
Evaluation Of The Vaccine Cold Chain At The Limapuluh Kota Community Health Center In Pekanbaru In 2026

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Abstract

Vaccines are biological preparations that are sensitive to temperature changes and therefore require appropriate cold chain management to maintain their quality, safety, stability, and effectiveness. Vaccine storage in health care facilities must consider temperature conditions, vaccine arrangement, Vaccine Vial Monitor (VVM), expiration dates, and the availability of supporting cold chain equipment. This study aimed to evaluate the implementation of vaccine cold chain management at Limapuluh Public Health Center, Pekanbaru, in 2026. A descriptive observational approach was used by observing vaccine management practices and reviewing storage procedures, temperature monitoring, recording, control, and distribution. The findings showed that vaccine storage temperatures were routinely monitored twice daily, in the morning and afternoon, and were supported by a temperature monitoring application accessed by the vaccine officer. Vaccine management also considered temperature sensitivity, VVM conditions, and the First Expired First Out (FEFO) principle. Vaccine receipt procedures included checking the type and quantity of vaccines, packaging condition, expiration date, batch number, VVM, and receiving temperature. Vaccine control and recording were supported by the SMILE application, enabling real-time monitoring and documentation. Therefore, vaccine cold chain management at Limapuluh Public Health Center has implemented important components to maintain vaccine quality and stability, although quantitative assessment of compliance requires a more structured checklist-based evaluation.

Keywords: *Evaluation, Vaccine, Cold Chain, Vaccine Storage, Public Health Center.*

INTRODUCTION

Vaccines are biological products that are used to stimulate the formation of active and specific immunity to certain diseases (Kementerian Kesehatan Republik Indonesia, 2017). Because they have biological characteristics, vaccines require appropriate handling and storage so that their quality and effectiveness are maintained (Kementerian Kesehatan Republik Indonesia, 2017). Temperature management is one of the important aspects of vaccine storage because inappropriate temperature changes can affect the stability and quality of the vaccine (Kementerian Kesehatan Republik Indonesia, 2021). In cold chain implementation, vaccines generally must be maintained in the temperature range of 2–8°C during the storage and distribution process (Kementerian Kesehatan Republik Indonesia, 2021).

Cold chain management is a series of activities that aim to maintain the condition of vaccines from the time they are received, stored, distributed, and used in immunization services (Kementerian Kesehatan Republik Indonesia, 2021). The success of this management is not only determined by storage temperature, but also by the condition of the refrigerator, vaccine arrangement, temperature monitoring, availability of cold packs, vaccine carriers, VVM monitoring, and recording and reporting (Kementerian Kesehatan Republik Indonesia, 2021).

Puskesmas as a primary health service facility has an important role in ensuring the availability and quality of vaccines before they are given to the community (Kementerian Kesehatan Republik Indonesia, 2024). Vaccine management at Puskesmas includes planning and procurement activities, receiving, storing, distributing, controlling, recording and reporting, monitoring, evaluation, and destruction (Kementerian Kesehatan Republik Indonesia, 2017; Kementerian Kesehatan Republik Indonesia, 2024). At the Limapuluh

Health Center in Pekanbaru, the vaccine procurement process is carried out based on the needs data from the Person in Charge of Immunization. Orders are made by the Assurance Management Assistant through the SMILE application and manually using the vaccine request letter submitted to the Health Office. After the application is approved, the vaccine is taken from IFLK with supporting documents in the form of a Handover Minutes (BAST) and Vaccine Arrival Report (VAR).

At the receiving stage, checks are carried out on the type and quantity of vaccines, the form of preparation, the condition of the label and packaging, the expiration date, VVM, batch number, and the temperature of the vaccine (Kementerian Kesehatan Republik Indonesia, 2021). Vaccine collection also uses vaccine carriers and cold packs to maintain temperature during the journey (Kementerian Kesehatan Republik Indonesia, 2021).

Storage is one of the critical stages in cold chain management (Kementerian Kesehatan Republik Indonesia, 2021). The Limapuluh Health Center of Pekanbaru City monitors the temperature of the vaccine twice a day, namely in the morning and evening. In addition to recording temperature, there is also a monitoring system through an application on the mobile phone of the person in charge of the vaccine so that temperature conditions can be monitored more continuously.

