COMPATIBILITY OF STORAGE AND DISTRIBUTION SYSTEMS COVID-19 VACCINE AT SEDAN HEALTH CENTER, REMBANG DISTRICT WITH KMK RI HK. 01.07/MENKES/ 4638/2021

Aprillia Puspitasari Tunggadewi[1]*, Yulia Pratiwi[2], Wildayanti [3], Mera Putri Pratitis[4], Liana Safitri[5], Setiaji Wisnu Wardana[6]

[1,2,3,4]Institut Teknologi Kesehatan cendekia Utama Kudus, Indonesia
[6]Universitas Ngudi Waluyo, Indonesia
Corresponding author: farilli4n@gmail.com

Abstract. Covid-19 is a virus that causes disease in humans and animals, which has symptoms such as the common cold and serious illnesses such as *severe Acute Respiratory syndrome or Middle East Respiratory Syndrome*. COVID-19 was first discovered in Wuhan in 2019 and spread worldwide, including Indonesia, which was first confirmed on March 2, 2020. Covid-19 continues to increase as time goes by. The vaccination program was carried out to reduce the Covid-19 pandemic.Vaccine management is carried out because storing and distributing vaccines is susceptible to damage, so special handling is needed to maintain vaccine quality. This research aims to determine the suitability of the vaccine storage and distribution system at the Sedan Community Health Center, Rembang Regency, with the Indonesian KMK (2021) and Community Health Center SOP. This research aims to determine the suitability of the vaccine storage and distribution system atthe Rembang Regency Sedan Health Center with the RI KMK (2021) and Community Health Center SOP. This research on COVID-19 uses *experimental* methods, which are descriptive and qualitative. Research data was obtained by direct observation (*observation*) interviews with employees in charge of storing and distributing the COVID-19 vaccine at the Sedan Community Health Center using sheet *checklist*s and documentation of tools and how to store and distribute them. The research results showed that the data was obtained from the sheet *checklist* with a percentage of storage of the COVID-19 vaccine with an average of 85.7% and distribution of the COVID-19 vaccine with an average of 92.3%, more than 75%. This research concludes that the vaccine storage and distribution system complies with the 2021 KMK RI standards and Puskesmas SOPs.

Keywords: Vaccines, Storage, Distribution, KMK RI 2021, Community Health Center.

INTRODUCTION

COVID-19 is a virus that causes disease in humans and animals, which has symptoms such as the common cold and serious illnesses such as *severe Acute Respiratory Syndrome* or *Middle East Respiratory Syndrome*. The COVID-19 disease outbreak first occurred in Wuhan, China, in December 2019, and COVID-19 has now become a pandemic occurring in many countries worldwide (WHO, 2020). Symptoms of COVID-19 range from mild symptoms such as fever and cough to severe respiratory syndrome, including pneumonia, and even death (Chen*et al*., 2020).

Based on data from the World Health Organization, on April 8, 2022, Europe became the world's number 1 country with the most people infected with the Coronavirus, with a total confirmed population of 206,611,315, America 151,241,852, Southeast Asia 57,338,863, Eastern Mediterranean 21,615,965, Western Pacific 49,169,628, and Africa 8,609,251, this data will continue to increase as the number of people infected with Covid-19 (WHO, 2022). The increase in COVID-19 in Indonesia is relatively high; the first case in Indonesia was known on March 2, 2020, when there were only two sufferers. All provinces have reported confirmed cases in one month. The number of confirmed cases of COVID-19 continues to increase as the coverage of exposed areas expands, both in urban and rural areas in remote areas (Ministry of Health of the Republic of Indonesia, 2021).

Cases in Central Java reported that on January 15, 2022, the total confirmed exposure to COVID-19 reached 625,836 and 41,038 were declared dead, 584,675 were recovered (Central Java Provincial Government, 2022). For the Rembang region itself, on January 15, 2022, the total confirmed cases of COVID-19 reached 7,846, and those declared dead reached 761, then those confirmed to have recovered reached 7,085. The number of people infected with the Coronavirus will continue to change as the number of people infected increases (Rembang Regency Government, 2022).

