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Challenges in the vaccine supply chain in Cameroon

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Abstract

Objective: To present the challenges of the vaccine supply chain in Cameroon. **Methodology**: This is a pile triage type of desk research, carried out in Cameroon within the Expanded Programme on Immunization from December 2023 to August 2024. The data was collected using the Standard Logistics Management Assessment Tool . **Results**: 85.71% of the cold rooms were functional and in good condition. To transport the vaccines, the EPI had four vehicles. The State and partners have shared the financing of vaccines, so that some vaccines are financed either by the State or by partners; while others benefit from State-Partner co-financing. Regarding financing, the State has a budget line allocated each year for this purpose, but the mobilization of these funds is not always effective. **Conclusion**: The challenges were marked by insufficient transport capacity and the low financial resources allocated by the State to supply chain activities.

Keywords*: EPI, vaccines, supply chain*.

I. Introduction

According to WHO, vaccines are an integral part of primary health care and one of the foundations of global health security [1]. Yet, despite considerable progress, nearly 20 million infants each year do not have sufficient access to vaccines [2]. Thus, one of the objectives of the Global Immunization Action Plan (GMAP) to 2030 is to ensure quality supply chains for vaccines and related products and effective vaccine management, as part of the primary health care delivery system [3]. Indeed, vaccines must be delivered to areas that are geographically, culturally, socially isolated and to marginalized populations as well as to people affected by conflict, political instability and natural disasters [4]. The vaccine supply chain is therefore an essential part of immunization programs, ensuring that vaccines reach target populations safely and in a timely manner [5]. A vaccine supply chain that can meet the present and future needs of the population is therefore a major challenge on a global scale, but even more so in developing countries. In Cameroon, while there is substantial political will and international support, ensuring equitable access to vaccines and ensuring the sustainability of the vaccine supply chain remains a concern. This study therefore looked at human resources, material resources, maintenance, means, devices, equipment, allocated budget, sources of supply and prices of vaccines as variables.

II. Methodology

This was a literature search of the pile sorting type. This type of study was chosen to collect factual and existing data from the strategic documents. The study was carried out in Cameroon, in the Centre Region within the Expanded Programme on Immunization for eight (08) months from December 2023 to August 2024. The target population consisted of the strategic documents for the supply of vaccines in Cameroon while the source population consisted of the strategic documents for the vaccine supply of the Expanded Programme on Immunization. Any policy document developed by the EPI between 2018 and 2024 that did not address aspects of the vaccine supply chain was excluded. It was therefore a question of an exhaustive type of sampling. The data was collected using the Standard Logistics Management Assessment Tool (SLMO) developed by the USAID project to assess the supply chain [6]. The analysis of the collected data was done using a color code, at the base of the dimension matrix and manually.

III. Results

1. Study population

The study population consisted of the following strategic and programmatic documents:

- The National Strategic Plans (NSPs) of the EPI. They contained the general objectives and the set of actions and strategies that facilitated the acquisition, use and allocation of resources to achieve the stated objectives. We have used the 2021-2023 Comprehensive Multi-Annual Plan

(PPAC) and the 2024-2028 National Vaccination Strategy;
- Annexes to national strategic plans. The 2018 EPI norms and standards, the 2022 procedures manuals;
- The 2019, 2020, 2021, 2022 and 2023 Annual Reports;
- The weekly presentations of the coordination meetings in March, April, May, June and July.

2. Cold chain equipment

Vaccines are fragile biological products. While some are sensitive to freezing, others are sensitive to heat or light. To maintain the quality of the vaccines, the EPI had 7 positive cold rooms (ChF Pos) and 3 negative cold rooms (ChF Nég). The elements of the technical sheet of this cold chain equipment are recorded in the following table.

