**PROGRAMMATIC AND FINANCIAL BENEFITS OF ESTABLISHING AN EFFECTIVE TEMPERATURE MONITORING SYSTEM IN THE VACCINES SUPPLY CHAIN**

CASE STUDY IN CAMEROON

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FINAL REPORT

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# INTRODUCTION

Heat or freezing can damage vaccines and cause considerable losses. Heat exposure is monitored by the vaccine vial monitor (VVM) which visually alerts to potential damage and triggers appropriate measures to correct the situation in a timely manner. Exposure to freezing is more insidious because there is no visual system on the vial to alert of its occurrence. Exposure to freezing temperatures poses a risk to freeze sensitive vaccines and when proven to be frozen by the shake test, causes irreversible losses.

According to a literature review conducted in 2007 by Matthias et al. [1] on the likelihood and extent of exposure to freezing temperature in the vaccine cold chain, exposure to freezing was raised as a major risk for freeze sensitive vaccines during storage and transportation. A similar study by Hanson et al [2] conducted in 2017 (ten years later) , found that 19.3% of vaccine deliveries in low- and middle-income countries (LMIC), are at risk of exposure to freezing temperatures during transportations and 31.7 % of vaccines are at risk of exposure to freezing temperatures during storage.

Manual temperature readings consisting of two readings at regular intervals during the day (usually one in the morning and the other on in the afternoon) has revealed many limits including but not limited to the below:

* The lack of evidence of what has happened between the 2 readings
* The lack of trust in manual temperature readings and records
* Additional workload for the health worker on weekends and holidays (lack of evidence of systematic temperature readings on weekends and holidays);
* The lack of alert in case of failure of the storage equipment /facilities
* The absence or weakness in systematic reviews and analysis of temperature records to trigger corrective measures.

.In order to maintain vaccine quality, it is essential to ensure a continuous monitoring of the temperature of vaccines throughout the supply chain.

The implementation of a temperature control system is guided by policies approved nationally or globally; the WHO Vaccine Management Handbook (Module VMH-E2-01.1), “How to monitor temperatures in the vaccine supply chain[3] recommends the following best practices:

* Best option for cold rooms and freezer rooms where large quantities of vaccine are usually stored is the use of programmable electronic temperature and events recorders. These devices are electronic systems which record temperatures continuously in the vaccine storage facilities using temperature sensors. They are connected to a server / central computer via wired or wireless connections. All data received and stored in the server are analyzed electronically and the system can be configured to generate reports and send alarm notifications when the recorded temperatures fluctuate outside the appropriate range. This alert notification is sent to designated health workers for rapid response/actions to prevent damage to the vaccine. Cold rooms and freezer rooms require also a reliable backup device to monitor temperatures in case the event logger system fails. (examples of backup include integrated digital thermometers, fixed gas/vapour pressure-dial thermometer, 30-day electronic temperature recorders, electronic freeze indicators)
* Best option for refrigerated vehicles used for vaccine transportations is the use of mobile programmable electronic temperature and event logger systems. These are equivalent to the event logger systems used for fixed storage facilities and have similar functionality options, including multi-point temperature monitoring and a dashboard mounted display and alarm system.
* Cold boxes and vaccine carriers with conditioned ice packs used for transporting vaccines that are sensitive to freezing, must systematically be equipped with freeze indicators. These devices have a visual indicator that shows whether the vaccine has been exposed to freezing temperatures. Once the alarm indicator is triggered, the device is no longer usable and should be discarded. Otherwise the device can be used until the built-in battery expires.
* For refrigerators, the use of 30-days temperature recorders (30DTR) is the minimum standard for continuous temperature monitoring. The 30DTR does not only provide temperature measurements at the time of inspection, they provide evidence of what has happened between readings. They record the temperature every 10 minutes or less for 30 consecutive days. They record and display a history of all temperature outside the norms including heat and freezing that occurred within 30 days. New models can store temperature data for 60 consecutive days which can then be downloaded on a computer. To continue the monitoring in case of the 30 DTR failure, vaccine refrigerators should also be equipped with a backup device (examples of back up include stem thermometers, electronic freeze indicators are sometimes)[[1]](#footnote-1).

The WHO and UNICEF initiative that set the vaccine management standards recommends that all vaccination programs implement a system to continuously monitor temperatures in the vaccine supply chain however, results from Effective Vaccine Management Assessments (EVM) in countries show that temperature monitoring in the vaccine supply chain is weak [4,5] and its improvement remain a challenge.

Main reasons include:

* The lack or insufficient understanding of the programmatic benefits of a proper temperature monitoring to advocate for its prioritization.
* The lack or insufficient technical, financial data and information that proves the cost-effectiveness of establishing a proper temperature monitoring system and supports the prioritization of its implementation.
* The lack or insufficient adequate human resources required to support the implementation process.

The present study aims at helping bridge such a gap; it uses a cost-benefit analysis (CBA) in the vaccine supply chain in Cameroon to analyze the implementation of the continuous temperature monitoring system that comply to the recommendations listed above from the WHO vaccine management handbook.

It also compares the consequences of a ‘‘do nothing’’ scenario with a set of hypothetical implementation scenarios that incorporate the programmatic gains of effective interventions scenarios.

# **SITUATION ANALYSIS**

## **The health system structure in Cameroon**

The health system in Cameroon consists of three levels: the central level, the intermediate level (made of 10 regional delegations of health), and the peripheral level (189 health districts and 1766 health areas). The new Health Sector Strategy (HSS) provides for the creation of a fourth level; the community level. The Service Points that deliver health care are classified in 7 categories.

In 2014, out of a total of 4034 health service points that deliver health care, 56% were public and 44% were private. As per the partnership strategy of the MoH, the government subsidizes nonprofit and NGOs health facilities.

