VVM-BASED VACCINE MANAGEMENT
Vaccine Vial Monitors

USE

Square is lighter than outer circle

The color of the inner square of the VVMs begins with a shade that is lighter than the outer circle and continues to darken with time and/or exposure to heat.

DO NOT USE

Square matches circle

Once a vaccine has reached or exceeded the discard point, the colour of the inner square will be the same colour or darker than the outer circle.

Square is darker than circle

Inform your supervisor

Cumulative heat exposure over time
There is no temperature monitoring device that has changed vaccine management practices as profoundly as VVM.
Some critical approaches we have today in vaccine management have only been made possible with the help of VVM, and others have been made more effective.
▪ The vaccine is currently prequalified by WHO.

▪ The vaccine is approved for use for up to 28 days after opening the vial, as determined by WHO.

▪ The expiry date of the vaccine has not passed.

▪ The vaccine vial has been, and will continue to be, stored at WHO- or manufacturer recommended temperatures; furthermore, the vaccine vial monitor, if one is attached, is visible on the vaccine label and is not past its discard-point, and the vaccine has not been damaged by freezing.
Proper handling of 2-dose vial
Cervarix HPV Vaccine

1. After opening, this vaccine vial should be handled in the same manner as a reconstituted BCG or measles vaccine vial.

2. Discard any unused dose at the end of the immunization session or six hours, whichever comes first.

3. During the session, put the open vials in the vaccine carrier, do not return them in the refrigerator.

- Shake before use
- Check the expiry date and the VVM before opening the vial
- Store in the cold chain at +2°C to +8°C
- Do not freeze, protect from light
SMART EXPIRY DATE
SMART EXPIRY DATE

Expiry in 6 months
Expiry in 12 months
USE FIRST based on VVM principle

VVM overrules the EEFO principle

Expiry in 6 months
Expiry in 12 months
USE FIRST based on EEFO principle
## ROTATING STOCKS WITH THE HELP OF VVM

### Table Data

<table>
<thead>
<tr>
<th>Data</th>
<th>Kujt i dergohet malli</th>
<th>Hyrje</th>
<th>Dalje</th>
<th>Mungesa/Teprica</th>
<th>Gjendje</th>
<th>Indikatore</th>
<th>Shenime</th>
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<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>FW</td>
<td>VVM</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

### Notes

- VVM: Value Variation Method
- CCM: Customized Consumption Method

**Data Example:**

- Item 1: Data 1234, Kujt i dergohet malli 5678, Hyrje 123, Dalje 456, Mungesa/Teprica 789, Gjendje 012, Indikatore 345, Shenime VVM.
KEEPING VACCINES IN ORDER

Arranging vaccines in front opening refrigerators

All vaccines must be segregated by type and each type must be kept in a tray to prevent vials from getting mixed up.

Vaccines that are already expired and with VVMs at or beyond the discard-point must not be kept in the refrigerator. They must be kept outside the cold chain with a clear marking “not for use” to obtain authorization to discard them.

Only matching quantities of Typhoidized vaccines and diluents must be kept in the refrigerator. Diluents are not interchangeable.

FREEZER

Only for water packs to produce ice

MIDDLE and BOTTOM SHELF

For freeze-sensitive vaccines and temperature monitoring device

CRISPER

Only for water-bottles

DOOR

NOTHING

If you have any shelves in the door REMOVE them.

TOP SHELF

For OPV and Typhoidized vaccines and their diluents

DILUENT

- Priority

OPEN

Applies only to OPV

unopened

VVM

lighter

longer

BACK

TOP SHELF

unopened

VVM

lighter

longer

BACK

MIDDLE and BOTTOM SHELF

For freeze-sensitive vaccines and temperature monitoring device

CRISPER

Only for water-bottles

DOOR

NOTHING

If you have any shelves in the door REMOVE them.