Table I: Technical Data Sheet of the EPI Cold Chain Equipment

ECF	Marque	Capacité brute (litres)	Date de mise en service	Etat de fonctionnalité
ChF_Pos_N°1	Haier	40 000	09/04/2022	Marche bien
ChF Pos N°2	Haier	40 000	09/04/2022	Marche bien
ChF Pos N°3	Zhendre	40 000	10/02/2023	Marche bien
ChF Pos N°4	Zhendre	40 000	10/02/2023	Marche bien
ChF Pos N°5	Zhendre	40 000	10/02/2023	Marche bien
ChF_Pos_N°6	Zhendre	30 000	05/2016	Marche bien
ChF Pos N°7	Zhendre	30 000	05/2016	Non fonctionnelle
ChF Nég N°1	Zhendre	20 000	05/2016	Marche bien
ChF Nég N°2	Zhendre	20 000	02/2024	Marche avec besoin de réparation
ChF Nég N°3	Zhendre	20 000	02/2024	Non fonctionnelle

85.71% of the cold rooms were functional and in good condition. In addition, for the maintenance of this equipment, the staff responsible for the cold chain monitored the preservation equipment on a daily basis and an external maintenance team ensured the semi-annual maintenance.

3. Temperature control

Temperature monitoring was also an element to be taken into account. To do this, temperature control devices were used for the storage but also for the transport of the vaccines as shown in the figure below.

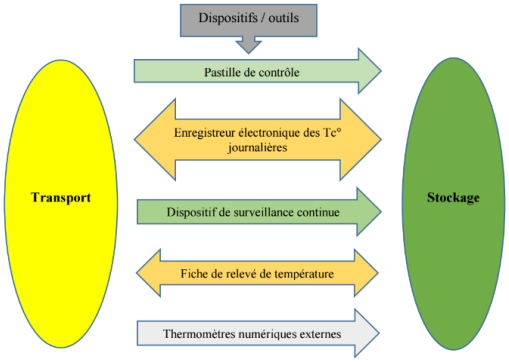


Figure 1: Temperature monitoring

The monitoring devices were installed inside and outside the cold rooms and made it possible to record temperature fluctuations (temperature excursion, high or low alarms). Temperatures were also recorded manually twice a day from the external digital thermometers. A contingency plan was also drawn up in anticipation of crisis situations that could arise in the operation of the cold chain.

4. Storage

With regard to the method of storage, apart from the FEFO method, vaccines were also classified according to their sensitivity to heat.

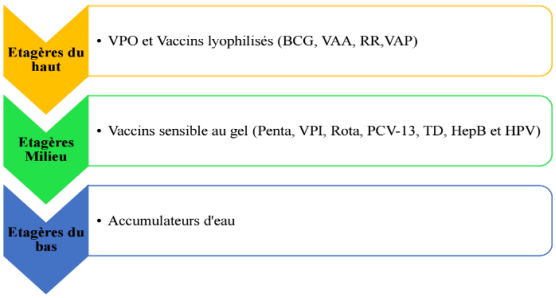


Figure 2: Vaccine Storage

5. Vaccine distribution

- The delivery circuit

The organization of transport is an integral part of the overall cold chain configuration and must be well planned and executed. A distribution plan was drawn up according to the needs of the regions and according to a cyclical shipping schedule every 3 months.

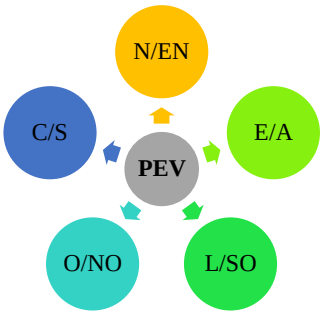
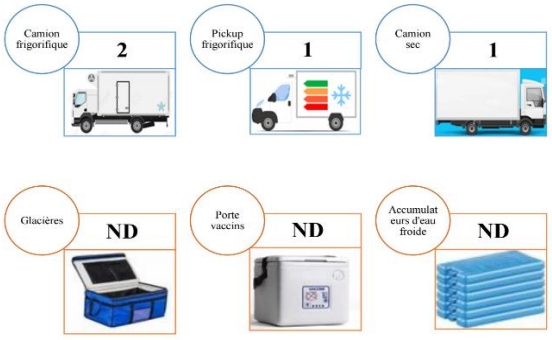


Figure 3: EPI delivery routes

The EPI had five delivery axes, namely Centre-South, West-North-West, Littoral-South-West, East-Adamawa and North-Far North.

