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ORIGINAL RESEARCH

THE IMPLEMENTATION OF IMMUNIZATION COLD CHAIN MANAGEMENT IN SURABAYA CITY

Deskripsi Pelaksanaan Manajemen Cold Chain Imunisasi di Kota Surabaya

Alfilia Lusita[1], Fariani Syahrul[2],Ponconugroho Ponconugroho[3]
[1] Faculty of Public Health, Universitas Airlangga, alfilia.lusita-2017@fkm.unair.ac.id
[2] Department of Epidemiology, Faculty of Public Health, Universitas Airlangga, fariani.s@fkm.unair.ac.id
[3] Health Office, Surabaya City, drpns73@gmail.com
Correspondence Author: Fariani Syahrul, fariani.s@fkm.unair.ac.id, Faculty of Public Health, Universitas Airlangga, Dr. Ir. H. Soekarno Street, Mulyorejo, Surabaya City, East Java, Indonesia, Postal Code

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ABSTRACT

Background: Immunization success rates can be determined by several factors. The factors that can cause occurrences of immunization preventable disease (PD3I) cases include the quality of the cold chain and invalid doses of immunization medicines. **Purpose**: The aim of this research was to analyze the implementation of cold chain management in the city of Surabaya. **Methods**: This research was conducted as a descriptive study with a cross-sectional research design. The population consisted of all primary health care centers in the city of Surabaya, and the data used were secondary data, guided by interviews with informants. **Results:** The majority of cold chain management personnel were found to have a medical education background of 98.42%, and primary health care workers have received cold chain-related training (100%). All primary health care equipment has a 100% cold chain. The completeness of cold chain reporting was 93.51%, and the accuracy of the cold chain reporting was 71.52%. Regarding the quality of the equipment, some vaccine refrigerators were found 12% of vaccine refrigerators were found not to be in optimal condition, and 14% of temperature monitoring devices was not activated. **Conclusion**: The implementation of cold chain management in public health center and the availability of equipment in the Surabaya City are going well, although there are still some problems such as undisciplined reporting and inadequate quality of tools for cold chain implementation as well as the discovery of vaccine refrigerators easily leaks, and their temperature can rise easily.

ABSTRAK

***Latar belakang**: Tingkat keberhasilan imunisasi dapat ditentukan oleh*

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beberapa faktor. Beberapa kemungkinan yang menyebabkan masih adanya kasus Penyakit yang Dapat Dicegah Dengan Imunisasi (PD3I), diantaranya mutu rantai dingin (cold chain) dan dosis pemberian imunisasi (invalid dose) yang tidak sesuai. ***Tujuan:*** *Penelitian ini bertujuan untuk menganalisis pelaksanaan manajemen rantai dingin (cold chain) di Kota Surabaya.* ***Metode:*** *Penelitian ini merupakan penelitian deskriptif dengan desain penelitian cross sectional. Populasi dalam penelitian yaitu seluruh puskesmas yang ada di Kota Surabaya. Data yang digunakan adalah data sekunder dan dipandukan dengan wawancara kepada informan.* ***Hasil:*** *Mayoritas tenaga pengelola cold chain berlatar belakang pendidikan medis sebesar 98,42%, dam seluruh petugas puskesmas sudah mendapatkan pelatihan terkait cold chain (100%). Seluruh puskesmas sudah memiliki peralatan cold chain (100%). Kelengkapan pelaporan cold chain sebesar 93,51% dan ketepatan pelaporan cold chain sebesar 71,52%. Berdasarkan kualitas alat, masih ditemukan 12% vaccine refrigerator yang tidak dalam kondisi optimal dan 14% alat pemantau suhu yang tidak diaktifasi.* ***Kesimpulan:*** *Pelaksanaan manajemen cold chain dan ketersediaan peralatan di puskesmas di Kota Surabaya berjalan dengan baik, walaupun masih terdapat beberapa permasalahan seperti pelaporan yang tidak disiplin dan kualitas alat yang kurang memadai untuk pelaksanaan cold chain serta masih ditemukannya vaccine refigerator yang mudah berair serta suhunya mudah naik (panas).*

