that describe all knowledge and responses that are followed by efforts to utilize it are called positive perceptions. Conversely, negative perceptions are defined as perceptions that describe all knowledge and responses that are not in harmony with the object being perceived. Therefore, the perception will always influence a person in acting. The emergence of these perceptions depends on how the individual describes all his knowledge about an object that is perceived.

A person's perception is influenced by several factors, which are broadly divided into 2 main factors, namely internal and external factors. Internal factors include all forms that come from the individual itself, including feelings, attitudes, individual personality, prejudice, desires or expectations, attention or focus, learning process, physical condition, values and needs or interests, and motivation. Conversely, external factors include all forms that come from outside the individual such as family background, information obtained, knowledge, and needs around.

This individual perception raises public perception because of the interaction process. Furthermore, an assessment of a person's attitudes, behavior, and actions in social life result from community perceptions [15].

2.2 Categorical Data Analysis

In categorical data analysis, the response variables used are categorical data, while the explanatory variables can be continuous or categorical data. Categorical variables are widely used in the social sciences to measure the attitudes and opinions of a person or group of people. A person's attitude towards a policy can be in the form of agreeing or disagreeing. In addition, public opinion on a policy can be in various categories such as supporting, not supporting, or not giving an opinion [16].

Basically, categorical variables that have an irregular scale are called nominal variables. Meanwhile, ordinal variables are variables that have naturally ordered categories. One example of a nominal variable is the location of residence which is categorized as rural and urban. Meanwhile, ordinal variables can be in the form of income levels which are categorized as non-existent, low, medium, and high.

2.3 Two-Way Contingency Table

Contingency tables are data compilation techniques used to measure the relationships that occur between categorical variables by summarizing each observation frequency in each category in the variable. In the 2-way contingency table, the variables involved are 2 variables. In general, a contingency table with variable A with several b categories and variable B with several k categories is called a contingency table b x k. In general, the form of the b x k contingency table is presented in Table 1.

Table 1: The general form of the contingency table b x k.

		Variable B				Total
		1	2	...	k	
Variable A	1	n_{11}	n_{12}	...	n_{1k}	$n_{1.}$
	2	n_{21}	n_{22}	...	n_{2k}	$n_{2.}$
	⋮	⋮	⋮	...	⋮	⋮
	b	n_{b1}	n_{b2}	...	n_{bk}	$n_{b.}$
Total		$n_{.1}$	$n_{.2}$	...	$n_{.k}$	$n_{..}$

The frequency of each cell in the table is called the joint frequency which is denoted by n_{ij}. Meanwhile, the total frequency of each row and column in each category of a particular variable is referred to as the marginal frequency. Each of these frequencies can be shown in the form of shared proportions. In population, it is denoted as π_{ij}. The notation commonly used to define shared proportions in the sample is p_{ij} which is formulated as follows [16].

$$p_{ij} = \frac{n_{ij}}{n_{..}} \tag{1}$$

In addition, the marginal proportion can be defined as follows.

$$p_{.j} = \frac{n_{.j}}{n_{..}} \tag{2}$$

$$p_{i.} = \frac{n_{i.}}{n_{..}} \tag{3}$$

2.4 Association Tests on Contingency Tables

The Pearson chi-square test statistical approach is widely used to test whether there is a relationship or association between variables in the contingency table. The hypothesis used is as follows.
H0: The two variables are independent (independent)
H1: The two variables are not independent (dependent)
or
H0: The first variable does not depend on the second variable
H1: The first variable depends on the second variable
Pearson chi-square test statistics that apply to contingency tables containing I row and J column are defined as follows [16-17].

$$X^2 = \sum_{i=1}^{I}\sum_{j=1}^{J}\frac{(O_{ij}-E_{ij})^2}{E_{ij}} \tag{4}$$

where,
O_{ij} : Observation frequency in the ith row and jth column.
E_{ij} : The expected frequency in the ith row and jth column.
The expected frequency in in the ith row and jth column is defined as follows.

$$E_{ij} = \frac{n_{i.}\, n_{.j}}{n_{..}} \tag{5}$$

In addition, the Pearson chi-square test statistic can be written in another form, namely as follows.

