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RESEARCH ARTICLE

The profile of cold chain management of vaccines in a primary healthcare centre in Kupang, Indonesia

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Abstract

Background: Vaccine quality is strongly influenced by the cold chain application in vaccine storage and distribution at the Primary Healthcare Centre (PHC). **Objective:** This study aimed to describe cold chain management in storing and distributing vaccines at the Primary Healthcare Centre in the Kupang City area. **Method:** This study was a cross-sectional study. The data collection instrument used was a checklist sheet containing 27 vaccine storage parameters and eight vaccine distribution parameters. The research looked at vaccine storage and distribution. The sample used the entire population, which included 11 Primary Healthcare Centres in the City of Kupang. **Result:** It was found that 19 vaccine storage criteria had been implemented in all Primary Healthcare Centres. Eight storage criteria had not been implemented in all Primary Healthcare Centres. Furthermore, in the distribution practice category of eight criteria, five of them had been implemented by all centres, while three criteria had not been met. Practices that need to be improved were thermometer calibration, availability of storage and distribution Standard operating procedures (SOPs), validation of delivery equipment, and availability of storage room air circulation equipment. **Conclusion:** The implementation of cold chain in vaccine storage and distribution practices in 11 sub-district healthcare centres was not optimal, therefore there is a need for improvement.

Introduction

Immunisation is a preventive health effort to provide specific immunity to a person (Riedman, 2010; WHO, 2015). This method has been shown to be effective in reducing morbidity and mortality in infants and toddlers (Shukla & Shah, 2018; Nayir *et al*., 2020), from the aspect of financing, it is the most cost-effective method (Zeng *et al*., 2019). The quality of immunisation is determined by the quality of vaccines, including the classification of cold chain products (WHO, 2002). The stability of the vaccine is strongly influenced by the establishment of temperature, so it is necessary to carry out good monitoring starting from the manufacturer to the time of use through the application of a cold chain (WHO, 2011; Ashok *et al*., 2017).

Indonesia is one of the countries that conduct immunisation programmes through vaccination, providing vaccines, and supporting logistics. However, there are still some deficiencies such as the condition of damaged vaccines (Permatasari, 2018), lack of facilities and equipment (Lusita, 2019), lack of training and knowledge of vaccine management officers (Syakur *et al*., 2021), and waste management not up to standard (Setiawan *et al*., 2021).

The implementation of vaccination in Kupang is still not running optimally, especially in the achievement of indicators and vaccine management. In 2020, the UCI (Universal Child Immunization) achievement indicator was still less than 80%, and up to 203 cases of hepatitis B were found even though it was supported by the availability of vaccines and supporting logistics in all health centres (Kupang Health Office, 2020). In vaccine management, there are still shortcomings in the

availability of storage equipment and temperature monitoring tools (Sambara *et al*., 2017). This indicates that the implementation of the immunisation programme is not optimal either in the achievement of indicators and vaccine management in the region. Therefore, it is necessary to conduct a study to describe the cold chain management in storing and distributing vaccines at the Primary Healthcare Centre (PHC) in Kupang.

Methods

Design

This research is a type of cross-sectional study carried out from March to April of 2022 in all (11 Public Health Centres) of Kupang, East Nusa Tenggara, Indonesia, which manages vaccines and immunisation programmes. The variables in this study were vaccine storage and distribution. Data analysis is descriptive in the form of frequency distribution and percentage. Research ethics was issued by the ethics committee of Citra Bangsa University, Kupang, East Nusa Tenggara Province (No.001/ EC/KEPK/FK/2022). The research implementation permit was issued by the One-Stop Integrated Service and Investment Services of East Nusa Tenggara Province (No.070 /624/DPMPTSP 4.3/03/2022).

Assessment

Data collection instruments to describe the cold chain management using checklist sheets containing 27 parameters, including 19 storage criteria and eight vaccine distribution criteria made based on the Vaccine Management Guidelines at Health Service Facilities 2021 issued by the Director General of Pharmaceuticals and Medical Devices of the Ministry of Health of the Republic of Indonesia (Ministry of Health, 2021).

Results

Table I presents data on the characteristics of 11 healthcare centres and the characteristics of vaccine managers.