It is worth noting that 80.6% of the population live within 5 km of a health facility with disparities in rural areas (69.6%) and in Adamawa Regions (54.2%), Far North (65.7%) and Eastern (67.7%). Poor Infrastructure and technical commodities in some health facilities make them not functional or providing a poor-quality service.

|  |  |  |  |
| --- | --- | --- | --- |
| **No.** | **REGION** | **Number of DS** | **Number of health area** |
| **1** | **Adamaoua** | **9** | **74** |
| **2** | **Centre** | **30** | **284** |
| **3** | **Est** | **14** | **111** |
| **4** | **Extrême Nord** | **30** | **278** |
| **5** | **Littoral** | **24** | **190** |
| **6** | **Nord** | **15** | **148** |
| **7** | **Nord-Ouest** | **19** | **228** |
| **8** | **Ouest** | **20** | **234** |
| **9** | **Sud** | **10** | **104** |
| **10** | **Sud-Ouest** | **18** | **115** |
| **TOTAL** | | **189** | **1766** |

**Table 1 :** Mapping of health facilities by level.

## **Objectives of the national EPI**

The 2015-2019 comprehensive multiyear plan (cMYP) provide an overview of the objectives of the national EPI; the objectives include the following:

* Increase the third dose of pentavalent vaccine from 88 to at least 92% nationally, and at least 80% in all health districts;
* increase the coverage for measles vaccine from 83 to 90% at national level;
* Reduce the gap between highest and lowest socioeconomic quintiles from 43.5% to 34.8%;
* Involve at least one community worker in the promotion of immunization and search for children who dropped out in all functional health districts and health areas
* For data collection and analysis
* Increase from 0% to 100% the proportion of health districts that collect vaccination data by gender by 2017;
* For new vaccines introduction
* Introduce new vaccines: (Men A) , HPV, IPV, MR, Measles 2nd dose, Td, HepB birth dose;
* Advocate to involve 100% of administrative officials (governors, prefects, sub-prefects, mayors, delegates of the government) and at least 80% of traditional and religious leaders to commit to child immunization;

Specific objectives regarding the supply chain include:

* Increase effectiveness in the vaccine distribution system at all levels of the supply chain;
* Strengthen cold storage capacity for all vaccines and storage capacity for supplies that require ambient storage;
* Provide 100% of the cold chain the equipment of with continuous temperature control devices;

## **Overview of the national supply chain structure for medicine (including vaccines)**

In 2013, Cameroon adopted a National Pharmaceutical Policy, to provide the accessibility and affordability of quality essential medicines to population. There is a fairly functional National Pharmaceutical Regulatory Agency (NPRA).

The National medicine supply system (SYNAME) is structured into 3 sub-groups:

* the CENAME (National Essentials Medicines and medical consumables Supply Center); for-profit wholesale distributors and nonprofit private entities.
* At the local level, there are the Regional Fund for Health Promotion (FRPS) and pharmacies within public and private health facilities. Quality control is not systematic for imported medicines and only a small proportion of circulating batch is controlled once in the market. Counterfeiting has grown and there is a vast network of illicit supply that feeds the market of the street and that may have connections with the legal sector (SSS 2016- 2027).
* In the area of EPI vaccine management, according to the Memorandum of Understanding for procurement services signed on 18 August 2009, the Ministry of Health is responsible for the purchase of supplies, equipment and other materials to support the EPI activities through UNICEF. The new and under-utilized vaccines (yellow fever, DTP-HepB-Hib, PCV and rotavirus 13) are co-financed with GAVI. Traditional vaccines (BCG, OPV, TT and RR) are funded by the Government.

## **Overview of the Effective Vaccines Management (EVM) Assessment results**

According to the EVM assessment conducted in August 2013, none of the nine criteria assessed (E1- E9) has reached the minimum required score of 80% nationally.

The criteria E2 related to temperature monitoring reached a national average score of 74% with respectively 31%, 59% and 82% for the central, regional and peripheral levels

An improvement plan was developed after the EVM assessment and its implementation started immediately.

At the time of this study, temperature monitoring devices in use during storage and transportation in the vaccine supply chain and improvement activities related to improving temperature monitoring, show the following figures:

* **Cold rooms where large quantities of vaccines are stored: The central level and** 10 regions in the country have a vaccine cold room. 6 cold rooms at the central level and 3 regional cold rooms (Adamawa, Littoral and South West) are equipped with programmable electronic temperature recorders and events (RTMD). Other cold rooms use Fridge tag2 as their main temperature monitoring device.
* **Transportation using refrigerated truck:** the central level has a refrigerated truck to supply regional stores. The truck is equipped with a programmable and mobile electronic temperature and events recorders. However, the temperature control device is not functional and temperature control is not done during transportation from intermediate to peripheral levels.
* **Transport using cold boxes and vaccine carriers are distribution of vaccines between the** intermediate and the peripheral level is done using cold boxes and vaccines carriers, but freezing indicators are not used when transporting vaccines sensitive to freezing with conditioned ice packs.
* **In all vaccines refrigerators that store vaccines,** Fridge-tag2 is used for temperature monitoring; there is no backup thermometer.

In terms of maintenance, contracts are signed with private service providers. To increase the expertise within the EPI program, a specific technical Unit is created at central level to train on the installation and maintenance of equipment.

To strengthen staff capacity, logisticians at central, regional and districts levels were trained on supply chain management under the GAVI HSS grant.

Regarding the vaccine’s stocks management, the SMT (Stock Management Tool) is used to monitor the stocks and temperature data at central and regional levels. The District Vaccine Data Management Tool (DVDMT) is used to monitor vaccine stocks and vaccinations data at district level and the Health centers use manual registers for their vaccine stock and vaccinations monitoring.

The next EVM assessment in the country is planned for 2019

# **ANALYSIS OF THE CURRENT TEMPERATURE MONITORING SYSTEM**

This section analyzes the temperature monitoring system in place in the vaccine supply chain in light of the best practices recommended in the WHO Vaccines Management Handbook “How to monitor temperatures in the vaccine supply chain”.

Referring to the above best practices to establish an optimal continuous temperature monitoring system, the analysis focus on the implementation of the below concrete activities:

• the installation of appropriate monitoring equipment at each level and each segment of the supply chain,

• the training of users in the use of the installed monitoring equipment

• the implementation of appropriate standard operating procedures for the monitoring,

• the implementation of a data management system to collect the data, analyze and provide effective feedback to users.

## **Performance of the current temperature monitoring system**

In this section, the level of implementation of the 4 concrete activities to comply with the best options recommended along the supply chain segments and levels in the country is summarized.

**A1 Storage at central level**

* the central level has six cold rooms that are equipped with a continuous monitoring system of temperature (RTMD)
* qualified staff receive SMS alerts if the temperature fluctuates outside the adequate temperature ranges and at least 2 staff were briefed and trained to use the equipment
* the data generated by the temperature monitoring system is analyzed weekly.
* Standard operating procedures that are validated are available

Graph 1 reflects the level of implementation for each component (temperature monitoring equipment, effective training, procedures/SOP and effective data analysis and feedback) required during storage at the central level. The implementation level and compliance to the best options of equipment and practices is satisfactory (100%) at the central level.

