



Analysis of The Distribution of Covid-19 Vaccines Using Cold Chain Methods to Maintain Vaccine Quality at Vaccination Service Centers in Jakarta, Bogor, Tangerang, and Bekasi

Husnil Barry*, Syamsurizal
Business Administration Department
Depok, Indonesia
*husnil.barry@bisnis.pnj.ac.id

Abstract—Corona Virus Disease 2019 (Covid-19) has been declared a pandemic by the World Health Organization (WHO). The Covid-19 virus is spreading rapidly in Indonesia. It is necessary to hold interventions such as vaccinations to achieve 70% herd immunity to reduce the number of Covid-19 cases. The distribution and storage aspects of cold systems are vital to get good vaccine quality. The purpose of this study was to determine the effect of cold chain systems and distribution on the quality of the Covid-19 vaccine. Vaccination services in Jakarta, Bekasi, Bogor, and Tangerang were included in the 38 survey samples. In this study, questionnaires were used to collecting data. PLS-SEM (Partial Least Square-Structural Equation Modeling) was used to analyze the research data. Based on the results of this study, Cold Chain variables have a direct and positive impact on distributions with coefficient values of 0.500 and P values of 0.001. Cold Chain variables directly and positively affect quality, with coefficient values of 0.372 and P-values of 0.025. Distribution variables directly and positively affect quality with a coefficient value of 0.624 and a P-value of 0.000, and Cold Chain variables also have an effect, and the Cold Chain variable has a positive effect on quality with the distribution variable as an intervening variable with a coefficient value of 0.312 and a P-value of 0.036.

Keywords—Cold Chain, Distribution, Quality

I. INTRODUCTION

Corona Virus Disease 2019 (Covid-19) has been declared a pandemic by the World Health Organization (WHO). The spread of the Covid-19 virus is growing every day. Covid-19 is not only spreading in the capital city but has spread to every province since one month after the first case was announced. Jakarta, Bogor, Bekasi, and Tangerang are the cities where the highest numbers of Covid-19 cases in Indonesia are reported. There is a need for intervention to reduce the number of Covid-19 cases. Vaccination is one such intervention that can break the transmission chain for the Covid-19 virus. To reduce morbidity and mortality through the Covid-19 vaccination, group immunity is created, referred to as Herd Immunity. To achieve herd immunity in Indonesia, the government plans to administer Covid-19 vaccination to 173 million, or 70 percent of the population of Indonesia.

Distribution of the Covid-19 vaccine in these health facilities requires good distribution of the vaccine. The central government is responsible for distributing vaccines to the provinces. The province is responsible for distributing the Covid-19 vaccine to its regencies or cities. Local or city governments are responsible for distributing Covid-19 vaccines to health services such as health centers, clinics, hospitals, or other vaccination service units.

The distribution of the Covid-19 vaccine is strictly managed and well prepared using an electronic logistics monitoring system, namely Bio Tracking and SMILE (Electronic Immunization and Logistics Monitoring System). The BioTracking system functions to find out real-time position, temperature sensors, track door sensors, checkpoints, and travel paths.

To maintain the quality of the Covid-19 vaccine, a good distribution, and storage system is necessary, namely the Vaccine Cold Chain system or the Cold Chain based on the GDM (Good Drug Distribution Method). Supervision of vaccine distribution for the Covid-19 vaccine is closely guarded by the POM Agency, which includes supervision of distribution channels by the PT. Bio Farma is suitable for both the distribution chain using the Vaccine Cold Chain, which is overseen by the CDOB. This method aims to ensure good distribution of vaccines so that the quality of the vaccine reaches the recipients

Due to the importance of the distribution of the Covid-19 vaccine and the cold chain system to vaccine quality, the authors are interested in conducting a study on how the Cold Chain system affects the distribution and quality of the Covid-19 vaccine at vaccination service centers in Jakarta, Bogor, Bekasi, and Tangerang. The purpose of this study was to examine the effect of the cold chain system and distribution on the quality of the Covid-19 vaccine partially, and the effect of the cold chain system on the quality of the Covid-19 vaccine with distribution as an intervening variable.