Table I: Demographic characteristics

Criteria	N (%)
Age (years old)	
30-39	8 (72.72)
40%-50%	2 (18.19)
>50	1 (9.09)
Mean (Age)	**38.91 ± SD 5.205**
Gender	
Male	1 (9.09)
Female	10 (90.9)
Type of profession	
Midwife	2 (18.19)
Nurse	8 (72.72)
Public health	1 (9.09)
Time worked as a vaccine manager	
<5 years	4 (36.36)
≥5 Years	7 (63.64)
Mean (Time worked as a vaccine manager)	4.82 ± SD 2.422
Training	
Ever	5 (45.45)
Never	6 (54.55)

Table II presents data related to the level of vaccine availability and the supporting logic of immunisation, in which the level of availability is (100%), then the description of the application of cold chain in vaccine storage consists of 19 criteria. Eight criteria have not been implemented properly, while the other 11 criteria have been carried out properly. In the aspect of vaccine distribution, namely the delivery of vaccines to vaccination service locations, the results showed that of the eight criteria, five criteria had been implemented in all healthcare centres, whilst three criteria had not.

Table II: Application profile of cold chain in vaccine storage and dispersion in 11 regional health centres in Kupang city

Criteria		N (%)
A.	**Availability of vaccines and supporting logistics**	
	Vaccines and immunisation programmes	11 (100)
	Immunisation supporting logistics	11 (100)
B.	**Vaccine storage**	
	Vaccine refrigerator availability according to WHO standards	11 (100)
	Distance of the refrigerator with wall ±15 cm (100%)	11 (100)
	Refrigerator not exposed to direct sunlight/dedicated storage room	6 (63.63)

Criteria		N (%)
	Availability of air circulation regulator *(Exhaust)*	5 (45.46)
	Vaccine refrigerator using one electrical contact	11 (100)
	Vaccine storage at 2-8°C and solvent (Room temperature)	11 (100)
	The bottom is not used to store vaccines	11 (100)
	Use of cool pack, aluminium/acrylic, or plastic multiplex to maintain temperature stability	11 (100)
	The distance between vaccines is at least 1-2 cm	6 (54.54)
	Freeze-sensitive vaccine is not placed near the evaporator	8 (72.73)
	Heat-sensitive vaccine placed near the evaporator	6 (54.55)
	Vaccine recording using stock cards	5 (45.46)
	Availability of vaccine storage standard operating procedures (SOPs)	5 (45.46)
	Availability of emergency SOP *(Contingency and emergency plan)*	4 (36.36)
	SOP routine maintenance of refrigerators/refrigerators	6 (54.54)
	Availability of a properly functioning generator set	11 (100)
	Temperature monitoring and recording two times a day	11 (100)
	Availability of *freeze tag* in good condition	3 (100)
	Thermometer calibration (once a year minimum)	8 (72.73)
C.	**Vaccine distribution**	
	Vaccine use paying attention to FEFO/FIFO	11 (100)
	Use attention to Vaccine Vial Monitor (VVM) conditions	11 (100)
	Availability of cool box/vaccine carrier	11 (100)
	Validated cool box/vaccine carrier	9 (81.82)
	SOPs related to the use/delivery of vaccines	3 (27.27)
	Use of temperature monitoring devices at the time of speech	7 (63.64)
	Use of a cool pack to maintain temperature stability	11 (100)
	Cool/Cold pack is not placed in contact with the vaccine	6 (54.54)

Discussion

Based on the results of this study, several shortcomings can be identified related to the application of cold chain both in the storage and distribution of vaccines and immunisation programmes. Most vaccine managers have not received training related to cold chains. According to Yassin and authors (2019), Mohammed and authors (2021), training will have an effect on the level of knowledge and quality of cold chain management. Training frequency and level will have a positive impact on cold chain application (Yassin *et al*., 2019; Mohammed *et al*., 2021; Feyisa *et al*., 2022). The standard of competence of the vaccine manager does not meet the regulatory requirements (Ministry of Health RI, 2021), namely a pharmacist. The gap at the professional level will also have an impact on the level of knowledge related to vaccine management (Bogale *et al*., 2019). The level of knowledge also has a significant effect on the quality of chain management implementation (Dairo & Osizimete, 2016; Yassin *et al*., 2019). Adjustments to the qualifications and competencies of those in charge of vaccines can certainly be considered in the future in order to achieve competency and qualification standards stipulated in regulations (President of the Republic of Indonesia, 2009; Ministry of Health Republic of Indonesia, 2021). In vaccine storage criteria, eight criteria have not been applied according to the guidelines in most health centres, such as the placement of refrigerator vaccines that are exposed to sunlight. This will certainly directly impact the vaccine's stability (WHO, 2002; Kumru *et al*., 2014). The lack of availability of air circulation regulators in the refrigerator vaccine storage room will reduce air circulation in the storage room and impact the temperature increase in the storage room (CDC & Ncird, 2022). The storage distance of vaccine placement is not in accordance with the standard, and the unavailability of standard procedures in the storage and emergency plan can reduce the effectiveness of the application of cold chain and readiness in facing emergencies (CDC & Ncird, 2022).