Efforts to reduce COVID-19 include vaccination programs by governments worldwide, including Indonesia. Vaccines are biological products containing antigens in the form of dead or live weakened microorganisms (Permenkes RI, 2017). To carry out a vaccination program, it is necessary to carry out accurate and comprehensive vaccine management, which will positively impact health services both medically, socially, and economically. Vaccines are susceptible to damage, so special handling is needed to maintain vaccine quality, such as effective and efficient storage and distribution activities (Ministry of Health of the Republic of Indonesia, 2021).

Improper vaccine production can cause deviations in vaccine quality. This deviation can cause damage to the vaccine, thereby reducing or eliminating its efficacy. Deviation factors in vaccines are caused by not following correct procedural guidelines for administering vaccines, lack of staff knowledge, refrigerators that do not function specifically for storing vaccines, no thermometers to measure temperature, and improper methods of carrying vaccines. Deviations usually occur in the delivery process (Permenkes RI, 2017). Poor storage and distribution can cause damage and loss to the country and society. Based on the above background, it is necessary to research "The Suitability of the Covid-19 Vaccine Storage & Distribution System at the Sedan Community Health Center, Rembang Regency with KMK RI Hk.01.07/MENKES/4638/2021".

METHODS

This research uses descriptive observational methods and monitoring ongoing activities, which are adapted to the KMK RI guidelines Hk.01.07/MENKES/4638/2021 and the Sedan Health Center SOP. Data collection techniques were carried out prospectively through observation, interviews, and documentation at the Sedan Community Health Center, Rembang Regency. The instruments used in this research were checklists and interviews.

RESULTS

1. Storage

Storage is a regulatory activity for pharmaceutical preparations by established requirements to ensure that they are not lost, free from physical and chemical damage, and their quality is guaranteed (Permenkes RI, 2016). The purpose of storage is to maintain the condition of the medicine so that it is always well maintained, does not spoil quickly, and can also avoid errors in the use of the medicine. Table 1 shows that the COVID-19 vaccine storage system at the Sedan Community Health Center has not reached 100%, namely 80.9%. These results are still based on the Action Plan for the Activities of the Directorate of Public Medicine and Health Supplies (Rak Dit bina oblik and Perbekkes) for 2020-2024, which is more than 75%.

Table 1. Storage and Distribution of COVID-19 Vaccine in Sedan Public Health

No.	Question	Informant Answers (Yes/No)		Compliance with RI KMK Standards/SOP for Sedan Health Center
		Midwife	Pharmacist	
Storage				
a. Facilities and infrastructure				
1	The Covid-19 vaccine is stored in a cold box	Yes	Yes	√
2	The COVID-19 vaccine is stored in the Vaccine Refrigerator/domestic refrigerator.	Yes	Yes	√
3	*Auto Disable Syringe*stored in a particular area	Yes	Yes	√
4	Alcohol Swabs are stored in a particular area	Yes	Yes	√
5	*Safety Box*stored in a particular area	No	No	-
6	Store the COVID-19 vaccine in the Community Health Center away from direct sunlight.	Yes	Yes	√
7	Storage The COVID-19 vaccine is stored in a separate vaccine refrigerator from other vaccines	Yes	Yes	√
8	The COVID-19 vaccine is not placed in the domestic/household refrigerator door.	Yes	Yes	√
9	The Pfizer vaccine is stored in a freezer	Yes	Yes	√