$$X^2 = n\left(\frac{1}{n_{1.}}\sum_{j=1}^{J}\frac{n_{1j}^2}{n_{.j}} + \frac{1}{n_{2.}}\sum_{j=1}^{J}\frac{n_{2j}^2}{n_{.j}} + \ldots + \frac{1}{n_{I.}}\sum_{j=1}^{J}\frac{n_{Ij}^2}{n_{.j}} - 1\right) \tag{6}$$

The critical area that applies to the test statistic is that the null hypothesis is rejected if it is
satisfied that $X^2 > X^2_{\alpha;v}$ with α is a certain level of significance and v is the degree of Pearson. In a contingency table containing the I row and J column, the degrees of Pearson are $(I-1)(J-1)$.

2.5 Odds Ratio

Basically, the odds of an event are the probability that an event can occur relative to an event not occurring. Mathematically, if the probability of an event occurring in the population is π, then odds are defined as follows [16-17].

$$Odds = \frac{\pi}{1-\pi} \tag{7}$$

In simple terms, the odds ratio can be interpreted as the ratio of 2 conditional odds (Rudas, 2018). The odds ratio is a measure that shows the comparison of the probability of an event occurring with the probability of not occurring. Mathematically, the odds ratio in the population that applies to the 2 x 2 contingency table is defined as follows [18].

$$\theta = \frac{\pi_{11}\,\pi_{22}}{\pi_{12}\,\pi_{21}} \tag{8}$$

In the sample, the odds ratio on the 2 x 2 contingency table can be defined as follows.

$$\hat{\theta} = \frac{n_{11}\,n_{22}}{n_{12}\,n_{21}} \tag{9}$$

Odds ratios can also be used to describe conditional relationships or associations in 3-way contingency tables. For 2 x 2 x K contingency tables, the odds ratio can be calculated on each K contingency table partially because each partial contingency table has a size of 2 x 2.

3. Material and Method

This section will explain the types of research, data and sampling techniques, research variables, and analysis procedures.

3.1 Research Type and Research Data

The type of this research is descriptive and associative research using survey methods. The population in this study were all Indonesian citizens domiciled in Indonesia with a minimum age of 12 years. The sample in this study were all Indonesian citizens who are domiciled in Indonesia with a minimum age of 12 years who are willing to fill out the questionnaire of this study.

Because the number of the population is infinite and the exact number is not counted, nonprobability sampling is used, so using the theory developed by Isaac Michael [19]. With α = 0.05 and p = 0.10, the minimum number of samples that the researcher had to obtain was 103 samples. In this study, 231 respondents were used. While for the purposive sampling technique, sampling is carried out based on certain criteria that have been determined by previous researchers:
1. Indonesian citizen
2. Minimum age 12 years
3. Knowing that there are issues regarding the government's plan to hold a mass COVID-19 vaccination in Indonesia

3.2 Research Variables

In this study, there are 5 variables analyzed for their relationship with public perceptions. The research variables used, operational definitions, and data scales are presented in Table 2.

Table 2: Research Variables.

Research Variables	Operational Definition	Data Scale
Indonesian Economic Development Area	According to the National Development Planning Agency, Indonesia is divided into 4 main development	Nominal: 1. Main Development Area A and

	areas, each of which is led by major cities such as: Medan (Main Development Area A), Jakarta (Main Development Area B), Surabaya (Main Development Area C), and Makassar (Main Development Area D).	Main Development Area B 2. Main Development Area C and Main Development Area D
Final Level of Formal Education	The last formal education level the respondent has completed and has received a diploma.	Nominal: 1. ≤ Senior High School / equivalent 2. Academy / Diploma / Bachelor degree
Gender	Biological characteristics possessed by respondents	Nominal: 1. Male 2. Female
Income per month	According to the Government Financial Accounting Standards in PSAK No. 23 concerning Income states that "Revenue is the gross inflow of economic benefits arising from the normal activities of the entity during the period if these inflows result in an increase in equity that does not come from the contribution of investors".	Nominal: 1. ≤ Five million rupiahs 2. > Five million rupiahs
Age	Respondents' life span from birth to the time they filled out our questionnaire which was calculated in years	Ordinal : 12-25 years 26-45 years > 45 years
Public Perception	Perception is a process by which a person selects, organizes, and interprets incoming information to create a picture of a meaningful whole.	Nominal: 1. Agree 2. Disagree