**Graph 1:** Temperature monitoring equipment and practices during storage at the central level

**A.2 Transportation from the central level to the regional level**

The vaccines transportation from the central store to regional stores is done with a refrigerated truck.

* The refrigerated truck is equipped with an electronic temperature recorder (RTMD).
* At least 2 staff are trained, and know how to operate the equipment;
* SOP on the operation of the equipment exist but at the time of this study data collection and management was not covered in the SOP.
* Data management and analysis is not systematic; the use of the equipment during transportation is sub optimal;

Graph 2 reflect the level of implementation and compliance for each component; The total compliance level for the temperature monitoring equipment and the practices required during transportation from the central store to the regional stores is satisfactory (scored 100%) for equipment required and the training. There is still some improvement required on procedures (scored 80%) and data management (scored 50%).

**Graph 2:** Temperature monitoring equipment and practices during vaccine transportation to the regions stores (DC)

**A3: Storage at regional level**

To reach 100% of total compliance, a maximum score of 25% is expected to be reached in each of the 4 components

In the current situation only 3 regions are equipped with RTMD. The other 7 regions do not comply to the monitoring equipment required in cold rooms (they use fridge tag2)., Training was provided to staff on RTMDs and SOPs and good practices exist in the 3 regions that are equipped with RTMDs. In the 7 regions not equipped with RTDM; their SOPs and practices refer to Fridge tag2, that is sub optimal for cold rooms; these regions are scored 10% for that component; In all regions data analysis is performed and feedback provided and each region is scored 25% for that component . *The total compliance level is reflected in graph 3 for each regional store.*

*While the total compliance level* for the temperature monitoring equipment and the practices required during storage *at regional store is satisfactory in 3 regions (100%) it is around 60% for the 7 other regions.*

**Graph 3:** monitoring equipment and practices during storage at regional stores

**A4. Transportation from regional stores to district stores**

The distribution of vaccines from the regional stores to the district stores is performed with insulated containers (cold boxes). During the study, workers confirmed that conditioned ice packs were used in the cold boxes to distribute freeze sensitive vaccine, but no freezing indicator is used during this transportation.

Graph 4 display for each region-district distribution route the level of compliance for the 4 components assessed (temperature monitoring equipment required), adequate training, availability of procedures/SOP, effective data management system in place)

The total compliance level for the temperature monitoring equipment and the practices required during transportation from regional stores to district stores is around 40% in all distribution routes

**Graph 4:** Temperature monitoring equipment and practices during transport from regional stores (CD) to districts stores (DS)

**A5. Storage at health center level**

Health centers are equipped with vaccine refrigerators

* Fridge-tag 2 is the temperature monitoring equipment in all vaccine refrigerators
* , health workers are trained in the use of this device but this training is generally a briefing during supervision and they do not master all functions of the devices; in addition new staff are not systematically trained or briefed.
* The EPI standards document the reference for operational procedures of the EPI it has been updated and validated at central level but not yet fully disseminated to the operational level
* Data management is effective with feedback.

The average level of compliance for the sample of health centers assessed in each district is summarized in the graph 5 for the 4 components assessed (temperature monitoring equipment required, adequate training, availability of procedures/SOP, effective data management system in place).

The total compliance level for the temperature monitoring equipment and the practices required during storage in health centers ranges between 50% and 72%

**Graph 5:** Temperature monitoring equipment and practices during storage in health centers

The performance of the current temperature monitoring system across the entire supply chain can also be illustrated by scoring 1 when the situation is considered fully compliant and 0 when the situation is suboptimal (partially /or not compliant to the requirement). Table 2 & table 3 illustrate the performance.

* **Performance for storage**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Central store** | **Regional stores** | **Peripheral stores** |
| **Equipment installed** | 1 | 3/10 | 1 |
| **Training of users** | 1 | 3/10 | 0 |
| **Procedures/SOP** | 1 | 1 | 0 |
| **Data Management** | 1 | 1 | 1 |
| **TOTAL** | **4** | **2.6** | **2** |

**Table 2 :** Performance of storage

With regards to the storage the temperature monitoring system can be considered satisfactory at central store (4/4), but not at the regional and peripheral levels (2.6/ 4 and 2/4 respectively)

* **Performance for transit (transportation)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Central store to regional stores** | **Regional stores to district stores** | **District stores to Health centers** |
| **Equipment installed** | 0 | 0 | 0 |
| **Training of users** | 1 | 0 | 0 |
| **Procedures/SOP** | 1 | 0 | 0 |
| **Data Management** | 1 | 0 | 0 |
| **TOTAL** | **3** | **0** | **0** |

**Table 3 :** Performance of transportation

Temperature monitoring system during transportation from the central store to the regional stores store is scored (3/4), and from regional stores to district and from district to health centers the scored is (0/4 and 0/4 respectively).

The optimal situation targets achieving a performance score of 1 (100%) for every segment and level.

## **Cost analysis of the current temperature monitoring system**

The implementation of the improvement plan with regards to the temperature monitoring started with the installation of RTMD in cold rooms at the central level and with the procurement of 3000 Fridge-tags for equipment in the supply chain. Central level staff were trained by the company that installed the RTMD, and the staff then installed in the 3 regions (with support provide by WHO and UNICEF for this deployment and installation). The installation of Fridge-tag 2 in vaccine refrigerators was not done with a formal training but through the opportunities of supervision strengthen health workers capacity at all levels.

The table below summarizes the costs that were incurred. In the 4 components (equipment, procedures, staff training and data management) of interest in this study. Currency values are presented in US dollars and the exchange rate used is 1 USD = 570.10 CFA francs.

|  |  |  |
| --- | --- | --- |
| **Investments** | **Total Amount** | **Comments** |
| **Temperature Monitoring equipment** |  |  |
| RTMD for cold rooms (central store and 3 regional stores) | 26.904 | procurement and installation cost |
| 30DTR for refrigerators (all levels) | 80,711 | procurement cost of 3000 fridge-tag |
| RTMD in the Refrigerated vehicle | 4,542 | Maintenance costs over two years |
| Freeze-tag for transportation of freeze sensitive vaccines in cold boxes/vaccine carriers |  |  |
| **Training** | 22,279 |  |
| **Procedures / SOP** | 21,049 |  |
| **Data management / analysis and feedback** | 58,302 |  |
| **TOTAL DES INVESTISSEMENTS** | **213,786** |  |

**Table 4 :** Investment cost

The total estimated investment cost of the current temperature monitoring system is $ 213.786.