10	Pfizer vaccine storage uses UCC	No	Yes	-
11	A thermometer accompanies the storage	Yes	Yes	√
b. Storage Temperature				
1	Vaccine storage at 2-80C	Yes	Yes	√
2	AstraZeneca vaccine is stored at 2-80C	Yes	Yes	√
3	Sinopharm vaccine is stored at 2-80C	Yes	Yes	√
4	Sinovac vaccine is stored at 2-80C	Yes	Yes	√
5	The Moderna vaccine is stored at -200C or at 2-80C	Yes	Yes	√
6	The Pfizer vaccine is stored at -700C	Yes	Yes	√
c. Temperature monitoring				√
1	Officers monitor temperatures	Yes	Yes	√
2	Temperature monitoring is carried out more than two times a day	No	No	-
3	Officers record the results of temperature monitoring	Yes	Yes	√
4	Temperature monitoring using the SMILE application	No	No	-
Total		**17**	**17**	
Average		**80.9%**	**80.9%**	
Distribution				
Facilities and infrastructure				
1	Distribution of the Covid-19 vaccine at Community Health Centers must be accompanied by a Proof of Exit Goods (SBBK)	Yes	Yes	√
2	Distribution of the COVID-19 vaccine accompanied by a Vaccine Arrival Report (Vaccine Arrival Report)	Yes	Yes	√
3	Distribution of the COVID-19 vaccine at community health centers accompanied by a packing slip (copy of goods)	Yes	Yes	√
4	Distribution of the COVID-19 vaccine at community health centers using Cold Boxes	Yes	Yes	√
5	Distribution of the COVID-19 vaccine using a Vaccine Carrier	Yes	Yes	√
6	Distribution of the COVID-19 vaccine accompanied by a Cool Pack	Yes	Yes	√
7	Distribution of the Covid-19 vaccine at Community Health Centers accompanied by temperature monitoring devices	Yes	Yes	√
8	Spraying disinfectant on the surface of the Cool Box, Vaccine Carrier, or other means of transportation	Yes	Yes	√
9	The disinfectant used must comply with the standards	Yes	Yes	√
10	Special marking for unopened Covid-19 vaccines	Yes	Yes	√
11	The unopened Covid-19 vaccine is stored back in the vaccine refrigerator	Yes	Yes	√
12	COVID-19 vaccines not used during service will be used first for the next vaccination.	Yes	Yes	√
13	Distribution of the Pfizer COVID-19 vaccine using the UCC tool at the time of service	No	No	-
14	Officers use surgical masks/medical masks when arranging vaccines	Yes	Yes	√
15	Officers use gloves when arranging vaccines	Yes	Yes	√
16	Officers wash their hands or use hand sanitizer before arranging the vaccine.	Yes	Yes	√
17	Officers monitor the expiration of the COVID-19 vaccine that will be used during services.	Yes	Yes	√
18	Officers wash their hands after administering the Covid-19 vaccine	Yes	Yes	√

19	During the vaccination process, the officer places the COVID-19 vaccine on the sponge/foam covering the vaccine carrier.	No	Yes	√
Total		**17**	**18**	
Average		**89.5%**	**95%**	

Source: Processed primary data (2022)

The research results based on interviews and storage checklist sheets are divided into three categories: vaccine storage facilities and infrastructure, vaccine storage temperature, and vaccine temperature monitoring.

a. Facilities and infrastructure

Vaccine storage at the Sedan Health Center is separate from the service room. When storing vaccines, the room is protected from exposure to direct sunlight, there are no leaks in the roof tiles of the vaccine house, and there is air ventilation in the form of windows. Based on research from Cian (2018) regarding the Medicine Storage System in the Manggarai Regency Pharmacy Warehouse, data was obtained that the warehouse roof was in good condition and had no leaks, the windows had curtains, special storage for vaccines and suppositories, air ventilation was available in the warehouse so that air circulation was smooth.

Storage can be good if the facilities and infrastructure support storage, such as vaccines in a cold box. The cold box is a storage area for vaccine services and brings the vaccine within the required temperature range. This is based on research by Prasetyo et al. (2021) regarding the knowledge level of vaccine management officers and evaluation of vaccine management at the Sleman Regency Health Center; the cold box must function well to classify storage as good.