TOP SHELF

For OPV and Typhoidized vaccines and their diluents

DILUENT

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lighter

longer

BACK

MIDDLE and BOTTOM SHELF

For freeze-sensitive vaccines and temperature monitoring device

CRISPER

Only for water-bottles

DOOR

NOTHING

If you have any shelves in the door REMOVE them.
WHICH VIAL TO USE FIRST?
WHEN THERE IS AN ALARM

Interpretation of temperature monitoring devices

30-day electronic Refrigerator temperature logger

High alarm

VVM visual cue

VVM on the label

VVM on the cap or neck of the ampoule

Unopened vial

Open vial

Use within 6 hours or until the end of immunization session, whichever comes first

DON’T USE

USE FIRST

DON’T USE

USE

DON’T USE

Remove from fridge

Also apply EEOF

Low alarm

Electronics freeze indicator

Red flag

Green flag

A refrigerated vaccine

A non-refrigerated vaccine

Conduct ALARM TEST

PASS: shake test

FAIL: shake test

DON’T USE

Remove from fridge

Non-refrigerated vaccines may react differently to storage

Physically separate vaccines and ensure

You may remove the vaccine from the refrigerator

When using the vaccine

DO NOT USE IF THERE IS NO LABEL.

1. All opened VVMs except multi-dose vials of vaccines should be discarded at the end of the immunization session or within 8 hours of opening. If the vaccine is combined into a single vial, the opened vial should be used within 8 hours after opening.

2. If the vaccine is stored below 4°C, the opened vial can be used and used up to 24 hours after opening. The oil is dry on the cap.

3. The PCE may be used for up to 24 hours after opening the vial, as recommended by WHO.

4. The expiry date of the vaccine has not passed.

5. The vaccine will have been, and will continue to be, stored at 4°C or below by the vaccine-monitoring campaign staff. Furthermore, the vaccine-monitoring staff is able to confirm that the vials have not been damaged by shaking.

6. For multi-dose vials, primary visual and electronic devices are available in WHO recommends. This multi-dose vial should not be discarded.


8. If a vaccine is available in refrigerated shake test may not be conducted, but all vaccine supervision is visual. Then the vaccine is kept in the refrigerator for diagnosis.

9. Do not conduct shake test for unpacked multi-dose vials, they may be damaged. However, if a vaccine type of unpacked vaccines is less than 4°C, you may keep the opened vial to be used first. For these sensitive vaccines, check package inserts whether it is stored at appropriate.
Use of Cool Water Packs To Prevent Freezing During Vaccine Transportation at the Country Level

**RESEARCH**

**Title:** Use of Cool Water Packs To Prevent Freezing During Vaccine Transportation at the Country Level

**Authors:** Kartoglu, S., Gokce, G., Gokce, S., and Altay, A.

**Abstract:**
To study the impact of the use of cool water packs versus no intervention on the cold-injury of vaccine transport boxes and the health of the vaccine Jl. Methods: 12 boxes were used to measure the temperature of vaccine shipments with cool water packs in laboratory and country evaluations. The temperature recordings were made using a thermocouple at each storage valve of the vaccine. The temperature variations were measured between 1-6°C from the vaccine storage valve of the vaccine. Results: All the boxes were checked at 1-6°C after 6 hours of transport. All the boxes were found to be the most effective vaccine after 6 hours of transport. The boxes were found to be the most effective vaccine after 6 hours of transport. Conclusion: Cool water packs are found to be better than no intervention for vaccine at cold storage conditions.

**KEYWORDS:** Cool water packs, Flowing, Transportation, Vaccine, VMM, Nepal, Myanmar, Turkey, Zimbabwe.

**Table II**

| Temperature Range of RH0°C and RH15°C during 6 Hours Exposure to 45°C and 45°C Ambient Temperature at 4°C (in °C) |
|---|---|---|---|
| Box Type | Temperature Difference (°C) | RH0°C | RH15°C |
| 1.2°C | 2.1°C | 2.6°C | 2.7°C |
| 1.2°C | 2.1°C | 2.6°C | 2.7°C |
| 1.2°C | 2.1°C | 2.6°C | 2.7°C |
| 1.2°C | 2.1°C | 2.6°C | 2.7°C |