The vaccine arrangement is carried out by taking into account the characteristics of the vaccine's sensitivity to temperature (Kementerian Kesehatan Republik Indonesia, 2021). Vaccines that are sensitive to heat are placed in an appropriate part to maintain temperature, while vaccines that are sensitive to freezing need to be placed in a position that can minimize the risk of exposure to freezing temperatures (Kementerian Kesehatan Republik Indonesia, 2021). Some of the vaccines available at the Limapuluh Health Center include MR, BCG, polio, DT, TT, Td, DPT, Hepatitis B, IPV, PCV, HPV, VAR, and rotavirus vaccines.

In addition to temperature, the condition of VVM is also one of the important parameters in determining the feasibility of using the vaccine (Kementerian Kesehatan Republik Indonesia, 2021). VVM is an indicator that shows the accumulated heat exposure received by the vaccine during storage and distribution (Kementerian Kesehatan Republik Indonesia, 2021). Stock management also applies the FEFO principle, where vaccines with a closer expiration date are prioritized for use first (Kementerian Kesehatan Republik Indonesia, 2021).

Based on this description, it is important to evaluate the management of cold chains at the Limapuluh Health Center in Pekanbaru City to determine the suitability of the vaccine storage and control process with the principles of cold chain management (Kementerian Kesehatan Republik Indonesia, 2021). The evaluation is expected to provide an overview of the implementation of vaccine storage and become a material for improvement to maintain the quality of vaccines while in health care facilities.

RESEARCH METHODS

Research Design

This study uses an observational descriptive method with a qualitative approach. This approach is used to obtain an overview of the implementation of vaccine cold chain management at the Limapuluh Health Center, Pekanbaru City in 2026. The aspects observed include the process of receiving, storing, temperature monitoring, vaccine arrangement, stock control, recording and reporting, distribution, and destruction of vaccines.

The observational descriptive method is also used in vaccine cold chain evaluation research as an approach to describe the suitability of the implementation of vaccine storage based on observations and information from officers.

Research Location and Time

The research will be carried out at the Limapuluh Health Center, Pekanbaru City in 2026.

Research Instruments

The instruments used are in the form of observation sheets and documentation of vaccine management. Observation aspects include vaccine storage conditions, refrigerator temperatures, vaccine arrangement based on temperature sensitivity, VVM conditions, FEFO implementation, temperature monitoring, cold chain facilities, and recording and reporting systems.

Research Procedure

Data collection was carried out through observation of the vaccine management process at the Limapuluh Health Center, Pekanbaru City and an examination of the recording and monitoring system used. Data on the process of receiving, storing, distributing, controlling, and destroying vaccines were studied based on the information available in the case study report.

Data Analysis

Data were analyzed descriptively by comparing the implementation of vaccine management found at the Limapuluh Health Center, Pekanbaru City with the principles of cold chain management used as a reference. The results of observations are presented in the form of descriptions and tables to illustrate the implementation of each component of vaccine management.

RESULTS AND DISCUSSION

Vaccine Procurement and Acceptance

Vaccine management at the Limapuluh Health Center in Pekanbaru City starts from the planning and procurement stage. Vaccine orders are made based on the needs data from the Person in Charge of Immunization. Orders are made through the SMILE application and using a vaccine request letter submitted to the Health Office. After the application is approved, the vaccine is taken from IFLK with the Minutes of Handover (BAST) and Vaccine Arrival Report (VAR) documents (Puskesmas Limapuluh Kota Pekanbaru, 2026).

At the time of receipt, checks are carried out on the type and quantity of vaccines, the form of preparation, the condition of the label and packaging, the expiration date, VVM, batch number, and the temperature of the vaccine. Vaccine collection uses a vaccine carrier and cold pack to help maintain temperature during the transportation process (Puskesmas Limapuluh Kota Pekanbaru, 2026; Kementerian Kesehatan RI, 2021).