This study can theoretically provide input and knowledge about the distribution and transportation system, especially regarding the Covid-19 vaccine, and it can be used in practice by the City

government, PT Bio Farma, Community Health Centers, and the Food and Drug Administration.

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II. LITERATURE REVIEW

A. Cold Chain

According to the Ministry of Health of the Republic of Indonesia (2017), the Cold chain is a vaccine management system intended to maintain the quality and safety of vaccines during the distribution process. The main purpose of the cold chain is to maintain the quality of the vaccine by maintaining the temperature of the vaccine during the distribution process. Based on CDOB guidelines (Food and Drug Supervisory Agency, 2020) the following aspects are considered important for handling cold chain products: Personnel and training, Buildings and Facilities, Operational, Maintenance, Qualification, calibration, and validation. According to Fauza et al (2019:23), the indicators chain include: Equipment, Officers

B. Distribution

Distribution, as defined by Tjijtono (2020: 187), is the delivery of goods or services that have gone through several series of intermediaries that are provided to consumers for consumption. As stated in the Regulation of the Minister of Health Number 84 of 2020 on the Implementation of Vaccination in the Context of Combating Corona Virus Disease 2019 (Covid-19) Pandemic, vaccine distribution should be carried out following the Good Drug Distribution Method (CDOB) and by the central government, which is responsible for the distribution of vaccines and supporting equipment to the provinces. According to Kumru (2014: 53), the indicators used for vaccine distribution include: Potency, Stability, and Convenience

C. Quality

1. According to Suryadi Prawirasentono (2017:112), the quality of a product is its physical condition, function, and characteristics that correspond to the amount of money exchanged for the product and that satisfy consumer needs and expectations. Following Regulation No. 12 of 2017, which is issued by the Ministry of Health of the Republic of Indonesia, the following factors must be taken into consideration when determining the quality and safety of vaccines: Vaccine has not expired, Vaccines have never been frozen, Vaccines have never been exposed to excessive sunlight, and vaccine has not exceed the limit for the use of the vaccine that has been opened.

III. RESEARCH METHOD

This research was conducted at vaccination service centers in Jakarta, Bogor, Bekasi, and Tangerang. It was conducted from March to August 2021. As part of the research objectives, the researchers used an explanatory research method and a quantitative research approach. The primary objective of using the explanatory research method is to test the proposed hypothesis, which can then be used to explain the relationship and influence between independent and dependent variables of the hypothesis.

There were 30 samples used and the population studied were officers responsible for managing the distribution of Covid-19 vaccines at vaccination centers in Jakarta, Bogor, Bekasi, and Tangerang.

This study used one variable X, one variable Y, and one variable Z. In this study, the cold chain is the X variable, the quality variable is the Y variable, and the distribution variable is the Z variable. Respondent data is obtained by distributing questionnaires to the officers responsible for the distribution of Covid-19 vaccines at the vaccination service points in Jakarta, Bogor, Bekasi, and Tangerang.

The questionnaire is distributed digitally via Google Form, using a Likert scale of 4 points. Data from respondents were tested and analyzed using Smart PLS software version 3.3.2

Tests of the outer model are conducted through validation and reliability of the instrument. After testing the inner model, tests of the outer model are conducted. A test of the inner model was conducted using F-square, R-square, Q-square, bootstrapping results (P-value and T-statistics), and intervening tests.

IV. RESULTS AND DISCUSSION

Specifically, this study examines the relationship between cold chain as variable X and quality as variable Y, along with distribution as the intervening variable Z. As a result of the validity and reliability test, 13 items did not meet the validity criteria. It is, therefore, necessary to remove the items and then retest them. Having been retested, all of the items are valid and reliable, meaning that the distribution of the instrument to respondents is feasible. The total number of items meeting both validity and reliability criteria is 54. After that, a Q-square test was conducted to determine how well the model was used.