Carrying out good stock management through planning and rotation of vaccine stocks, considering storage space capacity and vaccine needs can be a solution for better-structuring vaccine storage in healthcare facilities (CDC & Ncird, 2022). Regarding the availability

of procedures, not all puskesmas have implemented and have working procedures, including storage, maintenance, and emergency plans. This deficiency can reduce the effectiveness of implementing cold chain management and preparedness in dealing with emergencies (CDC & Ncird, 2022). The application of work procedures to cold chain management can be strengthened through supervision programmes in the form of supervision, and training for each vaccine officer at the health centre as stated by (Tambunan, 2014), supervision by the health office has been shown to increase the compliance of vaccine management officers in implementing cold chain management of vaccine management in health care facilities in the Northern Ethiopia region (Gebretnsae *et al*., 2022). In the vaccine distribution process, five criteria have been carried out in most health centers such as the application of the First Expired, First Out (FEFO) principle, monitoring VVM conditions, the availability of a vaccine finder, and validated cool box. Nevertheless, there are still some shortcomings in the availability of SOP in vaccine distribution, the implementation of cool packs, and temperature monitoring tools during the vaccine distribution process in several health centers.

The results of this study can certainly be an input for the local government, that there are still deficiencies in the practice of implementing cold chain management in health care facilities, which are not only found in the lack of availability of supporting facilities for cold chain management but are also found in the lack of compliance with the application of cold chain management in vaccine storage and distribution practices. Failure to apply cold chain can lead to losses due to vaccine damage (Rawal & Sagar, 2012; Prisillya & Pelealu, 2015), this also has an impact on the decreased quality of immunisation programmes due to the vaccine potential (Sieng *et al*., 2018). Research conducted by Ningtyas & Wibowo, (2015) shows that vaccine quality is related to the incidence of disease. Further research is needed on the factors that can affect the adherence of vaccine officers in the implementation of cold chain in health service facilities as input for the local government so that the quality and grade of vaccines as the key to the success of the immunisation programme can be maintained.

Conclusion

The implementation of a cold chain in the storage and distribution of vaccines in 11 healthcare centres in Kupang was not optimal. Therefore, some improvements need to be made in several aspects, including improving the qualification and capacity of human resources for vaccine managers, storing vaccines according to standards, implementation of Standard Operating Procedures, availability of guidelines, emergency plan, validation and calibration of temperature monitoring equipment, management of vaccine stock control. This is essential for maintaining the quality of cold chain management.

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References

Ashok, A., Brison, M., & LeTallec, Y. (2017). Improving cold chain systems: Challenges and solutions. *Vaccine*, **35**(17), 2217–2223. https://doi.org/10.1016/j.vaccine.2016.08.045

Bogale, H. A., Amhare, A. F., & Bogale, A. A. (2019). Assessment of factors affecting vaccine cold chain management practice in public health institutions in east Gojam zone of Amhara region. *BMC Public Health*, **19**(1), 1–6. https://doi.org/10.1186/s12889-019-7786-x

CDC, & Ncird. (2022). Vaccine storage and handling toolkit-updated with COVID-19 vaccine storage and handling information, *Addendum*. Available at: https://www.cdc.gov/vaccines/imz-managers/awardee-imz-websites.html

Dairo, D. M., & Osizimete, O. E. (2016). Factors affecting vaccine handling and storage practices among immunization service providers in Ibadan, Oyo State, Nigeria. *African Health Sciences*, **16**(2), 576–583. https://doi.org/10.4314/ahs.v16i2.27

Feyisa, D., Ejeta, F., Aferu, T., & Kebede, O. (2022). Adherence to WHO vaccine storage codes and vaccine cold chain management practices at primary healthcare facilities in Dalocha District of Silt'e Zone, Ethiopia. *Tropical Diseases, Travel Medicine and Vaccines*, **8**(1). https://doi.org/10.1186/S40794-022-00167-5

Kumru, O. S., Joshi, S. B., Smith, D. E., Middaugh, C. R., Prusik, T., & Volkin, D. B. (2014). Vaccine instability in the cold chain: Mechanisms, analysis and formulation strategies.