INTRODUCTION

There are three ways to improve the national health situation: through promotive, preventive, and rehabilitative efforts. These three approaches are expected to reduce morbidity and mortality from a particular disease. Vaccine-preventable diseases are expected to be eradicated or reduced in Indonesia by implementing immunization programs, which are activities aimed at increasing immunity to certain diseases. The role of immunization is to achieve individual protection as well as a level of protection against the surrounding environment known as herd immunity. The measure of Universal Child Immunization (UCI) is used as the indicator for a successful immunization program. Achievement of UCI requires immunization coverage of children aged 0–11 months nationally. The World Health Organization sets the indicators of UCI at 90% at the national level and 80% at the regional level. A decrease in vaccine-preventable disease cases should be continuous with a village's UCI achievements. The decrease is significant if the achievement rate of complete basic immunization before the age of one year is evenly and continuously higher than 85% in a village area (Ministry of Health RI, 2017).

In 2017, the UCI coverage of the villages in Indonesia was 80.34%. Figure 1 shows the coverage of UCI in the city of Surabaya, which tends to increase from year to year (Surabaya Health Office, 2019).

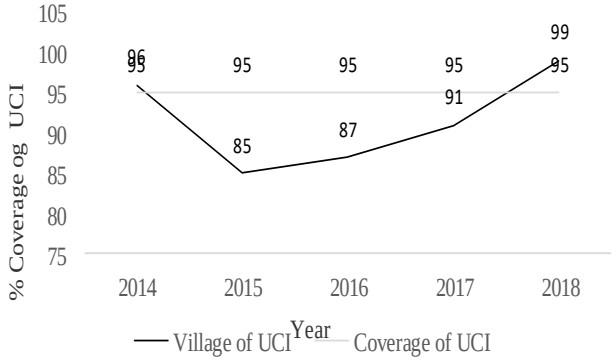

Figure 1. The UCI trend of villages in Surabaya 2014–2018

In 2018, complete basic immunization in Surabaya reached the level of 97.74%, surpassing the 2018 strategic plan target of 92.50%. According to public health center (PHC) data, there were 62 public health centers (88.89%) that achieved the strategy plan target of Ministry of

Health RI (Figure 2) (Surabaya Health Office, 2019).

Vaccine-preventable diseases such as diphtheria and measles are a type of "re-emerging disease" in Surabaya. The Surabaya city government has made various efforts for the provision of immunizations to infants up to 18 months old, with doses repeated at elementary school age. This program is being implemented because diphtheria and measles are diseases that can be prevented through immunization (Surabaya Health Office, 2019).

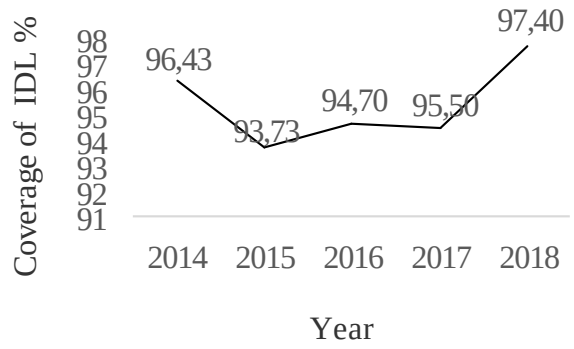

Figure 2. Surabaya IDL Coverage 2014–2018

Figure 3 shows that there was an increase in diphtheria cases in 2018, even though the UCI coverage had increased. The success rate of an immunization program is not only measured by the achievement of UCI; it can also be determined through several other factors, including immunity status, method of administration, and quantity and quality of the vaccine. When the quality of vaccines is not in accordance with the standards, these vaccines are not suitable for use and cannot provide protection against disease (Nsubuga et al., 2018).