Figure 1. Value of Q-square

$$Q^2 = 1 - (1 - 0,655)(1 - 0,746)$$

$$Q^2 = 1 - (0,345)(0,254)$$

$$Q^2 = 0,91227$$

Source : Results of processed data

Figure 1 shows that 91,244% of the Y variable can be explained by the X and Z variables, while 8,763% can be explained by variables not included in the research model so that the model has predictive relevance because it is above 0 and tends to be good because it is close to 1.

Table 1. Value of R-square

Variable	R-Square
Distribution	0.655
Quality	0.746

Source : Results of processed data

According to table 1, the R-square value for the distribution variable is 655. This means that the cold chain has an influence of 65,5% on the distribution and all of the rest is influenced by other factors. Furthermore, the R-Square value for the quality variable is 0,746. According to this finding, cold chain and distribution influence quality by 74,6% of the total, and the rest depends on other factors.

Table 2. Value of F-square

Relationship among variables	R Included	Effect F2	Expl.
Cold Chain -> Distribution	0.655	0.333	Moderate
Cold Chain -> Quality	0.746	0.394	Major
Distribution -> Quality	0.746	0.701	Major

Source : Results of processed data

As seen in Figure 2, two tracks have a major impact on quality, namely the cold chain and distribution. There is one track that has a moderate effect on distribution, namely, the cold chain.

Table 3. Results of Bootstrapping

	Path Coefficient	T Statistic	P Values
Cold Chain (X) -> Distribution (Z)	0.500	3.416	0.001
Cold Chain (X) -> Quality (Y)	0.372	2.155	0.025
Distribution (Z) -> Quality (Y)	0.624	3.928	0.000

Source : Results of processed data

Based on table 3 the results of hypothesis testing are obtained: T-count for the cold chain on the distribution of the Covid-19 vaccine is 3.416, which means it has a significant impact since it is greater than the T-table value of 2,030. The P-value is 0.001 < 0.05, which means it is significant.

T-count value of 2,155 indicates that the cold chain has a significant effect on the quality of the Covid-19 vaccine because it is greater than the T-table value of 2,030. The P-value is 0.025 < 0.05, which means it is significant.

T-count value for distribution on the quality of the Covid-19 vaccine is 3.928, which indicates it has a significant impact because it is higher than the T-table value of 2,030. The P-value is 0.000 < 0.05 which means it is significant.

Table 4. Results of Intervening

	(O)	STDEV	T Statistics	P Values
(X) -> (Z)	0.312	0.148	2.108	0.036

Source : Results of processed data

Based on table 4, the T-count value is 2,108, which means it has a significant effect because it is greater than the T-table value, which is 2,030. The P-value is 0.036 < 0.05, which means it is significant. There is a partial effect of the intervening variable.

V. DISCUSSION

This study of thirty vaccination management officers at vaccination service points in Jakarta, Bogor, Bekasi, and Tangerang indicated that cold chain and distribution have a significant influence on the quality of the Covid-19 vaccine at the Covid-19 vaccination service centers in Jakarta, Bogor,

Bekasi, and Tangerang. The distribution variable as an intervening variable has a partial effect.

This study's results are in agreement with the research conducted by Fauza, et al. (2019) which indicates the cold chain helps maintain vaccine temperature during the transportation process. Based on the study results, the better the cold chain management is, the better the distribution will be. This indicates that cold chain systems affect vaccine distribution. Similarly, Kumru (2014) found that better cold chain management will result in more precise and appropriate distribution as well.

Following Kumru (2014), the results of this study indicate that good vaccine distribution results in vaccines of the same quality from producer to vaccine recipient. Vaccine distribution can worsen the quality of vaccines if the transportation process is not managed by competent personnel and does not comply with the provisions (Peepliwal, 2017). This shows that the distribution affects the quality of the vaccine.