Vaccines are stored in the Vaccine Refrigerator, which has a door that opens upwards. When storing the COVID-19 vaccine in the Vaccine Refrigerator, it is arranged in a separate basket from other routine vaccines, accompanied by a Muller thermometer to monitor the temperature in the vaccine refrigerator. The distance between vaccine boxes gives the arrangement of vaccines. Vaccine Refrigerators are also used to store cool packs. Based on Zuhroh & Dyahariesti (2021) regarding Vaccine Storage in Mataram City, data was obtained for storing vaccines using a Refrigerator given a minimum distance of 15 cm; the distance between vaccine boxes is 1-2 cm.

According to the Ministry of Health's standards (2021), storage supporting equipment such as Auto disabled syringes, Alcohol swabs, and Safety boxes is stored in a particular area to differentiate supporting storage equipment from leading storage equipment. Storage of Auto Disable Syring and Alcohol Swabs at the Sedan Community Health Center is by standards. Meanwhile, the safety storage box needs to be more suitable because it is not placed in a particular area, only on cardboard. This is due to limited space and storage space. Based on Rizal (2021), the safety box is stored in a particular room before destruction.

To ensure that the quality of the vaccine is guaranteed and the quality of vaccine storage requires special attention; for example, the Sedan Community Health Center provides a generator (Generator Set) to deal with if the electricity supply is cut off and based on Ilmanafi'a (2019) in research on the evaluation of the suitability of storing the Dpt-Hb-Hib vaccine at the Blitar District Health Service using generators as spare parts when there is a power outage.

Vaccines have specific properties that require particular cold chain handling from factory production to use in health care units. Deviations from existing regulations can cause damage to the vaccine, reducing or even eliminating the benefits of the vaccine. Monitoring the storage temperature of vaccines is very important to determine whether the vaccine is suitable (Pracoyo et al., 2013).

b. Storage Temperature of the Covid-19 vaccine

According to WHO (2021), the storage temperature for the Covid-19 vaccine varies. The Sinovac vaccine lasts for 12 months (WHO, 2021a), AstraZeneca lasts until the expiration date stated on the label (WHO, 2021d), and Sinopharm lasts for 24 months (WHO, 2021e) if stored at a temperature of 2-8°C and should not be stored in the freezer. The Moderna vaccine is stored at -25°C to -15°C and should not be stored below a temperature of -40°C. It will last according to the expiration date stated on the label (WHO, 2021b). Meanwhile, the Pfizer vaccine is stored at -80°C to -60°C for nine months (WHO, 2021c).

Based on this research, which can be seen in Table 1. Storage of the COVID-19 vaccine at the Sedan Community Health Center, Rembang Regency, the AstraZeneca, Sinopharm, and Sinovac vaccines are stored at 2-8°C, which meets WHO standards (2021). The Moderna and Pfizer vaccines do not comply with the provisions because they are stored near the evaporator at a temperature of 4°C. The Moderna vaccine can only last 30 days, and the Pfizer vaccine lasts 31 days. According to Iswara (2021), the Pfizer vaccine can be stored in a refrigerator temperature of 2-8°C but can only last for one month. According to Rahmawati (2021), the Moderna vaccine can last one month at a refrigerator temperature of 2-8°C.

c. Temperature Monitoring

Based on the SOP, vaccine temperature monitoring is carried out three times a day, whereas in KMK RI (2021), temperature monitoring is carried out more than two times a day. The temperature of the COVID-19 vaccine at the Sedan Community Health Center is monitored periodically in the morning at 08.00 WIB and in the afternoon at 15.00 WIB by looking at the thermometer. Temperature monitoring is also carried out on holidays if someone is on duty. However, temperature monitoring is not carried out if no one is on duty. When monitoring vaccine temperature, officers ensure that the temperature in the vaccine refrigerator is maintained between 2-8°C. Monitoring results are recorded on temperature monitoring chart paper using maximum/minimum temperature information, date, time, and the person who checked and recorded the temperature. If a temperature deviation occurs, the vaccine management officer reports this problem to the person in charge of the facility by documenting the temperature deviation incident in the form of the date and time of the temperature deviation, the name of the person who made the report and a description of the incident. Meanwhile, according to Lumentut et al. (2015), Evaluation of Vaccine Storage and Distribution from the Manado City Department to the Tuminting Community Health Center, Paniki Bawah Community Health Center, and Wenang Community Health Center for temperature monitoring carried out twice a day.