- Transportation

To ensure the transport of the vaccines, the EPI had four vehicles, 3 of which were refrigerated. In addition to the rolling stock, the vaccines were placed in coolers and/or vaccine racks in which there were cold accumulators.



ND /UD : Undefined

Figure 4: Equipment used for vaccine distribution

During distribution, in addition to checking the status of the PCV and the expiration dates of each type of vaccine, the release of the vaccines complied with the FEFO rule with a prioritization of those with a PCV status close to the point of discharge.

6. Vaccine financing

Funding for vaccine supply chain activities came from the state on the one hand and partners on the other.

- Vaccines and their sources of funding

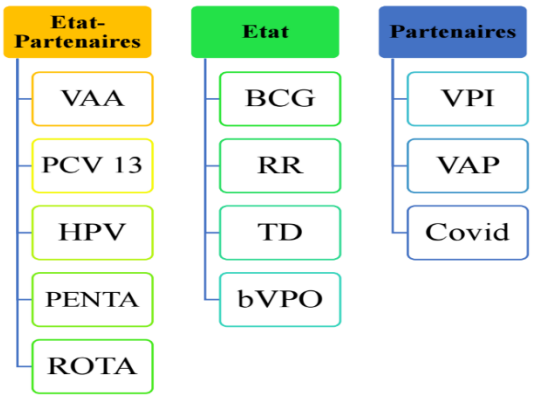


Figure 5: Sources of funding by vaccine

The State and partners have shared the financing of vaccines, so that some vaccines are financed either by the State or by partners; while others benefit from State-Partner co-financing, as shown in the figure above.

- The annual vaccine budget

According to the 2024 annual report of the Expanded Programme on Immunization [7], the budget required for the implementation of vaccine supply chain activities in Cameroon was estimated at 31,516,897,993 FCFA broken down by component according to the following distribution:

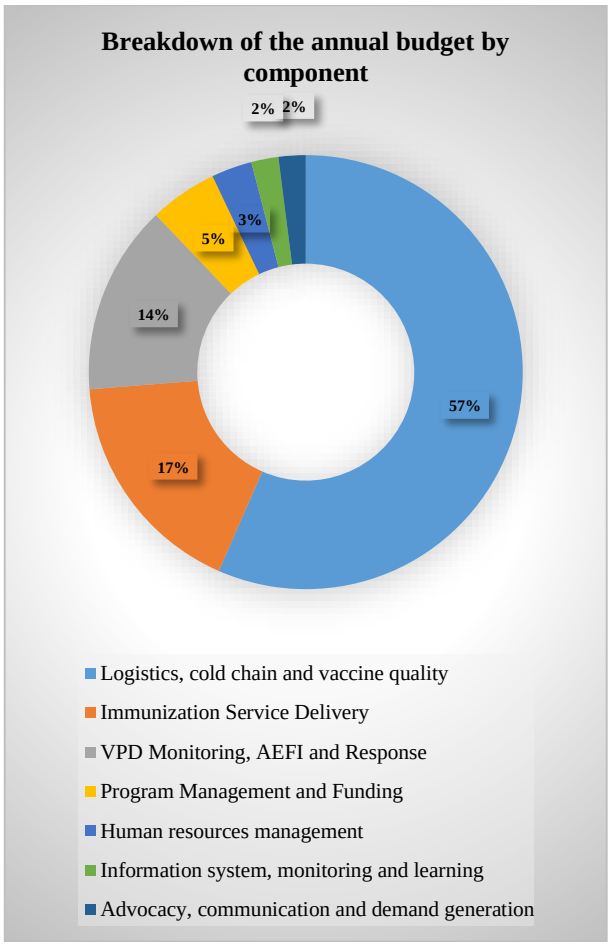


Figure 6: Annual EPI budget by component

There are 7 components for which 57% of the annual budget was allocated to logistics and cold chain; 17% to the provision of vaccination services; 14% to the monitoring of AEFIs and VPDs; 5% to the management of programmes and funding; 3% to human resources management; 2% for the information system and 2% for advocacy.

- The annual budget by source of funding

The financing of vaccines involves several actors, including the State and certain partners. As far as the State is concerned, a budget line is allocated each year for this purpose, but the mobilisation of these funds is not always effective. Partners include GAVI, CHAI, WHO, CDC and UNICEF. The breakdown of this funding is illustrated in the figure below.

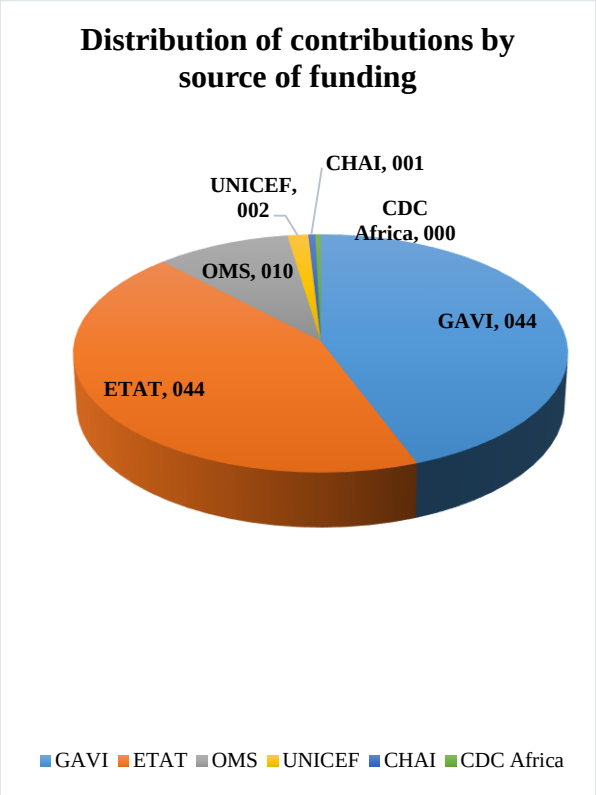


Figure 7: Contributions by Vaccine Funding Source

We note that GAVI finances 44.30% of vaccine supply chain activities, followed by the State with 43.70%. The WHO follows with 9.70%, then UNCEF with 1.50%, CHAI with 0.50% and finally CDC Africa with 0.40%.

Vaccine procurement for routine activities was mostly funded by partners. For supplementary immunization activities, vaccine procurement was fully funded by partners.

IV. Discussion

Limitations of the study

This work has limitations specific to qualitative research and to any knowledge review. At the time of data collection, some of the program's normative and policy documents were under review. An update of this work would therefore be necessary to maintain its relevance in the long term. Finally, although verbal authorizations were given, the main constraint was the delay in granting written authorizations, signed by the MINSANTE, which were not made available during the data collection phase.

Supply chain challenges

Expanded immunization programmes have introduced incremental and often much-needed improvements in the supply chain, such as investing in increased storage capacity or outsourcing transport. However, such coping mechanisms do not solve the underlying structural problems. New approaches need to rethink the entire supply chain system, taking into account distribution and inventory management policies, as well as the changing role of information systems and supply chain managers.