The graph below displays the investment costs in term of percentage for each component

**Graph 6:** Breakdown in percentage of the investment by component

Despite the effort and investment done to date to improve the temperature monitoring system; many gaps are still to be fulfilled; as described in the current situation analysis section the level of compliance of the current temperature monitoring system, to the requirements is still suboptimal.

The section below looks at what level of investment cost is needed to upgrade all the components (equipment, procedures, staff training and data management) to comply (100%) with the required recommendation and ensure an “optimal” temperature monitoring system along the supply chain.

# **COST TO ESTABLISH AN OPTIMAL TEMPERATURE MONITORING SYSTEM**

Upgrading each of the 4 components ((equipment, procedures, staff training and data management) to optimal levels (achieving a total score of 100% for each segment and level) throughout the entire supply chain, requires additional investment in each of them. The table below gives an estimate of the additional investment;

Using the current temperature monitoring system situation in Cameroon as a base for improvement, upgrading the system requires:

• The installation of the continuous temperature recording systems with alarm notification in the seven-remaining regional cold rooms;

• The procurement of 3,000 new fridge-tag 2 for refrigerators at all levels of the cold chain;

• The procurement of 9,000 freeze-tag for transporting vaccines from intermediate to peripheral level, at a rate of one freeze-tag per semester and vaccine store with a buffer stock of 1,180 units for the whole country to cover the needs for two years.

In addition to the equipment to be purchased and installed, funding is required for staff effective training before the introduction of new equipment, for the development/revision and dissemination of standard operating procedures on temperature monitoring and for the regular collection, analysis of temperature monitoring data and feedback to users.

This additional funding will upgrade the temperature monitoring in one-time manner, but it does not ensure continuity in a long time period because some equipment must be replaced after a period of time; this is the case for example for the 30 DTR (Fridge tag) that need to be replaced after a period of time due to batteries expiry date, other devices like (Freeze tag) will require restocking for immediate replacement because of their irreversibility once the alarm indicator is triggered ; in addition, the establishment of a temperature monitoring system generates recurring costs such as the access fees to the equipment (RTMD) provider’s online portal for the email alerts….

The section below analyzes the investment cost in a medium-term (over 5 years period) to provide a better visibility of the cost of such a project; table 5 below presents a scenario of investment for a five-year period based on the following assumptions:

* RTMD, are installed in the first year.
* The fridge-tag is the equipment adopted for all vaccines refrigerators, and a training is to be scheduled before the introduction of the new devices;
* The freeze-tag is used in all transport operations of freeze-sensitive vaccines with conditioned ice packs from intermediate to peripheral levels;
* Adequate training, monitoring procedures and data management are established at all levels
* A supervisory training is conducted every 6 months to enhance the capacity of operational staff.

| **N°** | **Designation** | **Quantities** | **Unit cost** | **Amount** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **TOTAL** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | CONTINUOUS MONITORING SYSTEM OF TEMPERATURE (RTMS) FOR COLD ROOM | | | | | | | | | |
|  | MULTIPLIER (Number of cold room) |  |  |  | 7 |  |  |  |  |  |
| 1 | ICE3 Extra Model BC440 | 1 | 580 | 580 | 4,060 | - | - |  |  | 4,060 |
| 2 | NTC thermistor Temperature Probes | 8 | 35 | 280 | 1,960 | - | - |  |  | 1,960 |
| 3 | Industrial Magnetic door contacts | 2 | 30 | 60 | 420 | - | - |  |  | 420 |
| 4 | 36 Months portal access Fee including all SIM and data | 1 | 1,440 | 1,440 | 10,080 | - | - | 10,080 |  | 20,160 |
| 5 | Customs Fees | 7 | 138 | 941 | 6,585 | - | - |  |  | 6,585 |
| 6 | Voltage Regulator | 1 | 583 | 583 | 4,081 | - | - |  |  | 4,081 |
| 7 | Installation training of staff in the logistician | 1 | 350 | 350 | 2,450 | - | - |  |  | 2,450 |
|  | TOTAL CONTINUOUS MONITORING SYSTEM OF TEMPERATURE | | | | 29,636 | - | - | 10,080 | - | 37,266 |
|  | RECORDERS ELECTRONICS OF TEMPERATURE 30 JRS FOR REFRIGERATORS | | | | | | | | | |
|  | MULTIPLIER |  |  |  | 3 |  | 3 |  | 3 |  |
| 1 | Fridge-tag 2 | 1,000 | 26 | 25,500 | 76,500 |  | 76,500 |  | 76,500 | 229,500 |
| 2 | Customs Fees | 1,404 | 1 | 1,404 | 4,211 |  | 12,634 |  | 4,211 | 21,057 |
| 3 | Staff training | 1 | 22,279 | 22,279 | 22,278.5 |  |  |  |  | 22,279 |
|  | TOTAL RECORDER TEMPERATURE ELECTRONIC | | | | 102,990 | - | 89,134 | - | 80,711 | 272,836 |
|  | INDICATORS FOR GEL TRANSPORT OF VACCINES FROM INTERMEDIATE LEVELS TO PERIPHERICS LEVELS | | | | | | | | | |
|  | MULTIPLIER |  |  |  | 6 |  | 6 |  | 6 |  |
| 1 | Freeze-tag | 1,500 | 4 | 6,510 | 39,060 | - | 39,060 | - | 39,060 | 117,180 |
| 2 | Customs Fees | 3 | 912 | 2,735 | 16,409 | - | 16,409 |  | 16,409 | 49,226 |
| 3 | Staff training | 1 | 22,279 | 22,279 | 22,279 |  |  |  |  | 22,279 |
|  | TOTAL FREEZE INDICATORS | | | | 77,747 | - | 55,469 | - | 55,469 | 188,684 |
|  | OTHER CHARGES | | | | | | | | | |
|  | MULTIPLICATEUR |  |  |  | 1 | 1 | 1 | 1 | 1 |  |
| 1 | Refrigerated truck maintenance | 757 | 5 | 3,785 | 3,785 | 3,785 | 3,785 | 3,785 | 3,785 | 18,923 |
| 2 | Biannual Monitoring | 13,933 | 2 | 27,866 | 27,866 | 27,866 | 27,866 | 27,866 | 27,866 | 139,332 |
|  | To review, validate and disseminate the SOPs | 10,524 | 1 | 10,524 | 10,524 |  |  |  |  | 10,524 |
|  | TOTAL OTHER CHARGES | | | | 42,175 | 31,651 | 31,651 | 31,651 | 31,651 | 168,779 |
|  | **TOTAL** | | | | **252,549** | **31,651** | **176,254** | **41,731** | **167,831** | **670016** |

**Table 5 :** Investment plan over 5 years.

# **COST-BENEFIT ANALYSIS AND PROGRAMMATIC BENEFITS**

## **Cost benefit analysis**

The analysis in this section uses a cost-benefit analysis (CBA) methodology to compare over the 5-year period the cumulative resources needed to establish an effective continuous temperature monitoring system for the entire country vaccine supply chain and the value of the vaccine at risk. The benefit in this study is defined as the financial value of the vaccines at risk at any given moment.