**Table III**

<table>
<thead>
<tr>
<th>VMM Volumes</th>
<th>VMM Water Pack Volume (ml)</th>
<th>Percentage of VMM Water Pack</th>
<th>Remaining VMM Life in Days at 4°C (in °C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VMM1</td>
<td>3.75</td>
<td>4.0</td>
<td>2.6</td>
</tr>
<tr>
<td>VMM2</td>
<td>6.25</td>
<td>6.25</td>
<td>2.25</td>
</tr>
<tr>
<td>VMM3</td>
<td>9.75</td>
<td>9.75</td>
<td>2.0</td>
</tr>
<tr>
<td>VMM4</td>
<td>13.25</td>
<td>13.25</td>
<td>1.8</td>
</tr>
<tr>
<td>VMM5</td>
<td>16.75</td>
<td>16.75</td>
<td>1.5</td>
</tr>
</tbody>
</table>

**Table IV**

<table>
<thead>
<tr>
<th>VMM Volumes</th>
<th>VMM Life (in °C)</th>
<th>Remaining VMM Life in Days at 4°C (in °C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VMM1</td>
<td>2.35</td>
<td>2.35</td>
</tr>
<tr>
<td>VMM2</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>VMM3</td>
<td>5.6</td>
<td>5.6</td>
</tr>
<tr>
<td>VMM4</td>
<td>7.2</td>
<td>7.2</td>
</tr>
<tr>
<td>VMM5</td>
<td>8.8</td>
<td>8.8</td>
</tr>
</tbody>
</table>

**Figure 1**

- **Vaccine** are transported four times between two points (1). The temperature exposure is applied to cold water packs in the VMM. Vaccine are shipped at 4°C using cool water packs (2). The boxes are found to be the most effective vaccine after 6 hours of transport. All the boxes were found to be the most effective vaccine after 6 hours of transport.

- **Figure 2**

- **Vaccine** are transported four times between two points (1). The temperature exposure is applied to cold water packs in the VMM. Vaccine are shipped at 4°C using cool water packs (2). The boxes are found to be the most effective vaccine after 6 hours of transport. All the boxes were found to be the most effective vaccine after 6 hours of transport.

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**Journal:** PDA Journal of Pharmaceutical Science and Technology

**Volume/Number:** Vol. 93, No. 1, January-February 2008

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[Link to the full document](http://kartoglu.ch/papers/14_Use-of-Cool-Water-Packs-to- Prevent-Freezing-During-Vaccine-Transportation-at-the.pdf)
CONTROLLED TEMPERATURE CHAIN: Strategic Roadmap for Priority Vaccines 2017-2020
▪ CTC use of vaccines allows for a single excursion of a vaccine into ambient temperatures not exceeding +40°C for a minimum of 3 days, just prior to administration.

▪ Heat-stable vaccines differ in the length of time they can be stored in a CTC and the maximum temperature they can endure while remaining stable and potent.

▪ CTC qualification involves regulatory approval and prequalification by WHO.

▪ CTC is a priority for vaccines used in campaigns and special strategies.
There are currently three vaccines that are thermostable and qualified for CTC use.

- Serum Institute of India’s MenAfriVac® (conjugate meningitis A vaccine) that can be used for up to 4 days at temperatures not exceeding 40°C.
- Merck’s Gardasil® 4 (quadrivalent human papillomavirus vaccine) that can be used for 3 days at temperatures not exceeding 42°C.
- Shantha Biotechnics Shanchol™ (oral cholera vaccine) that can be used for 14 days at temperatures not exceeding 40°C.

A number of vaccine manufacturers are in the process of qualifying their existing and pipeline liquid vaccines for CTC use.

Some vaccines are inherently heat stable, others may require additional formulation efforts to improve their stability, and some vaccines may never qualify for CTC use.
Although a VVM changes color in response to cumulative heat exposure, its response is not rapid enough at higher temperatures (e.g., above 37°C).