Table 1. Vaccine Procurement and Receipt Checklist

No.	Indicators Assessed	Observation Results	Compatibility
1	Planning for vaccine needs	Based on the data on the needs of the Person in Charge of Immunization	✓ Fit
2	Vaccine booking	Using the SMILE app and vaccine request letter	✓ Fit
3	Admission documents	BAST and VAR available	✓ Fit
4	Examination of the type of vaccine	Examination of the type of vaccine was carried out	✓ Fit
5	Checking the number of vaccines	Checking the number of vaccines	✓ Fit
6	Packaging and label inspection	Inspection of packaging and label conditions	✓ Fit
7	Expiry checks	Expiry date checked	✓ Fit
8	VVM Inspection	VVM condition checked	✓ Fit

9	Batch number check	Batch number checked	✓ Fit
10	Vaccine transport	Using <i>vaccine carriers</i> and <i>cold packs</i>	✓ Fit

Description: The observation data is sourced from the Case Study Report: Cold Chain Management in Ensuring the Quality and Stability of the Vaccine at the Limapuluh Health Center in Pekanbaru City in 2026. The reference for vaccine management refers to the Kementerian Kesehatan RI (2021).

Temperature Storage and Monitoring

Vaccine storage is carried out by maintaining appropriate temperature conditions to maintain the quality and stability of the vaccine. At the Limapuluh Health Center in Pekanbaru City, temperature monitoring is carried out twice a day, namely in the morning and evening. In addition to routine monitoring, there is a temperature monitoring application that can be accessed through the mobile phone of the person in charge of the vaccine so that temperature conditions can be monitored continuously (Puskesmas Limapuluh Kota Pekanbaru, 2026).

Temperature monitoring is also supported by the use of *fridge tags* and temperature monitoring forms as part of documentation of vaccine storage conditions (Puskesmas Limapuluh Kota Pekanbaru, 2026).

In general, vaccine storage in health care facilities needs to maintain a temperature range that is in accordance with the characteristics of each vaccine. Temperature control is an important part of the cold chain system to maintain the quality of vaccines during storage (Kementerian Kesehatan RI, 2021).

Table 2. Checklist of Vaccine Storage Conditions

No.	Indicators Assessed	Observation Results	Compatibility
1	Storage temperature range	Vaccines are stored at a temperature of 2–8°C	✓ Fit
2	Morning temperature monitoring	Done every morning	✓ Fit
3	Afternoon temperature monitoring	Done every afternoon	✓ Fit
4	Monitoring through the app	An application is available on the vaccine APJ device	✓ Fit
5	<i>Fridge tag</i>	Available	✓ Fit
6	Monitoring form	Temperature monitoring form available	✓ Fit
7	VVM	Observed in vaccine management	✓ Fit
8	FEFO	Applied in vaccine stock management	✓ Fit

Source: Puskesmas Limapuluh Kota Pekanbaru (2026); Kementerian Kesehatan RI (2021)

Vaccine Arrangement Based on Temperature Sensitivity

The vaccine arrangement is carried out by paying attention to the sensitivity characteristics of each vaccine to temperature. Heat-sensitive vaccines such as MR, polio, and BCG are placed in appropriate parts to maintain temperature conditions. Meanwhile, vaccines that are sensitive to freezing such as DT, TT, Td, DPT, Hepatitis B, IPV, and PCV need to be placed in areas that can minimize the risk of freezing. Rotavirus vaccines are also stored at a temperature of 2–8°C (Puskesmas Limapuluh Kota Pekanbaru, 2026).

In vaccine storage, the vaccine is not placed directly attached to the refrigerator wall and is given a distance of about 1–2 cm to support cold air circulation. The vaccine is also not placed on the refrigerator door because the temperature in that part tends to be less stable (Puskesmas Limapuluh Kota Pekanbaru, 2026; Kementerian Kesehatan RI, 2021).

Table 3. Vaccine Arrangement Checklist

No.	Indicator	Observation Results	Compatibility
1	Styling based on temperature sensitivity	Structuring pays attention to the characteristics of the vaccine	✓ Fit
2	MR Vaccine	Observed against heat exposure	✓ Fit
3	Polio vaccine	Observed against heat exposure	✓ Fit
4	BCG Vaccine	Observed against heat exposure	✓ Fit
5	DT, TT, Td, DPT	Attention to the risk of freezing	✓ Fit
6	Hepatitis B, IPV, PCV	Attention to the risk of freezing	✓ Fit
7	Rotavirus	Stored at 2–8°C	✓ Fit
8	Distance to the wall of the refrigerator	Spaced about 1–2 cm apart	✓ Fit
9	Storage on the refrigerator door	Not placed on the door	✓ Fit

Source: Puskesmas Limapuluh Kota Pekanbaru (2026).