The effectiveness of vaccines depends largely on maintaining optimal storage conditions and applying appropriate handling and transport practices. A vaccine may be reduced in effectiveness in whole or in part, if it is exposed to excessive temperatures, whether too high or too low, potentially resulting in the need to discard it [8]. Over the past 30 years, the cost per person for vaccination has increased sixfold. However, investments in supply chain systems have remained constant, with a primary focus on cold chain equipment. Gavi, the Vaccine Alliance, estimates that around US$280 million per year is needed to meet supply chain needs in resource-constrained countries [9].

To maintain the quality of vaccines, it is important to use a cold chain that satisfies the recommended temperature ranges. The EPI had seven (7) positive cold rooms and three negative cold rooms with a total capacity of 320,000 litres. From a quantitative point of view, this capacity is sufficient for the storage of all vaccines. In Burkina Faso, EPI vaccines were stored centrally in 10 cold rooms with a total net capacity of 108,000 liters [61], which is far below the results obtained in EPI Cameroon. The cold rooms were rather functional and in good condition: 6/7 (85.71%) for the positive ones and 1/3 (33.33%) for the negative ones. In addition, for the maintenance of this equipment, the staff responsible for the cold chain monitored the preservation equipment on a daily, weekly and monthly basis, and an external maintenance team provided semi-annual maintenance. This result does not corroborate that of Mali, where functional and healthy cold chain equipment accounted for only 56% [10]. This difference could be explained by the fact that more than half of this equipment is more than 5 years old, therefore obsolete with frequent breakdowns and is in a depreciation process, which can lead to a reduction in the net volume available for storage.

The temperature at which vaccines are subjected must be monitored, recorded and communicated throughout the supply chain, from the manufacturer to the place of vaccination. To achieve this, States should define appropriate policies and standard operating procedures and also provide adequate training, tools, supervision and resources for the implementation of these policies [11].

In this study, the monitoring devices were installed inside and outside the cold rooms and were used to record temperature fluctuations. These were the fridge tags and the Beyond Wireless device for remote temperature control with digital notification.

Temperatures were also recorded manually twice a day from the external digital thermometers. This operation has been found in Burkina Faso where the central cold chain was equipped with a remote temperature monitoring device with an SMS sent in the event of an alarm [9]. These results are appreciable. Indeed, vaccine temperature control devices have a significant positive impact on immunization services and public health by ensuring vaccine efficacy, reducing losses, building public confidence, and contributing to the prevention of epidemics. They also enable more effective management of resources, support the expansion of immunization programs, and strengthen the capacity of health systems. A contingency plan was drawn up in anticipation of crisis situations that may arise in the operation of the cold chain.

For the storage method, the FEFO method was used and the vaccines were also classified according to their sensitivity to heat, according to the procedures manual. By following the FEFO method, vaccines are used before their expiration date, reducing the waste of expensive doses. This allows for better use of financial resources, with savings that can be reinvested in other aspects of immunization services and even the supply chain. By minimizing losses, both methods ensure that vaccines are used optimally, which is crucial for maintaining high vaccination rates and preventing outbreaks.

The means of transport used are not always suitable for the transport of fragile products such as vaccines, and it is therefore necessary to take certain precautions to avoid the loss of products [12]. Indeed, it is important to evaluate means of transport according to the quality requirements of health products, the maintenance of their effectiveness and the conditions required. As in the case of storage, distribution plays a major role in the healthcare logistics system. Distribution consists of moving products from the national central warehouse until they are delivered to end users. However, to maintain a well-functioning distribution system, punctuality of distribution must be taken into consideration, as the uninterrupted availability of vaccines in health facilities depends on it. After an investigation, it emerged that the EPI ensured the distribution of all vaccines to the regions according to a well-defined distribution plan every 3 months. The EPI had 5 delivery axes. During distribution, in addition to checking the status of the PCV and the expiration dates of each type of vaccine, the release of the vaccines complied with the FEFO rule with a prioritization of those with a PCV status close to the point of discharge.