In this case study, the stock of the vaccines at any moment, at central and regional levels is considered as the stock of the vaccine in the supply chain. Table 6 provides the vaccines stock inventory (inventory of vaccines at central and regional stores) as of January 1st, 2018 and table 7 the estimated value of this stock of vaccines.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **BCG** | **bOPV** | **DPT-HepB-Hib** | **Rota\_liq** | **PCV-13** | **IPV** | **YF** | **MR** | **Td** |
| **CENTRAL STORE** | 189,400 | 1,550,000 | 33,600 | 546,400 | 799,050 | 261,000 | 739,780 |  |  |
| **ADAMAOUA** | 7,200 | 48,950 | 16,350 | 38,300 | 16,000 | 7,000 | 18,300 |  | 60 |
| **CENTRE** | 34,900 | 13,810 | 43,230 | 77,820 | 50,650 | 24,420 | 46,200 |  | 3,200 |
| **EST** | 11,000 | 9,500 |  | 14,400 | 15,500 | 4,800 | 9,700 |  |  |
| **EXTREME-NORD** | 56,800 | 12,030 | 24,450 | 109,500 | 58,500 | 35,360 | 63,200 |  |  |
| **LITTORAL** | 34,140 | 42,170 | 54,140 | 62,204 | 34,217 | 19,290 | 33,770 | 930 | 1,970 |
| **NORD** | 25,500 | 4,320 | 6,900 | 104,400 | 45,700 | 27,500 | 36,500 |  |  |
| **NORD-OUEST** | 23,300 | 82,780 | 17,260 | 41,400 | 28,350 | 16,500 | 25,100 |  | 6,040 |
| **OUEST** | 27,380 | 20 | 6,350 | 54,100 | 30,300 | 14,430 | 28,410 |  | 8,680 |
| **SUD** | 10,600 | 2,190 | 9,450 | 13,080 | 7,600 | 3,740 | 8,150 |  | 2,010 |
| **SUD-OUEST** | 31,500 | 10,800 | 28,850 | 55,068 | 33,200 | 16,350 | 28,770 | 2,000 |  |

**Table 6:** Inventory of vaccine stocks (in doses) as of January 1st 2018 at central and regional levels.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **BCG** | **bOPV** | **DPT-HepB-Hib** | **Rota\_liq** | **PCV-13** | **IPV** | **YF** | **MR** | **Td** | **TOTAL** |
| **Unit Cost** | 0.14 | 0.31 | 1.65 | 2.63 | 3.3 | 0.98 | 1.17 | 0.52 | 0.12 |  |
| **Dépôt central** | 26,516 | 480,500 | 55,440 | 1,437,032 | 2,636,865 | 255,780 | 865,543 | - | - | **5,757,676** |
| **ADAMAOUA** | 1,008 | 15,175 | 26,978 | 100,729 | 52,800 | 6,860 | 21,411 | - | 7.2 | **224,967** |
| **CENTRE** | 4,886 | 4,281 | 71,330 | 204,667 | 167,145 | 23,932 | 54,054 | - | 384 | **530,678** |
| **EST** | 1,540 | 2,945 | - | 37,872 | 51,150 | 4,704 | 11,349 | - | - | **109,560** |
| **EXTREME-NORD** | 7,952 | 3,729 | 40,343 | 287,985 | 193,050 | 34,653 | 73,944 | - | - | **641,656** |
| **LITTORAL** | 4,780 | 13,073 | 89,331 | 163,597 | 112,916 | 18,904 | 39,511 | 484 | 236 | **442,831** |
| **NORD** | 3,570 | 1,339 | 11,385 | 274,572 | 150,810 | 26,950 | 42,705 | - | - | **511,331** |
| **NORD-OUEST** | 3,262 | 25,662 | 28,479 | 108,882 | 93,555 | 16,170 | 29,367 | - | 725 | **306,102** |
| **OUEST** | 3,833 | 6.2 | 10,478 | 142,283 | 99,990 | 14,141 | 33,240 | - | 1,042 | **305,013** |
| **SUD** | 1,484 | 679 | 15,593 | 34,400 | 25,080 | 3,665 | 9,536 | - | 241 | **90,678** |
| **SUD-OUEST** | 4,410 | 3,348 | 47,603 | 144,829 | 109,560 | 16,023 | 33,661 | 1,040 | - | **360,473** |
| TOTAL | 63,241 | 550,737 | 396,957 | 2,936,847 | 3,692,921 | 421,782 | 1,214,320 | 1,524 | 2,635 | **9,280,964** |

**Table 7 :** Value of the vaccine stocks in the supply chain

The estimated total value of the vaccines in the supply chain (inventory at central and regional level on January 2018) is: 9280964 USD

The investment to date to establish the current status of the temperature is estimated at $213786

The investment cost to date represents only 2.3% of the value of the stock of vaccines (2018 stock value).

The total additional cost to upgrading the temperature monitoring system over the next 5 years period is estimated at $670016. The total investment (the initial investment to date and the additional investment) over the 5 years amount to $883802. This represents 9.5% of the value of the stock of vaccines (2018 stock value)

The value of the cost-benefit ratio calculated above suggest that such an investment would be a good value for money.