VVM and Expiration Monitoring

VVM (Vaccine Vial Monitor) is used as an indicator to monitor the accumulated heat exposure received by the vaccine during storage and distribution. The condition of VVM is one of the considerations in determining the feasibility of the vaccine for use (Puskesmas Limapuluh Kota Pekanbaru, 2026; Kementerian Kesehatan RI, 2021).

The management of vaccine stocks at the Limapuluh Health Center also applies the FEFO (First Expired First Out) principle, which is that vaccines with a closer expiration date are prioritized for use first. The application of this principle aims to reduce the risk of vaccines expiring during storage (Puskesmas Limapuluh Kota Pekanbaru, 2026).

Table 4. VVM and Expiration Monitoring Checklist

No.	Indicator	Observation Results	Compatibility
1	VVM Inspection	VVM is observed in vaccine management	✓ Fit
2	Expiration date check	Done at the time of receipt and stock management	✓ Fit
3	Implementation of FEFO	Vaccines with closer expiration are prioritized	✓ Fit

Vaccine Distribution

Vaccine distribution is carried out based on service needs and immunization targets. Vaccines can be distributed to Posyandu, Independent Practice Midwives, and immunization services in the building (Puskesmas Limapuluh Kota Pekanbaru, 2026).

During the distribution process, the use of cold chain facilities is required to maintain the condition of the vaccine. The temperature of the vaccine during storage, distribution, and use is maintained at appropriate conditions and avoided from exposure to heat or freezing (Puskesmas Limapuluh Kota Pekanbaru, 2026; Kementerian Kesehatan RI, 2021).

Table 5. Vaccine Distribution Checklist

No.	Indicator	Observation Results	Compatibility
1	Distribution basis	Based on immunization needs and goals	✓ Fit
2	Distribution receivers	Posyandu, Independent Practice Midwives, and services in the building	✓ Fit
3	Means of distribution	Using cold chain means	✓ Fit
4	Temperature maintenance	Temperature is maintained during the distribution process	✓ Fit

Handling, Recording and Reporting

Vaccine control is carried out using the SMILE (Electronic Immunization and Logistics Monitoring System) application. The application is used to document various

stages of vaccine management, ranging from receipt, storage, distribution to vaccine use (Puskesmas Limapuluh Kota Pekanbaru, 2026).

Recording includes physical and temperature checks upon receipt, vaccine stock, batch number, expiration date, temperature monitoring, and vaccine distribution and use. The temperature monitoring system is also supported by IoT-based automatic sensors so that recording can be done in real-time (Puskesmas Limapuluh Kota Pekanbaru, 2026).

Table 6. Vaccine Control and Recording Checklist

No.	Indicator	Observation Results	Compatibility
1	Logging system	Using the SMILE app	✓ Fit
2	Admission recording	Recorded in the system	✓ Fit
3	Stock recording	Done through SMILE	✓ Fit
4	Batch number recording	Noted	✓ Fit
5	Expired logs	Noted	✓ Fit
6	Temperature monitoring	Done regularly	✓ Fit
7	Automatic monitoring	Supported by IoT-based temperature sensors	✓ Fit
8	Stock recording	Carried out at the end of the month until the 5th of the following month	✓ Fit

Source: Puskesmas Limapuluh Kota Pekanbaru (2026)

Destruction of Vaccines

Vaccines that have passed the time limit for use, are damaged, or have expired are not reused. The rest of the vaccine from multidose vials that no longer meet the requirements for use is disposed of in a yellow box of infectious medical waste. Damaged or expired vaccines are handed over to the Person in Charge of Environmental Health for destruction according to applicable procedures. Destruction activities are reported through the SMILE application by listing the reason for destruction (Puskesmas Limapuluh Kota Pekanbaru, 2026).

Table 7. Vaccine Destruction Checklist

No.	Indicator	Observation Results	Compatibility	Source
1	Expired vaccines	Not reused	✓ Fit	Fifty Days of Health, 2026
2	Damaged vaccines	Submitted to PJ Kesling	✓ Fit	Fifty Days of Health, 2026
3	The rest of the multidose vaccine	Disposed of in yellow boxes of infectious medical waste	✓ Fit	Fifty Days of Health, 2026
4	Destruction reporting	Reported via SMILE	✓ Fit	Fifty Days of Health, 2026

Discussion

Vaccine cold chain management is an important part of maintaining the quality of vaccines from receipt to use in immunization services. Inappropriate storage can cause changes in vaccine quality, potentially reducing its effectiveness. Therefore, temperature control, refrigerator conditions, vaccine arrangement, VVM, and recording systems must be implemented consistently.