3.3 Step of Analysis

The data obtained from the questionnaire were grouped according to research variables grouped by development area, final formal education level, gender, monthly income, and age. After grouping based on the 5 research variables, each data group was further divided into two categories. Respondents' perceptions of agreeing and perceptions of disagreeing were decided based on the answers selected in the questionnaire. Then, the data were analyzed using the Pearson test and the measure of suitability by considering the Odds Ratio value.

4. Results and Discussion

In this case, the researcher has obtained research data from a questionnaire that has been filled in by 231 respondents. The data obtained is in the form of the Indonesian Economic Development Area which will later be categorized into 2 categories, that is Main Development Areas A and B and Main Development Areas C and D. Furthermore, there is the Indonesian People Perception of the COVID-19 Vaccine which will later be categorized into 2 categories, that is agree or support and disagree or doesn't support. Then there is the Last Education Level which will later be categorized into 2 categories, that is less than or equal to senior high school and Academy / Diploma / Degree.

Third, there is Gender which will be categorized into 2 categories, that is Male and Female. Next, there are Income Ranges which will be categorized into 2 categories, that is less than or equal to Rp. 5,000,000.00 and more than Rp. 5,000,000.00. And the last one is Age Range which will be categorized into 3 categories, that is 12-25 years old, 26-45 years old, and more than 45 years old. Therefore, researchers need to present the primary data in a 2-way contingency table so that data analysis can be carried out.

4.1 Pearson Test and Association Measure For Indonesian People Perception of the COVID-19 Vaccine With Indonesian Economic Development Area

Can be seen in (Table 3) which is a 2-way contingency table for the Indonesian People Perception of the COVID-19 Vaccine according to Indonesia's Economic Development Area.

Table 3: Indonesian People Perception of the COVID-19 Vaccine according to Indonesia's Economic Development Area

		Public Perception of the COVID-19 Vaccine	
		Agree / support	Disagree / Doesn't support
Indonesian Economic Development Area	The main development area A & B	120	23
	The main development area C & D	63	25

From (Table 3) It can be seen that the number of Indonesian people who agree or support the COVID-19 vaccine is dominated by Indonesians in the main development areas A & B and those who disagree or does'nt support more in the main development areas of C & D. In this Pearson test, the null hypothesis will be tested, which is "There is no relationship between the Perception of the Indonesian People of the COVID-19 Vaccine and the

Indonesian Economic Development Area" and the alternative hypothesis is "There is a relationship between the Perception of the Indonesian People of the COVID-19 Vaccine and the Indonesian Development Area", and here are the results.

Table 4: The results of the Pearson test of Indonesian People Perception of the COVID-19 Vaccine With Indonesian Economic Development Area

Pearson Chi-Square	Asymptotic Significance (2-sided)
5.027	0.025

From (Table 4) we get a decision to reject the null hypothesis because the Pearson Chi-Square value (5.027) is more than $\chi^2_{\alpha,1}(3.842)$ and the Asymptotic Significance (2-sided) value (0.025) is smaller than α (0.05). and we can conclude that there is a relationship between the Indonesian People Perception of the COVID-19 Vaccine and the Indonesian Economic Development Area. We can calculate the association measure through the odds ratio.

Table 5: The result of the association measure of Indonesian People Perception of the COVID-19 Vaccine With Indonesian Economic Development Area

Odds Ratio Estimate
2.070

It can be seen from (Table 5), that the odds ratio value is 2.070, which means that Indonesian people in the main development areas of A & B have the potential to agree or support the COVID-19 vaccine 2.070 times greater than Indonesians in the main development areas C & D.

4.2 Pearson Test and Association Measure For Indonesian People Perception of the COVID-19 Vaccine With Last Education Level

In (Table 6) it can be seen that the number of Indonesian people who agree or support the COVID-19 vaccine is dominated by people with the latest education level of academy / diploma / degree. With the null hypothesis is "There is no a relationship between the Perception of the Indonesian People of the COVID-19 Vaccine and the Last Education Level", a pearson test will be carried out using $\alpha = 5\%$.