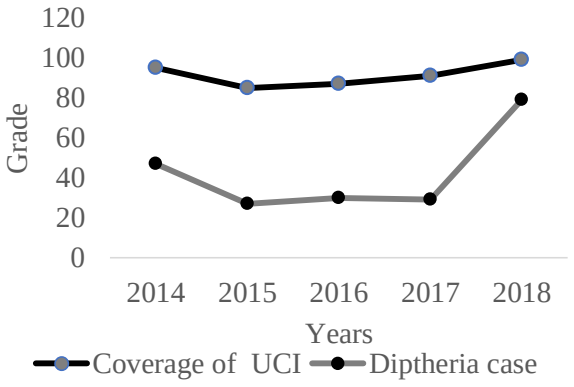

Figure 3. UCI targets and numbers of diphtheria cases

There are several factors that can cause children who have been immunized to still contract one of the vaccine-preventable diseases. One of these concerns the quality of the cold chain and invalid doses of immunization; therefore, it is crucial to monitor the cold chain at health centers (Ningtyas & Wibowo, 2015).

Vaccines are substances that can be easily damaged by exposure to cold and hot temperatures; therefore, it is necessary to maintain and manage the vaccine doses. Factors that need to be considered in keeping vaccines in safe conditions are covered by implementing vaccine cold chain management. Previous research has shown that a great deal of vaccine damage is caused by poorly managed equipment (Fauza, Firdawati, & Rasyid, 2019).

Cold chain management is a procedure that is applied to maintain a vaccine at a predetermined temperature (2ºC–8ºC), thus guaranteeing the quality of the vaccine (Kairul, Udiyono, & Saraswati, 2016). Vaccine cold chains that are not managed properly will eliminate the potential of the vaccines, and so immunization programs require special attention regarding the cold chain and effective vaccine management (EVM). EVM helps in improving the quality of cold chain vaccines within an immunization program (Bhatnagar et al., 2018). One study conducted on vaccine samples stored in refrigerators showed that 29% of the vaccines had been exposed to hot temperatures during distribution and 44% had been exposed to freezing temperatures in storage (Kairul, Udiyono, & Saraswati, 2016)

The obstacles faced in the field for the implementation of cold chain management include a lack of training in the related field, imbalances in the distribution of workers, worker motivation issues, management of vaccine stocks, and reporting (Mujiati & Yuniar, 2016). The aim of the current study was to analyze the implementation of cold chain management in Surabaya.

METHODS

This study was conducted as descriptive research with a cross-sectional research design. The population for this study consisted of 63 PHC in the research location of Surabaya. The inclusion criterion for the study was the implementation of cold chain management at public health centers' health service facilities. Cold chain management data from health service facilities in hospitals/clinics/doctors' practices were excluded from the study. The basis for selecting variables

was a questionnaire adopted from a study entitled "Independent Evaluation of Measles Rubella (MR) Immunization Coverage in East Java Province, Indonesia 2017." The operational definitions of the studied variables were human resources, availability of tools, and reporting cold chain administration. The human resource variables studied were the levels of education and training that had been received by cold chain management officers at the public health centers. The instrument availability variables were the presence and use of cold chain equipment, including vaccine refrigerators, vaccine carriers, cool packs, freeze tags, and thermometers, with categorization using scores (1 for existing and functioning, and 0 for no functioning equipment). The administrative reporting variables were completeness and accuracy in cold chain reporting. The data collected related to cold chain management in Surabaya were secondary data based on responses to the same questionnaire mentioned above, combined with primary data obtained from observations and interviews with an informant: a section chief and charge person of surveillance and immunization programs. The data collection techniques applied included document studies and in-depth interviews. The data obtained were descriptively analyzed using univariable analysis techniques and presented in tabular form. A letter of ethical eligibility was received for this study from the Faculty of Dentistry, Universitas Airlangga (No. 530 / HRECC.FODM / VII / 2019; dated July 30, 2019).