This study supports the findings of Peepliwal (2017), that handling and managing vaccines in a cold chain are very important because the presence or absence of a cold chain will affect the quality of the vaccine. The management of the vaccine cold chain can ensure the continued potency of the vaccine by using the proper equipment, as suggested by Fauza et al (2019). The CDOB Guidelines on Regulation of the Food and Drug Supervisory Agency (2020) explain that the cold chain, which includes equipment, personnel, maintenance, and operations, functions to maintain the temperature of the vaccine in order not to reduce its potency. This shows that cold chain management affects vaccine quality.

Those findings are in line with Peepliwal (2017), who states that cold chain management (CCM) allows vaccines to be maintained and distributed to recipients while maintaining vaccine quality. According to CDOB Guidelines on the Regulation of the Food and Drug Supervisory Agency (2020), it is explained that the cold chain consists of equipment, personnel, maintenance, and operations that function to maintain the temperature of the vaccine, which is also explained that a cold chain is required for vaccine delivery or distribution. Cold chain management of the vaccine affects its quality, with the distribution of the vaccine affecting its quality to protect the Covid-19 vaccine.

In this study, the results indicate that the better the cold chain system is applied, the better the distribution of the Covid-19 vaccine and the quality of the Covid-19 vaccine is produced. Based on the summary of respondents' answers to the cold chain variable (X), it can be concluded that cold chain management is considered very good. In other words, the staff and equipment have been managed properly and following CDOB regulations. As a result of the quality variable (Y), it can be concluded that the Covid-19 vaccine has been classified as very good. This means that from the distribution of vaccines to the delivery of guaranteed storage, right up to the distribution of vaccines to recipients, covid-19 vaccines are of the highest quality. Based on the distribution variable (Z), it can be concluded that the management of the distribution of the Covid-19 vaccine at vaccination service points in Jakarta, Bogor, Bekasi, and Tangerang has been categorized as excellent. Thus, vaccine distribution always considers temperature stability, potential vaccine damage, and ease of distribution of Covid-19 vaccines.

Nevertheless, there have been several reports of the Covid-19 vaccine having undergone color change and deposition evidenced by the presence of strongly disagree and disagree responses by respondents. Contrary to the Minister of Health of Indonesia's Regulation No. 12 of 2017, the only quality vaccine does not change color and does not freeze. The reason for this color change and deposition is the unstable storage temperature of the vaccine, meaning that the temperature is too high, too low, or a sharp temperature change.

Several respondents disagreed that training should be conducted regularly and systematically. This is contrary to the Regulation of the Indonesian Food and Drug Monitoring Agency (2007), which provides training for officers regularly by competent personnel to ensure that staff members are familiar with CDOB regulations. Those who disagreed with the training recorded the expiration date of the vaccine, which conflicted with the Food and Drug Supervisory Agency's Regulation of 2020 concerning Good Drug Distribution Methods, which states that the stored vaccines should be recorded with expiration dates and distributed according to the FEFO system.

VI. CONCLUSION

This study has concluded that the cold chain has a positive effect on the distribution of the Covid-19 vaccine. Distribution has a positive effect on the quality of the Covid-19 vaccine. In addition to improving the quality of the Covid-19 vaccine, cold chain safety is also important. Cold chain has a positive effect on the quality of the Covid-19 vaccine, with distribution as an intervening variable. Following the results of the study, the distribution variable has a partial effect.

VI. SUGGESTION

The suggestions given by the authors to improve the quality of the Covid-19 vaccine are:

The City Government needs to periodically control the cold chain equipment in every community health center and every health center must properly record the lack or the insufficiency of equipment so that there are no obstacles in the storage and distribution of the Covid-19 vaccine;

A regular and systematic training program should be conducted by the City Government on how to monitor vaccine temperatures, record vaccine temperatures, maintain vaccines, and report deviations from vaccine temperatures;

Vaccine officers must manage the cold chain according to instructions in the training, such as using 4 cool-packs for each vaccine carrier, performing routine VVM checks, and using a vaccine carrier to temporarily store Covid-19 vaccines;

Recording the expiry date must be done because it is better to use a vaccine that has an earlier expiration date.

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