The table below presents the cost benefice ratio to upgrade and sustain the establishment of an optimal temperature monitoring in the country for the next 5 years period

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **Year 1** | **Year 2** | **Year 3** | **Year e 4** | **Year 5** |
| **Current investment (to date)** | 213,786 |  |  |  |  |  |
| **Projected additional funding to upgrade to optimal and sustain over 5 years period** |  | 252,549 | 31,651 | 176,254 | 41,731 | 167,831 |
| **Cumulated investments** |  | 466,335 | 497,986 | 674,240 | 715,971 | 883,802 |
| **Total value of vaccines in the supply chain (2018)** |  | 37,679,040 | 37,679,040 | 37,679,040 | 37,679,040 | 37,679,040 |
| **Cost -benefit ratio** |  | 0,01 | 0,01 | 0,02 | 0,02 | 0,02 |
| **Cost-benefit ratio in percentage** |  | 1,2% | 1,3% | 1,8% | 1,9% | 2,3% |

**Table 8:** Cost-benefit ratios over 5 years.

According to this table, by investing 1.2% of the total value of vaccines during the first year, the country will established an optimal temperature monitoring system (full filling the requirements…) in all segments of the cold chain capable to ensure the quality of the vaccines during storage and transportation.

The value of the total investment increased to 2.3% of the total value of the vaccines in the supply chain in the fifth year; this value seems to increase from one year to another because the total value of vaccines is fixed throughout the 5 years.

In the reality, the value of the vaccines in the supply chain is expected to increase from one year to another since the target population and/or coverage objectives keep rising, but also because of the introduction of new vaccines that increase the amount of vaccines in the cold chain; in addition the analysis did not take into consideration the stocks of vaccines at peripheral level.

## **Programmatic benefits of establishing an optimal temperature monitoring system**

Exposure to non-recommended temperatures is a major cause of loss of unopened vaccine vials. Such losses of unopened vials of vaccine always indicate a weakness somewhere within the supply chain.

In Cameroon, no study exists on vaccine wastage, so there is no evidence available on the level or the profile of wastage. However, in a context where the temperature monitoring system is suboptimal, the lack of information on the quality of the vaccine conservation does not mean a lack of vaccine exposure to adverse temperatures.

Table 11 below illustrates scenarios and their consequences on the EPI program performance. The risk of occurrence of the above situation is described in the following table depending on the performance of the monitoring system.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Scenario | Level of investment | CONSEQUENCES | | |
|  |  | Risk of exposure of vaccines to unknown/ damaging temperatures | Potential losses of vaccines | Impact on the Program |
| **Do nothing scenario:**  No temperature monitoring established | No investment to establish a continuous temperature monitoring | Total lack of information on the quality of vaccine during storage and transportation in the supply chain | Very high | Stock / balance (excluding losses) may be insufficient to reach the target,  High cost of the potential stock loss  Target may be vaccinated with non-potent vaccines: (target vaccinated but not immunized)  Trust in the program may be eroded |
| **Intermediary scenario:** Suboptimal temperature Monitoring | Partial investment for temperature monitoring | Partial information available on storage and transportation quality; weaknesses exist in some segments of the supply chain | High to Very high | Stock / balance (excluding losses) may be insufficient to reach the target,  High cost of the potential stock loss  Target may be vaccinated with non-potent vaccines: (not immunized)  Trust in the EPI program may be eroded |
| **Required scenario**: Continuous temperature monitoring is established | Optimal investment for continuous temperature monitoring | Complete information available on time on the quality of vaccines during storage and transportation; can trigger corrective actions on time | Nil to very low | Target population vaccinated with potent vaccines (and immunized)  Trust of population in the EPI program is high |

**Tableau 9:** Summary of the impact assessment

Although the improved continuous temperature monitoring in Cameroon is not yet optimal, the country provided numerous efforts, the commitment level of funding in the project remains low compared to the value of vaccines that the country must secure because the amount of vaccine used here is a stock at a time, larger quantities are moving in the supply chain program.

# **STUDY LIMITATIONS**

The main limitation of this study is the difficulty to directly correlate the weakness or absence of continuous monitoring of temperature to a defined risk of losing unopened vaccine vials.

A specific study on the vaccines wastage rates would have been a good basis, to establish a link; unfortunately, such a study has never been conducted in the country.

The stock of vaccines in the supply chain used in this study for the cost-benefit analysis takes into account only the stock at central and intermediate level and is assumed to be constant over the 5 years, although in reality, larger quantities of vaccine will transit through the vaccine supply chain over the 5 years’ period considered for the cost analysis. This limitation however confirms the effectiveness of investing to establish a continuous temperature monitoring system.

# **CONCLUSION**

According to a literature review by Matthias et al. and Hanson and al., in low- and middle-income countries, vaccines are exposed to damaging temperatures in the vaccines supply chain; e.g. 19.3% of shipments present a risk of exposure to freezing temperatures during transport. Although there is not a study linking directly the inadequacy or absence of a continuous monitoring system of temperature to a possible loss of vaccines, continuous temperature monitoring that informs and/or alerts to potential damage and triggers appropriate measures to correct the situation in a timely manner is strongly recommended in WHO and EVM guidelines for vaccine storage and transportation.

Concrete steps consist in the implementation include specifically:

• Installation of appropriate monitoring equipment at each level and each segment of the supply chain,

• Training in the use of such equipment

• Implementation of appropriate standard operating procedures,

• Data management / analysis and effective feedback.

This study analyzed first the performance of the current monitoring system across the entire segments and levels of the supply chain; the gaps that need to be fulfilled to upgrade the entire temperature monitoring system and additional investment are identified.

Using the CBA methodology, the incidence of funding to establishing an effective continuous temperature monitoring system was analyzed over a 5-year time period by comparing over the 5-year period the cumulative resources needed to implement the optimal continuous temperature monitoring in all the segment of the vaccine supply chain to the value of the vaccine at risk.

The present study shows that by investing to implement the WHO/EVM recommendations as minimum standards, a country put itself on safe zone to avoiding loss of vaccines or use of non-potent vaccines due to temperature damage in the supply chain. Minimum resources needed to establishing an effective continuous temperature monitoring system average around 1.5% to 3% of the total cost of the vaccine at risk; however this funding level will vary depending on the choice of equipment, the country’s strategic decisions/policies with regards to the temperature monitoring and the logistics management in general.