Table 6: Indonesian People Perception of the COVID-19 Vaccine With Last Education Level

		Public Perception of the COVID-19 Vaccine	
		Agree / support	Disagree / Doesn't support
Last Level of Education	less than or equal to senior high school	63	33
	Akademy/ Diploma / Degree	120	15

Table 7: The result of the Pearson test of Indonesian People Perception of the COVID-19 Vaccine With Last Education Level

Pearson Chi-Square	Asymptotic Significance (2-sided)
18.445	0.000

From (Table 7), with the Pearson Chi-Square value (18,445) is greater than $\chi^2_{\alpha,2}(5.991)$ and the value of Asymptotic Significance (2-sided) (0,000) smaller than α (0.05) we get the result that null hypothesis is rejected so the conclusion is that there is a relationship between the Indonesian Public Perception of the COVID-19 Vaccine and the Latest Level of Education. Then the association measure can be calculated through the odds ratio.

Table 8: The result of the association measure of Indonesian People Perception of the COVID-19 Vaccine With Last Education Level

Odds Ratio Estimate
0.239

The odds ratio value of 0.239 means that Indonesian people with a recent education level of less than or equivalent to senior high school have the potential to approve or support the COVID-19 vaccine 0.239 times less than the last education level of a college / diploma / degree..

4.3 Pearson Test and Association Measure For Indonesian People Perception of the COVID-19 Vaccine With Gender

The following shows a 2-way contingency table between Indonesians' Perceptions of the COVID-19 Vaccine according to Gender in (Table 9)

Table 9: Indonesian People Perception of the COVID-19 Vaccine With Gender

		Public Perception of the COVID-19 Vaccine	
		Agree / support	Disagree / Doesn't support
Gender	Male	69	20
	Female	114	28

From Table 9, it can be seen that the female gender in Indonesia dominates the number of COVID-19 vaccine support as many as 114 respondents. By using the null hypothesis, namely "There is no Relationship between Indonesian Perceptions of the COVID-19 Vaccine and Gender", a freedom test was carried out.

Table 10: The result of the Pearson test of Indonesian People Perception of the COVID-19 Vaccine With Gender

Pearson Chi-Square	Asymptotic Significance (2-sided)
0.252	0.616

Unlike the previous one, this time we cannot reject the null hypothesis because the Pearson Chi-Square value (0.252) is less than $\chi^2_{\alpha,1}(3.842)$ and the value of Asymptotic Significance (2-sided) (0,616) greater than α (0.05). Thus it can be concluded that there is no relationship between the Indonesian Public Perception of the COVID-19 Vaccine and Gender. The calculation of association measure through the odds ratio is shown as follows.

Table 11: The result of the association measure of Indonesian People Perception of the COVID-19 Vaccine With Gender

Odds Ratio Estimate
0.847

From the results of the calculation of the odds ratio above, it can be seen that the Indonesian population who is male has the potential to support the COVID-19 vaccine 0.847 times smaller than that of females.

4.4 Pearson Test and Association Measure For Indonesian People Perception of the COVID-19 Vaccine With Income Ranges

The same as before, a 2-way contingency table will be presented between the Indonesian Public Perception of the COVID-19 Vaccine by Income Range.

Table 12: Indonesian People Perception of the COVID-19 Vaccine With Income Ranges

		Public Perception of the COVID-19 Vaccine	
		Agree / support	Disagree / Doesn't support
Income	≤ IDR 5,000,000.00	99	31
	> IDR 5.000,000.00	84	17

In (Table 12) it can be seen that the most COVID-19 vaccine support comes from people with an income range of more than IDR 5,000,000.00. Furthermore, the Pearson test was carried out using the null hypothesis which states that "There is no correlation between Indonesian people 'perceptions of the COVID-19 vaccine and income ranges"

Table 13: The result of the Pearson test of Indonesian People Perception of the COVID-19 Vaccine With Income Ranges

Pearson Chi-Square	Asymptotic Significance (2-sided)
1.699	0.192

In (Table 13), it is known that the Pearson Chi-Square value (1.699) is smaller than $\chi^2_{\alpha,1}(3.842)$ and the value of Asymptotic Significance (2-sided) (0,192) greater than α (0.05) so it is not sufficiently strong evidence to reject null hypothesis. Thus there is no a relationship between the Indonesian Public Perception of the COVID-19 Vaccine and the Income Ranges.