A threshold indicator (TI) is therefore also needed when vaccines are kept in a CTC. TIs react rapidly if exposed at or above a defined threshold temperature.
At present, a standalone TI is used in vaccine carriers and cold boxes.

The TI is on a card and the indicator changes color from light grey to black as soon as the temperature has exceeded +40°C.

The need to supply, distribute, and provide training on TI cards is a barrier to CTC vaccine introduction.

PEAK TEMPERATURE THRESHOLD INDICATOR

INSTRUCTIONS
Check the indicator as follows:

• When you load the vaccines into the cold box
• As you remove each vial from the cold box
• When the last dose of vaccine for the day is administered

Still good

Take action!
If the INNER CIRCLE IS BLACK, DO NOT USE the vaccines and contact your supervisor
A combined VVM-TI on primary containers undergoes gradual color change up to the specified threshold temperature and rapidly reacts if exposed at or above the threshold temperature.
VVM+ developed for Controlled Temperature Chain (CTC)

- VVM+ reacts like VVM up to 37°C
- At 40°C VVM+ reaches end point rapidly to show exposure to critical peak temperature
- VVM+ supports CTC initiatives
WHO PQS specification for COMBINED VVM and TI

VVM+250, VVM250 and TI Prequalified
VVM+ shortlisted on VACCINE INNOVATION PRIORITIZATION STRATEGY (VIPS)

Under Phase I, 9 innovations have been short-listed:

- Microarray patches (MAPs)
- Solid-dose implants
- Heat stable/controlled temperature chain (CTC) qualified liquid formulations
- Combined Vaccine vial Monitor (VVM) and Threshold Indicator (TI)
- Dual-chamber delivery devices
- Compact prefilled auto-disable devices (CPADs)
- AD sharps-injury protection (SIP) syringes
- Freeze damage resistant liquid formulations
- Barcodes / Radio Frequency Identification (RFID)
BARCODES
Gavi announced GS1 barcodes required on secondary packaging

Tenders after

1 OCTOBER 2019

https://www.unicef.org/supply/index_103734.html

- First step to transition track and trace system technology on vaccines to a labelling requirement

  GAVI announcement: vaccine manufacturer GS1 compliance

  Starting 1st October 2019, for vaccine tenders backed by Gavi financing and issued by UNICEF, GS1 barcoding on the secondary packaging will be a requirement by latest 31st December 2021.

- WHO is developing a Track and Trace Policy Brief
US CDC 2D barcode update

>80% compliance of 2D barcodes on vials and prefilled syringes
US CDC 2D barcode update

Essentially all US vaccine vials and syringes have 2D barcodes

GSK Hep B  Pfizer – Pneumo  Merck – Gardasil  Sanofi - Tdap

GTIN, lot number, expiry date
Transformational innovation

2D barcode and digitized VVM (eVVM)
2D barcode with embedded temperature sensor

Digitize chemical indicators with unit of sale level data connection

Enhance the value of 2D barcodes for stock management, patient safety and anti-counterfeiting by incorporating temperature integrity

- Specific area has cumulative (VVM) and/or threshold ink printed as part of barcode
- Rapid reading with phone or scanner
- Connect with cloud-based data set of other sensors
GS1 2D datamatrix with VVM

VVM – gradual, irreversible color change from light to dark develops with cumulative temperature exposure over time.
Demo of OneScan™ indicator

Hot Plate

Before Heat

After Heat
2D barcode with embedded VVM active

Color evolution over time

Early adoption would likely maintain classic VVM
Size doesn’t matter for product integrity

Temperature monitoring and traceability for shipping box, carton box, vial, syringe, ampoule
Leverage value of VVM with linkage to HMIS
Link health and logistics management systems

Improve data quality and integrity

Scan Uniquely Identified Immunization Card

Scan Uniquely Identified Vial

Link each infant with the vaccines they receive
Thank you...