The results of the evaluation at the Limapuluh Health Center in Pekanbaru City show that temperature monitoring has become a routine part of vaccine management. The temperature is checked twice a day, namely in the morning and evening, and is supported by a monitoring system through an application. The monitoring system provides an advantage because officers can obtain information about temperature conditions more continuously.

The use of an automatic temperature monitoring system can also help detect temperature changes faster.

In addition to temperature monitoring, the vaccine arrangement has paid attention to the sensitivity characteristics of the vaccine. Vaccines that are sensitive to heat and vaccines that are sensitive to freezing require different storage treatments. Separation based on these characteristics is necessary to reduce the risk of damage due to exposure to inappropriate temperatures. The material at the Limapuluh Health Center also emphasized that the vaccine should not be placed attached to the wall of the refrigerator and needs to be spaced about 1–2 cm apart to maintain cold air circulation.

The use of VVM is also an important part of vaccine quality control. VVM can provide an overview of the accumulated heat exposure that the vaccine has received. By paying attention to the condition of the VVM, officers can help ensure that the vaccine used is still in acceptable condition.

The application of FEFO to stock management is also an important aspect. Vaccines with a closer expiration date should be prioritized for use so that the risk of expired vaccines can be reduced. Management based on FEFO can also support the efficiency of the use of vaccine stocks in healthcare facilities.

From the reception aspect, the checks carried out include the type and amount of vaccines, physical conditions, labels, expiration dates, VVM, batch numbers, and temperature. This process is the initial stage to ensure that the vaccine that enters the health care facility is in the right condition. The use of vaccine carriers and cold packs during vaccine collection also supports temperature maintenance during the transportation process.

From the control aspect, the use of the SMILE application provides support for recording and monitoring vaccine management. Data on receipt, stock, temperature, distribution, and use can be documented in one system. The use of digital-based systems also allows the monitoring process to be carried out in a more structured manner and supports supervision by the person in charge of the vaccine.

These results generally show that the implementation of cold chain at the Limapuluh Health Center in Pekanbaru City has covered various main components of vaccine management. However, based on the available case study materials, there is no quantitative checklist data that allows researchers to calculate the percentage of suitability in each indicator as in previous studies. Therefore, the results of the evaluation in this study are more accurately presented descriptively based on the management components that have been observed and documented.

The research on the Karangrejo Health Center which is an example in the preparation of the article uses a checklist to assess storage conditions, facilities and infrastructure, vaccine refrigerator, and its maintenance. The study showed that aspects of storage, refrigerator conditions, infrastructure facilities, and maintenance can be evaluated separately to obtain an idea of the level of suitability.

Thus, the next evaluation at the Limapuluh Health Center in Pekanbaru City can be developed using a standardized checklist so that each indicator can be scored and calculated as a percentage of conformity. This approach will produce more objective data to determine aspects that have met the standards and aspects that still need improvement.

CONCLUSION

Based on the results of the evaluation, the management of the cold chain of vaccine storage at the Limapuluh Health Center in Pekanbaru City in 2026 has implemented several main components in maintaining the quality and stability of the vaccine. Temperature monitoring is carried out twice a day in the morning and evening and is supported by a

monitoring system through an application. Vaccine storage takes into account sensitivity to heat and freezing, while VVM conditions and expiration dates are part of vaccine quality control.

Vaccine acceptance is carried out through checking the type and quantity of preparations, packaging conditions, labels, expiration dates, batch numbers, VVM, and temperature. Distribution uses cold chain facilities such as vaccine carriers and cold packs. Stock control, recording, temperature monitoring, and reporting are supported by the SMILE application which allows integrated and real-time documentation.

Overall, based on the available case study data, the cold chain system at the Limapuluh Health Center in Pekanbaru City has applied important principles in vaccine management. However, the percentage of conformity rate cannot be determined because the numerical assessment checklist data is not yet available in the case study. Further evaluation is recommended using a structured checklist instrument so that the level of conformity of each aspect can be quantitatively calculated and the aspects that need improvement can be identified more clearly.

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