2. Distribution

Table 1 shows that the Covid-19 vaccine distribution system at the Sedan Community Health Center has not reached 100%. However, the distribution system is still categorized according to the Activity Action Plan of the Directorate for Public Medicine and Health Supplies (Rak Dit bina Oblik and Perbekkes) for 2020-2024 because the result is 92.3% more than 75%.

a. Facilities and infrastructure

Vaccines from the Health Service at the Sedan Community Health Center were received by the pharmacist in charge at the vaccine house. When the goods arrive, the packaging, quantity, type, and expiry are constantly checked, then checked with the SBBK (Proof of Outgoing Goods), including the Packing slip (copy of the goods). Based on research by Susyanty et al. (2014) regarding the Vaccine Management and Inventory System in two Indonesian Provinces resulted in data for proof of outgoing goods being recorded manually to minimize the occurrence of errors due to negligent officers.

Suppose a vaccine is damaged or expired when received. In that case, the Puskesmas officer is obliged to refuse and return the immunization to the District Health Service by submitting an official report on the return of the vaccine. After checking, the officer signs the acceptance document/SBBK. The officer then recorded it in the Sedan Health Center warehouse stock book. After receiving the vaccine, the officer arranges the vaccine according to the specified temperature. This is by research by Zipursky et al. (2011) regarding assessing the potential of oral polio vaccine stored outside the cold chain during the national immunization campaign in Chad. Obtained data on receipt and delivery of the vaccine as well as the condition of the vaccine upon arrival.

Officers also need equipment to support vaccine carriers, such as cold boxes and vaccine carriers, to distribute vaccines. Before using the tool, first clean the tool with disinfectant. The disinfectant used by the Sedan Health Center is 95% alcohol. Cleaning the surface of the cold box, vaccine carrier, and other supporting equipment is carried out before and after use. Cleaning using disinfectant with

How to wipe using cotton wool treated with 95% alcohol. According to research results

from Noviansari (2012), alcohol functions as an antibacterial or can kill bacteria. Cool packs and temperature monitoring devices must accompany distribution using cold boxes and vaccine carriers. Cold boxes are used for distribution if the number of vaccines is large. Meanwhile, vaccine carriers are used to distribute small quantities of vaccines.

In the distribution of the Pfizer vaccine at the Sedan Community Health Center, they do not use UCC equipment (ULT freezers and special transportation equipment) during service but use a cold box equipped with a temperature measuring device if the amount of vaccine is small, whereas if the amount of vaccine is large, use a vaccine carrier. Based on research conducted by Lumentut et al. (2015) on the Evaluation of Vaccine Storage and Distribution from the Manado City Department to the Tuminting Community Health Center, Paniki Bawah Community Health Center and Wenang Community Health Center for distribution of the COVID-19 vaccine using a cold box containing an excellent pack and a temperature measuring device.

After the vaccination service, the officers return the COVID-19 vaccine, which has not been opened, and give a special marking, and put it in the vaccine refrigerator for use in the next vaccination service. Labels for vaccines not opened at the Sedan Community Health Center are placed in a plastic clip, and an expiration date and the number of vaccines are given.

Vaccines that have been used for service should be placed in the sponge/foam cover of the vaccine carrier, while those that have not been used are put back in the vaccine carrier, but this is not done because the staff places the vaccine that has been used in the instrument tray. The vaccine is placed on the sponge/foam only to separate the vaccine that has been used from the COVID-19 vaccine that has not been used. Based on Wedhaswary (2021), vaccines that have been opened must not be stored again in the vaccine carrier storage area.

b. Distribution Officer

The vaccine arrangement carried out at the Sedan Community Health Center is by Ministry of Health standards (2021). Before and after arranging the vaccine, officers wash their hands using soap/hand sanitizer and then wear masks and gloves. During the arrangement, officers monitor vaccine expiration. If there is an expired vaccine, the officer reports it to the person in charge of the vaccination program.