To ensure the transport of the vaccines, the EPI had four vehicles, 3 of which were refrigerated, and periodically resorted to the rental of refrigerated trucks to reinforce this activity. In Burkina Faso, the central level had a functional refrigerated truck, two non-functional pick-up type refrigerated vehicles and two functional 20T trucks to support health regions in the supply of vaccines and vaccination consumables [9]. In Benin, for the delivery of vaccines and consumables, there were two trucks (one dry and one refrigerated) acquired in 2014 and 2015 respectively [13]. And finally in Côte d'Ivoire, the distribution of vaccines was carried out by 6 refrigerated trucks, 2 of 16 m3 each, 2 of 22 m3 each and 2 of 12 m3 each; and 6 utility trucks of 40 c m3 each for the distribution of consumables [14]. These results provide information on the impact of the organization and rolling stock for the transport of vaccines. Indeed, in resource-limited settings, transport vehicles must be equipped to maintain the cold chain. In remote or underserved areas, effective distribution helps reduce health inequities. This contributes to more equitable vaccination coverage, which is essential to prevent epidemics throughout the population. Also, in some regions, the road network can be in poor condition, complicating the distribution of vaccines involving the use of specially adapted vehicles.

According to WHO, the accessibility and availability of medicines must be supported by sustainable financing. A public health program must establish strategies to ensure a sustainable source of funding to meet the needs of the population. All EPI vaccines used under WHO-recommended schedules typically cost less than US$1.

In the present research, vaccine funding was distributed as follows: 4/12 (33%) for fully state-funded vaccines; 5/12 (42%) for co-funded vaccines and 3/12 (25%) for partner-funded vaccines. In 2019 in Chad, funding was 4/8 for vaccines fully funded by the state; 3/8 for co-financed vaccines and 1/8 for GAVI-funded vaccines [15]. Similarly, in 2019 in Côte d'Ivoire, funding was 4/10 for vaccines fully funded by the State; 5/10 for co-funded vaccines and 1/10 for GAVI-funded vaccines [16]. In Kenya, the proportions were 4/11 for fully state-funded vaccines; 5/11 for co-funded vaccines and 2/11 for GAVI-funded vaccines [17]. This similarity could be explained by the fact that the financing of traditional vaccines is entirely provided by the State (BCG, VPO, RR, TD). Also, the vaccine co-financing policy of the GAVI member countries is common. Since 2008, all countries applying for Gavi support for a new vaccine have had to co-finance part of its cost, based on eligibility criteria. The amount of co-financing required depends on the country's transition phase. During the initial self-financing phase, the government contribution is fixed: US$0.20 per dose for any vaccine supported by Gavi as part of routine immunization. During the preparatory transition phase, this contribution increases by 15% per year. Finally, in an accelerated transition phase, the proportion of vaccine costs covered by the

government increases from the previous level, reaching 100% of the cost over a five-year period. However, vaccine funding for supplementary immunization activities is the responsibility of partners [18].

The financial support of partners makes it possible to improve the financial accessibility of the population to medicines and other health products. In Cameroon, the top-down approach to health programs also contributes to the complexity of the financing system for medicines and other health products.

Resource mobilization remains a major challenge given the economic context in low-resource countries. However, countries must be prepared to take full responsibility for funding the immunization programs they establish.

V. Conclusion

Regarding the challenges to be met, they were marked by the insufficient transport capacity to ensure optimal distribution of vaccines from the central level to the regions and the weakness of financial resources allocated by the State to supply chain activities.

A high-quality supply of high-quality supplies through a reliable cold chain ensures that the vaccination service is maintained in the long term. To achieve this, optimizing logistics is an effective strategy to anticipate epidemics and strengthen surveillance, based on reliable data [19]. It is time to set up new vaccine supply chains, carefully designed and regularly updated, to respond to developments such as the introduction of new vaccines, epidemics, emergencies, and the need to update the EPI [9].

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