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# ANNEXES

Annex 1: List of people interviewed

|  |  |  |  |
| --- | --- | --- | --- |
| **N°** | **Structure** | **Last and First names** | **Function** |
| 1 | GTC-PEV | NSANGOU Charles | SPA |
| 2 | GTC-PEV | VOUKING Marius | Logistic Manager |
| 3 | GTC-PEV | AVINA Sandrine | Warehouse Manager |
| 4 | UR-PEV Adamaoua | AZOUGO HIRI Emmanuel | Regional Logistician |
| 5 | UR-PEV Centre | ASSOMO OMGBA Christelle | Regional Logistician |
| 6 | UR-PEV Littoral | DIKONGUE Sipora Nelly | Regional Logistician |
| 7 | UR-PEV Sud | MOUKOUOK BIAKONG Bertrand | Regional Logistician |
| 8 | UR-PEV Sud-ouest | MBIDA NDI Daniel | Regional Logistician |
| 9 | DS Meiganga | BELLO Jean | EPI focal Point |
| 10 | DS N’Gaoundéré Urbain | MOHAMADOU Yaya | Logistic officer |
| 11 | DS Mfou | BIKOULA Yves Martin | EPI focal Point |
| 12 | DS Cité Verte | NGO BILONG Berthe Anne | EPI focal Point |
| 13 | DS Ambam | OWONO Serges Landry | EPI focal Point |
| 14 | DS Ebolowa | AVOMO Nathalie | Logistic officer |
| 15 | DS Edea | TJANDA Adalbert Irenée | Chief Health office |
| 16 | DS Buea | Laura NINI KUMI WANTIM | EPI focal Point |
| 17 | DS Limbe | TABE Lucie Engomi | Logistic officer |

Annex 2 : Interview Guide

**EVALUATING THE PROGRAMMATIC AND FINANCIAL BENEFITS OF IMPLEMENTING AN EFFECTIVE SYSTEM OF TEMPERATURE CONTROL IN THE COLD CHAIN: INTERVIEW GUIDE**

1. **RESPONSIBILITIES AND PROCESS**

Who is responsible for assessing needs for continuous temperature monitoring equipment?

Last and first names: ………………………………………………………………………………………………………………………….

Contact Phone/ email: ………………………………………………………………………………………………………………….......

Describe the needs assessment process:

……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….

Who is responsible for purchasing orders for continuous temperature monitoring equipment?

Last and first names……………………………………………………………………………………..

Contact Phone/ email :…………………………………………………………………………….......

Describe the process for placing orders:

……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….

Who is responsible for equipment selecting for the continuous monitoring of the temperature?

Last and first names……………………………………………………………………………………..

Contact Phone/ email :……………………………………………………………………………….......

Give the criteria for selecting equipment:

……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….

Who is responsible for receiving the equipment on arrival?

Last and first names……………………………………………………………………………………..

Contact Phone/ email :……………………………………………………………………………….......

Who is responsible for monitoring continuous temperature monitoring equipment at the central level?

Last and first names……………………………………………………………………………………..

Contact Phone/ email :……………………………………………………………………………….......

Describe the process of monitoring equipment:

……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….

Who is responsible for the collection and analysis of temperature data at central level (National Data Review)?

Last and first names……………………………………………………………………………………..

Contact Phone/ email :……………………………………………………………………………….......

Describe the data collection process:

……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….

Describe the data analysis process:

……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….

Is a feedback data analysis given to health facilities?

Yes  No

Who is responsible for transporting vaccines to regional / departmental stores??

Last and first names……………………………………………………………………………………..

Contact Phone/ email :……………………………………………………………………………….......

1. **PLANNING**

What motivated the country to deploy / improve routine monitoring of temperature and into policy and program objectives?

……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………...

What is the vision of the Program for continuous monitoring of the temperature?

………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………

Describe the plan deployment of temperature monitoring equipment (small-scale or national?)

………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………

Is there a scale deployment plan?

Yes No

If so what is its level of implementation?

……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….

Is there a specific budget program dedicated to monitoring of the temperature?

Yes No

If so, provide a copy of this budget:

What are the current sources of funding for monitoring of the temperature?

………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………..

If state funding: are these funds made directly available to the program? ?

Yes No

Describe the supply process for temperature monitoring equipment:

……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………...

What date monitoring equipment was installed in the country?

………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………..

Did the program update temperature monitoring SOPs after installation?

Yes No

Has it already made revisions to these SOPs?

Yes No

If yes how many times? (Period between 2 revisions)

1. **ACQUISITION AND INSTALLATION**

As for the cold chain, did it for political buy only pre-qualified equipment by WHO? ……………………………………………………………………………………………………………………

Did we buy sufficient temperature control devices for the whole equipment of the cooling and transportation equipment chain and for replacements?

Yes No

How many continuous temperature monitoring equipment controls the country goes in one year (reference year 2017)?? …………………………………………………………………………..

Who is responsible for the installation of continuous monitoring equipment to the temperature at all levels the health pyramid?

…………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………......

1. **LOGISTICS AND MAINTENANCE**

Was a temperature control study conducted in the country?

Yes No

The temperature control devices are they distributed and lit by rigorously ensuring that those whose expiry date is closest to the be first, so as to prevent them from being prematurely obsolete? Yes No

Is there a procedure suitable for the disposal and replacement in good conditions of devices including integrated battery is empty and this procedure is it respected? Yes No

What is the date of the last update continuous monitoring of temperature SOP?

……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….

The Country Has it in the past, lost vaccines because of the weakness / lack of continuous monitoring of the temperature?

Yes No

If yes, specify quantity: …………………………………………………………………………………………………...

………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………..

1. **TRAINING AND SUPERVISION**

Has it implemented the continuous monitoring of temperature SOP in all schools?

Yes No

Is the staff trained in the use of these SOPs?

Yes No

The staff, at all levels of the health pyramid, has he been trained in the use of continuous monitoring equipment to the temperature?

Yes No

If so what were the topics modules?

* Thermal sensitivity of vaccines and their proper storage temperature?
* The risk of freezing methods to prevent freezing and how to recognize that a vaccine has been damaged by a shake test?
* How to use temperature control devices?
* How to behave in case of temperature deviation or alarm?

The educational material and training sessions are they systematically updated to include information on new developments in vaccines and temperature control devices?

Yes No

How supervision of the temperature monitoring the country conducted in 2017?

……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….

Annex 3 : Data collection Tool- Level of vaccines deposits

**EVALUATION OF THE IMPLEMENTATION OF AN EFFECTIVE TEMPERATURE MONITORING SYSTEM IN THE VACCINE COLD CHAIN: PROGRAMMATIC AND FINANCIAL BENEFITS: SURVEY DATA COLLECTION (deposits Level vaccines).**

|  |  |  |  |
| --- | --- | --- | --- |
| 1. **IDENTIFICATION OF STORE** | | | |
| Région : | D : | ZS : | FOSA : |
| Number of cold room: | | Number of freezer : | |
| Number of refrigerator : | | Temperature control Equipement used :  -  -  -  -  - | |
|  | |
|  | | | |

1. **RESPONSABILITIES AND PROCESS**

Who is responsible for assessing needs continuous temperature monitoring equipment?