CONCLUSION

The storage and distribution system for the COVID-19 vaccine complies with the Indonesian KMK standards (2021) and the SOP for the Community Health Center at the Sedan Community Health Center, Rembang Regency.

REFERENCES

Bachri, BS 2010. Ensuring Data Validity Through Triangulation in Qualitative Research. *Education technology*, 10, 46–62.

Badriyah, L. 2020. The drug storage system is based on pharmaceutical service standards in *South Tegal Community Health Center*. 10–11.

BPOM. 2020. Technical Guidelines for Good Medicine Distribution Methods (CDOB). National Agency of Drug and Food Control.

Chen, N., Zhou, M., Dong, X., Qu, J., Gong, F., Han, Y., Qiu, Y., Wang, J., Liu, Y., Wei, Y., Xia, J., Yu, T., Zhang, X., & Zhang, L. 2020. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study.

Cian, W. 2018. Medicine Storage System in Manggarai Regency Pharmacy Warehouse. 5–11. Guan, W., Ni, Z., Hu, Y., Liang, W., Ou, C., He, J., Zhu, S. 2020. Clinical Characteristics of Coronavirus Disease 2019 in China. New England Journal of Medicine, 1–13.

Ilmafi'a, L. 2019. Evaluation of the Suitability of Storage of the DPT-Hb-Hib Vaccine at the Blitar District Health Service. 112.

Iswara, JA 2021. BPOM US: Pfizer vaccine can be stored at refrigerator temperature for a month. Compass. May 23, 2021.

Indonesian Ministry of Health. 2021. Minister of Health Decree No. HK.01.07/MENKES/4638/2021 Concerning Technical Instructions for Implementing Vaccinations in the Context of Handling