Table 14: The result of the association measure of Indonesian People Perception of the COVID-19 Vaccine With Income Ranges

Odds Ratio Estimate
0.646

By using the odds ratio, it can be seen that the size of the closeness between the perceptions of the Indonesian people towards the COVID-19 Vaccine and the Income Range. Furthermore, in (Table 14), the odds ratio is 0.646 which means Indonesian people with an income range of less than or equal to IDR 5,000,000.00 has the potential to agree or support the COVID-19 vaccine 0.646 times smaller than Indonesian people with an income range of more than IDR 5,000,000.00.

4.5 Pearson Test and Association Measure Indonesian People Perception of the COVID-19 Vaccine With Age Ranges

2-way contingency table between Indonesians' Perceptions of COVID-19 Vaccine by Age Range is shown in table 15

Table 15: Indonesian People Perception of the COVID-19 Vaccine With Ranges

	Public Perception of the COVID-19 Vaccine	
	Agree / support	Disagree / Doesn't

			support
Age	12 – 25 years old	70	18
	26 – 45 years old	24	12
	> 45 years old	89	18

It can be seen that the age range of 12-25 years dominates the number of COVID-19 vaccine support as many as 70 people, while the population aged 26-45 years dominates the number of refusals against COVID 19 mass vaccination in Indonesia. Then the Pearson test was carried out and the null hypothesis was formulated, namely "There is no correlation between the perceptions of the Indonesian people about the COVID-19 vaccine and the age range". By using α = 5%, the critical area of the null hypothesis is rejected if the Pearson Chi-square value < $\chi^2_{\alpha,2}(5.991)$ and the value of Asymptotic Significance (2-sided) > α

Table 16. The result of the Pearson test of Indonesian People Perception of the COVID-19 Vaccine With Age Ranges

Pearson Chi-Square	Asymptotic Significance (2-sided)
4.470	0.107

In (Table 16) the values for Pearson Chi-Square (4.470) and Asymptotic Significance (2-sided) (0.107) are obtained so that the critical area is not met. Thus there is no relationship between Indonesian Perceptions of COVID-19 Vaccine and Age Range. Through the symmetric measures, we can also calculate the association measure. In (Table 17), it can be seen that the contingency coefficient value is 0.138, which means that there is a low relationship between the perceptions of the Indonesian people about the COVID-19 vaccine and the age range.

Table 17. The result of the association measure of Indonesian People Perception of the COVID-19 Vaccine With Age Ranges

Contingency Coefficient
0.138

5. Conclusions

In general, most people show their support for the planned mass COVID-19 vaccination in Indonesia. Based on the results of the analysis, the community's perception does not depend on the gender, income range, and age range of the community. Basically, elements of society on certain sexes, income ranges, and age ranges have the same view, namely expressing support for the planned mass COVID-19 vaccination in Indonesia. This is evidenced by the test results on the Pearson test with the Pearson chi-square approach which is not significant at the 5% significance level. However, the development area or community location and the level of community education showed a significant relationship to community perceptions. Communities who disagree with the mass vaccination plan in Indonesia are dominated by people who live or come from development areas C and D. Whereas, in terms of education level, most of the people with the latest education at high school level are equivalent or lower, show a perception that they do not agree. To realize the mass COVID-19 vaccination plan in Indonesia, the government needs to take several approaches so that people accept and agree to the plan. This approach can be carried out through socialization and education about the benefits and importance of vaccination in the community, especially those located in developing areas C and D, as well as in communities with high school education levels of the same or lower. The main target in socialization and education is based on the results of the previous analysis so that it is hoped that the approach made by the government can be more targeted. Thus, the public can become more aware of the benefits and importance of vaccination so that the perception of the community that supports and agrees with the vaccination plan can increase.

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