RESULTS

Description of Cold Chain Management

Human Resources

Cold chain management personnel are people who have a medical education background and have received training related to immunization. These management staff can comprise midwives, nurses, and doctors who have knowledge about immunization. Data obtained from 63 health centers showed that 62 cold chain management officers had a medical education background (midwife and nurse) (98.40%) and one had a non-medical background (trained at the Health School [vocational high school]). All 63 officers who administered cold chain procedures had received training on immunization. This was conducted by the Surabaya City Health Office in May 2019 by inviting all officers related to the immunization program (100%) (Table 1).

Availability of Cold Chain Equipment

All public health centers in Surabaya are equipped with cold chain apparatus (100%) (Table 2). The results of the observation conducted in Gudang Farmasi Kesehatan (GFK) in Surabaya show that all the public health centers in Surabaya had distributed the vaccines properly (100%) (Table 2).

Table 1
Characteristics of Human Resources

Characteristics	N	%
Education		
Medical	62	98.40
Non-Medical	1	1.60
Received Training		
Yes	63	100.00
No	0	0.00
Total	63	100.00

Secondary results were taken from the reports on cold chain equipment and from interviews with relevant staff members. All of the health centers were supposedly equipped with cold chain apparatus. Based on annual data from the Surveillance and Immunization section of the Surabaya Health Department, the cold chain equipment was in good condition and had been calibrated. However, observations showed that as much as 13% of the refrigerator vaccine stock was in poor condition, with problems including vaccines being watery (2%) and high temperatures (11%). Almost all PHC had freeze tags, but their use was not optimized; for example, one still used a muller, five log tags were missing, one log tag had not been activated, two log tags had expired in 2017, and 1 freeze tag was dead (Table 2).

Accuracy and completeness of reports at the health centers

Secondary data results from the health information system (SIK) of Surabaya Health Office regarding the noting and reporting of vaccine logistics consisted of vaccine requests, refrigerator temperature reports, and vaccine vial monitor (VVM) conditions in the temperature recording system. The completeness of reporting was based on the suitability of the reports logged at the Surabaya Health Office. The percentage of completeness of reports reached 93.51%, which indicates that almost all working areas of the Surabaya Health Office were already achieving complete reporting. In terms of accuracy, the reports were reported maximum the fifth day of

every month. The accuracy here is not matched by the completeness of the reporting, because the reported percentage which is 71.52% is still far below the target of at least 80%. The accuracy and reporting findings were obtained from secondary data on the Local Area Monitoring (LAM) form in the Surabaya Health Information System from January to July 2019 (Table 2).

Table 2
Distribution of Cold Chain Management Implementation

Cold Chain	N	%
Tools Availability		
Vaccine Refrigerator	63	100.00
Vaccine Carrier	63	100.00
Cool Pack	63	100.00
Safety Box	63	100.00
ADS	63	100.00
Thermometer	63	100.00
Freeze Tag	63	100.00
Temperature Card	63	100.00
Vaccine Distribution		
Transporting with Cold Box	63	100.00
Presence of Cool Pack in Vaccine Carrier or Cold Box	63	100.00
Routine inspection of VVM condition	63	100.00
Application of FIFO Method	63	100.00
Date Written on the Remaining Vaccines	63	100.00
High-Quality Equipment		
Calibration	63	100.00
Vaccine Refrigerator	55	87.00
Vaccine Carrier	63	100.00
Cool Pack	63	100.00
Thermometer	63	100.00
Recording and Reporting		
Completeness	59	93.51
Accuracy	45	71.42

DISCUSSION

Characteristics of Human Resources

The results of this research show that all health centers in Surabaya already have cold chain management staff. This is in accordance with Ministry of Health RI (2017) guidance concerning the provision of personnel in the implementation of the immunization program, which requires a minimum of one person managing the immunization program and the post-immunization follow-up event as well as cold chain management officers at the health center level.