Last and first names……………………………………………………………………………………..

Contact Phone/ email :……………………………………………………………………………….......

Describe the needs assessment process:

……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….

Who is responsible for orders placement for continuous monitoring equipment for temperature control?

Last and first names……………………………………………………………………………………..

Contact Phone/ email :……………………………………………………………………………….......

Describe the process for placing orders:

……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….

Who is responsible for receiving the equipment on arrival?

Last and first names……………………………………………………………………………………..

Contact Phone/ email :……………………………………………………………………………….......

Who is responsible for monitoring continuous monitoring equipment to the temperature at the store?

Last and first names……………………………………………………………………………………..

Contact Phone/ email :……………………………………………………………………………….......

Describe the process of monitoring equipment:

……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….

Who is responsible for the analysis of temperature data at the store?

Last and first names……………………………………………………………………………………..

Contact Phone/ email :……………………………………………………………………………….......

Describe the data analysis process:

……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….

Is a feedback data analysis is done to the health structures of the lower level?

Yes No

1. **PLANNING**

When does the continuous monitoring equipment temperature were installed in the CDF deposit?

……………………………………………………………………………………………………………………………………………

Since the installation, he has used this deposition equipment without interruption?

Yes: No

If not: estimate the duration (s) interruption (s): …………………………………………………………………………………………………………….……………………………………………………………………………………………………………………………………………………………………………………………………………

Does the store has a continuous monitoring of temperature SOP update?

Yes: No

What is the date of the last update continuous monitoring of temperature SOP?

…………………………………………………………………………………………………………………………………………………………….

Is there a procedure suitable for the disposal and replacement in good conditions of devices including integrated battery is empty and this procedure is respected? NO

………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….

1. **DATA MANAGEMENT**

Temperature control data are they identified and recorded at each arrival of vaccines? Yes: No :

…………………………………………………………………………………………………………………………………………………………….

Is the temperature measured and recorded twice daily and seven times a week at each equipment of the cold chain where vaccines are stored?

Yes: No

…………………………………………………………………………………………………………………………………………………………….

Temperature readings displayed outside of each equipment of the cold chain?

Yes No

…………………………………………………………………………………………………………………………………………………………….

Are temperature differences in the data available to the right people so that problems can be analyzed and resolved? Yes: No

When there is wastage of vaccines, the causes are they recorded and analyzed?

Yes: No

Are temperature control data summarized, archived (for at least three years) and analyzed at least once a month at district / county and national?

Yes: No

Is there any analysis of deposition temperature data reports with recommendations and corrective actions?

Yes : No

1. **TRAINING, SUPERVISION AND TRANSPORT**

Has he staff was trained in the installation and use of continuous monitoring equipment to the temperature?

 Yes: No

If so what were the topics modules?

* Thermal sensitivity of vaccines and their proper storage temperature?
* The risk of freezing methods to prevent freezing and how to recognize that a vaccine has been damaged by a shake test?
* How to use temperature control devices?
* How to behave in case of temperature deviation or alarm?

……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….

What is the date of the last supervision of the continuous monitoring of the temperature in the upper level?

…………………………………………………………………………………………………………………………………………..

In cold rooms and freezer rooms: is there a thermal mapping?

Yes: No

Is there been repairs since the last map?

What are the arrangements for transporting vaccines to the lower level?

………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….

The temperature control devices are they distributed and lit by rigorously ensuring that those whose expiry date is closest to the be first, so as to prevent them from being prematurely obsolete? Yes : No

The store has he in the past, lost vaccines because of the weakness / lack of continuous monitoring of the temperature?

Yes : No

If so, specify the period and quantity ………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….

Is the emergency plan available and displayed?

Yes No

Personnel responsible for continuous monitoring of temperature he mastered this plan?

Yes No

Are they continuously monitoring the temperature of SOPs available and accessible to appropriate personnel?

Yes No

Is there a charge of manual temperature reading?

Yes No

Indicate the hours of temperature reading:

Morning: In the afternoon :

Annex 4 : Financial data collection

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **INVESTMENT TABLE** | | | | |
|  |  |  |  |  |
| **N°** | **Labels** | **Unit cost** | **Quantity** | **Total amount** |
|  | INITIAL INVESTMENT | | | |
| 1 |  |  |  |  |
| 2 |  |  |  |  |
| 3 |  |  |  |  |
| 4 |  |  |  |  |
| 5 |  |  |  |  |
| 6 |  |  |  |  |
| 7 |  |  |  |  |
| 8 |  |  |  |  |
| 9 |  |  |  |  |
| 10 |  |  |  |  |
| Total initial investment | |  |  |  |
|  | EXPANSION INVESTMENT | | | |
| 1 |  |  |  |  |
| 2 |  |  |  |  |
| 3 |  |  |  |  |
| 4 |  |  |  |  |
| 5 |  |  |  |  |
| 6 |  |  |  |  |
| 7 |  |  |  |  |
| 8 |  |  |  |  |
| 9 |  |  |  |  |
| 10 |  |  |  |  |
| Total expansion investment | |  |  |  |
|  | RENEWAL INVESTMENT | | | |
| 1 |  |  |  |  |
| 2 |  |  |  |  |
| 3 |  |  |  |  |
| 4 |  |  |  |  |
| 5 |  |  |  |  |
| 6 |  |  |  |  |
| 7 |  |  |  |  |
| 8 |  |  |  |  |
| 9 |  |  |  |  |
| 10 |  |  |  |  |
| Total renewal investment | |  |  |  |
|  | INVESTISSEMENT GENERATED BY EXPLOITATION | | | |
| 1 |  |  |  |  |
| 2 |  |  |  |  |
| 3 |  |  |  |  |
| 4 |  |  |  |  |
| 5 |  |  |  |  |
| 6 |  |  |  |  |
| 7 |  |  |  |  |
| 8 |  |  |  |  |
| 9 |  |  |  |  |
| 10 |  |  |  |  |
| Total investissement generate by exploitation. | |  |  |  |
| **TOTAL INVESTMENT** | |  |  |  |

1. It is worth noting that regardless of the temperature monitoring device used, temperatures in fixed storage locations should continue to be recorded manually twice a day, seven days a week in large vaccine stores and at least five days a week in smaller subnational vaccine stores and health facilities. Recording temperatures twice daily manually ensures that there is a staff member tasked with monitoring cold chain equipment performance and who can act to resolve issues quickly [↑](#footnote-ref-1)