Biologicals, **42**(5), 237–259. https://doi.org/10.1016/J.BIOLOGICALS.2014.05.007

Lusita, A. (2019). Evaluasi pelaksanaan cold chain dan cakupan imunisasi berdasarkan daerah urban dan rural di propinsi Jawa Timur tahun 2018. *Universitas Airlangga*. https://repository.unair.ac.id/96023/

Mohammed, S. A., Workneh, B. D., & Kahissay, M. H. (2021). Knowledge, attitude and practice of vaccinators and vaccine handlers on vaccine cold chain management in public health facilities, Ethiopia: Cross-sectional study. *In PLoS ONE*, **16**(2). https://doi.org/10.1371/journal.pone.0247459

Nayir, T., Nazlıcan, E., Şahin, M., Kara, F., & Alp Meşe, E. (2020). Effects of immunization program on morbidity and mortality rates ofvaccine-preventable diseases in Turkey. *Turkish Journal of Medical Sciences*, **50**(8), 1909–1915. https://doi.org/10.3906/sag-2008-177

Ningtyas, D. W., & Wibowo, A. (2015). The influence of quality of measles vaccine to the incidence of measles in Pasuruan Regency. *Jurnal Berkala Epidemiologi*, **3**(3), 315–326. https://doi.org/https://doi.org/10.20473/jbe.V3I32015.315-326

Permatasari, D. dan I. D. (2018). Evaluasi implementasi managemen rantai dingin vaksin dengan viabilitas vaksin di suku Dinas Kesehatan Jakarta Timur dan jajarannya. *Universitas Gadjah Mada.* http://etd.repository.ugm.ac.id/penelitian/detail/166754

Prisillya, Pelealu, W. (2015). Evaluasi penyimpanan dan pendistribusian vaksin dari dinas kesehatan Kota Manado ke Puskesmas Tuminting, Puskesmas Paniki Bawah dan Puskesmas Wenang. *Pharmacon*, **4**(3), 9–15. https://doi.org/10.35799/pha.4.2015.8831

Rawal, R., & Sagar, B. (2012). Cold chain for vaccines. *Journal of Drug Delivery and Therapeutics*, **2**(4), 46–50. https://doi.org/10.22270/jddt.v2i4.175

Sambara, J., Yuliani, N. N., Lenggu, M., & Ceme, Y. (2018). Vaccine storage profile in public health centers in Kupang City. *Jurnal Info Kesehatan*, **16**(1), 143–163. https://doi.org/10.31965/infokes.Vol16.Iss1.181

Setiawan, A., Saraswati, L. D., Adi, M. S., & Udijono, A. (2021). Gambaran kualitas pengelolaan rantai dingin vaksin meningitis di wilayah provinsi Daerah Istimewa Yogyakarta. *Media Penelitian Dan Pengembangan Kesehatan*, **31**(2), 97–108. https://doi.org/10.22435/mpk.v31i2.3706

Shukla, V. V., & Shah, R. C. (2018). Vaccinations in Primary Care. *Indian Journal of Pediatrics*, **85**(12), 1118–1127. https://doi.org/10.1007/s12098-017-2555-2

Sieng, S., Walkden-Brown, S.W., & Kerr, J. (2018). Effect of vaccine storage temperatures and dose rate on antibody responses to foot and mouth disease vaccination in Cambodia. *Veterinary Medicine and Science*, **4**(1), 35. https://doi.org/10.1002/VMS3.86

Syakur, A., Sandra, C., & Bumi, C. (2021). Evaluasi cold chain management vaksin di Puskesmas Kabupaten Jember. *Jurnal Manajemen Kesehatan Indonesia*, **9**(1), 21–27. https://doi.org/10.14710/jmki.9.1.2021.21-27

World Health Organization. (2002). Vaccines and biologicals vaccines and biologicals ensuring the quality of vaccines. Available at: https://apps.who.int/iris/bitstream/handle/10665/67824/WHO_V-B_02.16_eng.pdf

World Health Organization. (2011). Study protocol for temperature monitoring in the vaccine cold chain. *World Health Organization*. Available at: https://apps.who.int/iris/handle/10665/70752

Yassin, Z. J., Yimer Nega, H., Derseh, B. T., Sisay Yehuala, Y., & Dad, A. F. (2019). Knowledge of health professionals on cold chain management and associated factors in Ezha District, Gurage Zone, Ethiopia. *Scientifica*. https://doi.org/10.1155/2019/6937291

Zeng, Y., Luo, M., Chen, J., He, H., Deng, X., Xie, S., & Fang, Y. (2019). An economic evaluation of the current measles vaccination program: A case study in Zhejiang Province, East China. *Vaccine*, **37**(23), 3071–3077. https://doi.org/10.1016/J.VACCINE.2019.04.0