Our findings also show that 98.40% of the officers in our sample had obtained a health diploma. This is in accordance with Ministry of Health RI (2017) guidance, which states that cold chain management staff must be individuals with knowledge regarding immunization programs that are in accordance with their competencies as doctors, midwives, or nurses. This is also in accordance with research conducted by Dinengsih & Hendriyani (2018), which shows that individuals with a higher level of education are more able to receive and process information.

All the staff members in the 63 public health centers had received training related to the immunization program. According to Susyanty, Sasanti, Syaripuddin, & Yuniar (2014), training is especially important for field officers to ensure that they all have competence in immunization services. This is a very useful way to support the quality of service officers. Research conducted by Ogboghodo, Omuemu, Odijie, & Odaman (2017) also shows the importance of training to improve immunization programs. Staff members are the spearhead in carrying out the vaccine chain process. Without competent staff, even the best facilities and systems will not be effective; therefore, investing in staff members in the form of job training is a shared need and obligation between the central and regional governments (Selviani, 2016).

Condition of the Cold Chain

According to the Regulation of the Minister of Health of the Republic of Indonesia number 12 of 2017 concerning the implementation of immunization, the availability of tools refers to the availability of vaccine refrigerators, vaccine carriers, cool packs, safety boxes, ADS, thermometers, and temperature monitoring cards (Ministry of Health RI, 2017).

According to research conducted by Helmi, Saraswati, Kusariana, & Udijono (2019) concerning vaccine protection to ensure that it remains in a stable condition, at the administrative level, cold chain resources need to include cold rooms, vaccine refrigerators, and freezers, and other facilities must be available at the district or city level. Our results show that the facilities and infrastructure in the health centers in our sample were in accordance with applicable regulations.

Vaccine distribution is the process of distributing vaccines to health services using

vaccine cold chain management. This process is carried out using a cold box (a vaccine carrier containing a cool pack), and it involves checking the condition of the VVM and applying the first-in-first-out method in issuing the vaccine, as well as checking expiration dates for the remaining vaccine (Ministry of Health RI, 2017).

The distribution is carried out by the Surabaya Health Department to the public health center level. This is carried out by the health center staff picking it up as needed and transporting the cold chain equipment. This is in accordance with research conducted by Medisa & Nugraheni (2017), which shows that the quality and effectiveness of vaccines can be maintained by delivering/transporting them with cold chain equipment. This is further supported by research conducted by Lumentut, Pelealu, & Wullur (2015). Vaccine management and the inventory system for vaccine collection is carried out directly by district/city health service officers in the health pharmaceutical warehouse of the Provincial Health Department. At the public health center level, the distribution of vaccines is also carried out in line with the district/city processes, i.e., the health center staff collect vaccines from the district/city health office. Research conducted by Fauza, Firdawati, & Rasyid (2019) showed that 73.80% of their research objects had implemented cold chain management well in health facilities.

Vaccine damage during the transportation process can be caused by exposure to freezing temperatures, by exposure to hot temperatures, and by exposure to direct sunlight. This is highlighted by research conducted by Yakum, Ateudjieu, Walter, & Watcho (2015) in Cameroon, with findings showing that around 28.27% of health facilities did not store vaccines according to the required procedures.

Our findings indicate that 13% of vaccine refrigerators in Surabaya health centers were not of a suitable quality in accordance with the regulations. This can cause various problems such as the vaccine refrigerators easily leaks, and their temperature can rise easily. This is in accordance with research conducted by Helmi, Saraswati, Kusariana, & Udijono (2019) regarding the quality of vaccine management in the city of Semarang, which found poor-quality vaccine management in 84 private healthcare (60.90%), refrigerator temperatures above 8ºC (52.30%), frozen vaccines in 15 private healthcare (10.90%), and expired vaccines in 6 private healthcare (4.50%). Risk factors that affect the quality of vaccine management include the function of the refrigerator not being specifically for storing vaccines, no thermometer being available, and vaccines being stored incorrectly.