the COVID-Pandemic 19. Indonesian Ministry of Health, 2021, 1–157.
Li, X., Geng, M., Peng, Y., Meng, L., & Lu, S. 2020. Molecular immune pathogenesis and diagnosis of COVID-19. Journal of Pharmaceutical Analysis, 10(2), 102–108.
Liu, J., Zheng, X., Tong, Q., Li, W., Wang, B., Sutter, K., Yang, D. 2020. Overlapping and discrete aspects of the pathology and pathogenesis of the emerging human pathogen coronaviruses SARS-CoV, MERS-CoV, and 2019-nCoV. Journal of Medical Virology, (February), 1–4.
Lumentut, GP, Pelealu, NC, & Wullur AC 2015. Evaluation of Vaccine Storage and Distribution from the Manado City Health Service to the Tuminting Community Health Center, Paniki Bawah Community Health Center, and Wenang Community Health Center. Pharmaceutical Scientific Journal –, 4(3), 9–15.
Noviansari, R. 2012. Transformation of Methyl Eugenol into the Compound 3-(3,4-Dimethoxy Phenyl)-1- Propanol and Test of Its Activity as an Antibacterial Against Escherichia coli.
Rembang Regency Government. 2022. Monitoring COVID-19 in Rembang district. https://covid19.rembangkab.go.id/
Central Java Provincial Government. 2022. Central Java COVID-19 Case Statistics. https://corona.jatengprov.go.id/data
RI Minister of Health Regulation. 2016. Regulation of the Minister of Health of the Republic of Indonesia Number 74 of 2016. *Minister of Health of the Republic of Indonesia*, 206, 1–48.
RI Minister of Health Regulation. 2017. Regulation of the Minister of Health of the Republic of Indonesia Number 12 of 2017 concerning the Implementation of Immunization. Minister of Health of the Republic of Indonesia, 6, 1–162.
RI Minister of Health Regulation. 2020. Regulation of the Minister of Health of the Republic of Indonesia Number 84 of 2020 concerning the Implementation of Vaccination in the Context of Pandemic Management. 2019, 4.
Pracoyo, NE, Jekti, RP, Puspandari, N., & W, DB 2013. The Relationship Between Knowledge and Attitudes of Vaccine Managers and Vaccine Management Scores in Diphtheria Case Areas in East Java. Health Research and Development Media, 23(September 3), 102–109.
Prasetyo, SD, Vidia Ningrum, BC, Irianingrum, EH, Oktarini, FT, & Nizza, I. 2021. Level of Knowledge of Vaccine Management Officers and Evaluation of Vaccine Management at the Sleman Regency Health Center. Pharmaceutics Magazine, 17(2), 249.
Rahmawati, Y. 2021. Unlike other Covid-19 vaccines, the Moderna vaccine can be stored longer.
Rizal, JG 2021. Distributed, this is how the Sinovac vaccine is stored. Compass, 10 Januar 2021.
Santoso, R., Anggriani, A. & Suryaman, A. 2021. Storage and Distribution of Vaccine Preparations at the Garut District Health Service. Storage and Distribution of Vaccine Preparations at the Garut District Health Service, 4(2), 1–7.
Sariningsih, R., & Purwasih, R. 2017. Problem-Based Learning to Improve Mathematical Problem Solving Abilities and Self-Efficacy of Prospective Teacher Students. JNPM (National Journal of Mathematics Education), 1(1), 163.
Shereen, M.A. Khan, S., Kazmi, A., Bashir, N., Siddique, R. 2020. 'COVID-19 infection: Origin, transmission, and characteristics of human coronaviruses', Journal of Advanced Research, 24, pp. 91–98. doi: 10.1016/j.jare.2020.03.005.
Susyanty, AL, Sasanti, R., Syaripuddin, M., & Yuniar, Y. 2014. Vaccine Management and Supply Systems in Two Indonesian Provinces. Health Research Bulletin, 42(2), 108– 121.
Wei, WE, Li, Z., Chiew, CJ, Yong, SE, Toh, MP, & Lee, VJ 2020. Presymptomatic Transmission of SARS-CoV-2-Singapore. Morbidity and Mortality Weekly Report, 69(14), 411–415.
WHO. 2021. COVID-19 Weekly Epidemiological Update Edition. World Health Organization, June 1.
World Health Organization. 2020. Questions and answers related to Coronavirus.
World Health Organization. 2021a. COVID-19 Vaccine (Vero Cell), Inactivated (Sinopharm).
COVID-19 Vaccine Explainer, May, 1–6.
World Health Organization. 2021b. COVID-19 Vaccine Astrazeneca. Covid-19 Vaccine Explainer, February 1–7.
World Health Organization. 2021c. COVID-19 Vaccine Sinovac. June, 1–6. World Health Organization. 2021d. Moderna COVID-19 vaccine (mRNA-1273).
World Health Organization. 2021e. Pfizer-BioNTech COVID-19 vaccine. COVID-19 Vaccine Explainer, May, 7.
WHO. 2022. WHO Coronavirus(COVID-19) Dashboard. May 8. https://covid19.who.int/

Zipursky, S., Boualam, L., Cheikh, D.O., Fournier-Caruana, J., Hamid, D., Janssen, M., Kartoglu, U., Waeterloos, G., & Ronveaux, O. 2011. Assessing the potency of the oral polio vaccine kept Outside of the cold chain during a national immunization campaign in Chad. Vaccines, 29(34), 5652–5656. https://doi.org/10.1016/j.vaccine.2011.06.011

Zuhroh, H., & Dyahariesti, N. 2021. Evaluation of Storage Management for COVID-19 Vaccine Preparations in the Mataram City Health Service Pharmacy Installation Warehouse. Assessment of Storage Management for COVID-19 Vaccine Preparations in the Mataram City Health Service Pharmacy Installation Warehouse, 1, 1–10.