All the health centers in Surabaya already had freeze tags/log tags, but there were still some non-functioning tools such as log tags that were not activated, two log tags that often returned errors, and one freeze tags that could not be used. This is in line with research conducted by Kairul, Udiyono, & Saraswati (2016), who did not find freeze tags in several puskesmas in Sorolangin. Similar conditions were also found in research conducted by Sambara, Yuliani, Lenggu, & Ceme (2017), who reported that cold chain facilities including the ability to monitor storage temperature and vaccine conditions were not yet fully available at the Oepoi health center in Kupang.

Cold chain vaccine management must be carried out properly for basic immunizations. Appropriate management can start from the health department to the health center. Hanson, George, Sawadogo, & Schreiber (2017) also highlight that frozen vaccines are often found in cold chain management; therefore, facilities, infrastructure, and professional personnel are needed to prevent vaccine damage. Assessment of cold chain conditions should be combined with EVM to determine the condition of the cold chain based on a scoring system. In Bhatnagar et al (2018) study, they found that no cold chain fulfilled an EVM score of 80%. This was due to the incompleteness of equipment, the conditions of the buildings and the equipment, and the disposal of waste not being carried out properly.

Accuracy and completeness of the equipment at the health centers

The majority of health centers in Surabaya had reported correctly and completely (80%). According to Kareth, Purnami, & Sriatmi (2015), the registration of immunization is carried out by village midwifes, while the reporting is carried out by each unit delivering immunization activities, starting from the health center, hospital, or other health facilities, through to the program manager at the appropriate administrative level. Reporting from the health center level to the district is completed no later than the 5th of the following month.

The implementation of cold chain management in Surabaya is generally good, but there are still some obstacles, including the accuracy and completeness of the reporting. It can be assumed that, if the cold chain management in

Surabaya is effective, the cases of vaccine-preventable diseases should be reducing. This is indicated by Has & Cahyadi (2018), who report that most of the basic complete immunization recording systems at public health centers are in the good category (75%). This means that the recording system is a strength that can be used to improve the quality of complete basic immunization services.

Vaccine-preventable disease cases can also occur due to invalid doses, population density, and population migration. According to research conducted by Oktaviasari (2018), a measles incident that occurred in Sidoarajo and Surabaya could have been due to population immigration or the activities of the residents of the two cities close together. Population density can also be a factor in why vaccine-preventable diseases continue to occur in the city of Surabaya. This is also in accordance with research conducted by Alfiansyah (2015), which explains that the level of education and level of parental knowledge also influenced the diphtheria extraordinary event (KLB). Furthermore, Saifudin, Wahyuni, & Martini (2016) states that room humidity and lighting are factors that influence the incidence of diphtheria in Blitar.

Research Limitation

The limitations of this study were the lack of information regarding the maintenance of cold chain equipment and the process of storing vaccines in health facilities. This was due to time restrictions and licensing limitations. The researchers only examined the limited availability of tools and were not able to investigate the condition of cold chain equipment.

CONCLUSION

The implementation of cold chain management at public health centers in the city of Surabaya, both in terms of management staff and the availability of equipment, has been running well. However, there are still some problems, including undisciplined reporting and inadequate quality of tools for cold chain implementation. Also, some vaccine refrigerators easily leaks, and their temperature can rise easily.

CONFLICT OF INTEREST

The authors state that there is no conflict of interest in this study.

AUTHOR CONTRIBUTION

AL served as the researcher and data collector, developed ideas, and analyzed the data. FS contributed by providing constructive criticism and support for the research. P provided input and information as well as contributing an understanding of surveillance and immunization in the Health Department of Surabaya.

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