



# Immunization in Cameroon: Uncovering Progress, Confronting Challenges, and Paving the Path towards Achieving Sustainable Development Goal 2030 Targets

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## ABSTRACT

**Background:** Childhood mortality remains a significant public health issue in Cameroon, despite efforts to reduce mortality rates. Vaccination is recognized as an effective measure to prevent mortality, morbidity, and complications from infectious diseases. The Cameroon Expanded Program on Immunization (EPI) has made remarkable progress in introducing and scaling up several vaccines to reduce infant morbidity and mortality rates, but the program's performance needs to be evaluated to achieve the Sustainable Development Goals (SDGs) by 2030.

**Objective:** This study aimed to evaluate the performance of the EPI and identify its strengths, weaknesses, opportunities for improvement, and factors contributing to its successes and challenges.

**Methods:** A mixed-method approach was employed, comprising a web-based qualitative analysis and a quantitative analysis of EPI performance from 2006 to 2019 in Cameroon. Qualitative data was collected through open-ended interviews and focus group discussions with various stakeholders, while quantitative data was obtained from EPI routine reports. The study included all key immunization stakeholders and actors in Cameroon, as well as children aged 0-11 months between 2006 and 2019.

While Cameroon has made significant progress in introducing new vaccines and eliminating some target diseases, it has lagged behind in vaccination coverage, program management, and financing. The COVID-19 pandemic and other factors have further burdened the immunization system. The weaknesses identified included failure to meet the targeted vaccination coverage of all antigens, low coverage in some health districts, and insufficient quality of vaccination data. The country also lagged in geographical equity, program management, and financing.

**Conclusion:** We recommend intensifying efforts to fill gaps and weaknesses in the immunization system, prioritizing immunization programs for primary health care and universal health coverage, and amplifying efforts to achieve the ambitious targets of the immunization agenda 2030. Cameroon needs to address the challenges posed by the COVID-19 pandemic, conflicts, social unrest, and widespread misinformation that negatively impact the output of vaccination services. By doing so, Cameroon can ensure a strong immunization system and improve the health and well-being of its population, not be left behind in attaining the targets for this decade embedded in the SDGs.

**Keywords:** Assessment; Expanded program of immunization; SDG 2030; GVAP

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## ABBREVIATIONS

AIDS: Acquired Immune Deficiency Syndrome; CCEOP: Cold Chain Equipment Optimization Platform; cMYP: comprehensive Multi-Year Plan; CVDPV2: Circulating Vaccine-Derived Polio Virus type 2; DTP3: Third dose of the vaccine (Diphtheria, Pertussis, Tetanus) or (Diphtheria, Pertussis, Tetanus, Hepatitis B virus, Haemophilus influenzae B; EPI: Expanded Program of Immunization; GAVI: Global Alliance for Vaccines Immunization; GVAP: Global Vaccine Action Plan; HIV: Human Immune Deficiency Virus; IMR: Infant Mortality Rate; MCV: Measles Containing Vaccine; MenAfriVac®: Meningococcal Meningitis A Vaccine; MNT: Maternal and Neonatal Tetanus; SDGs: Sustainable Development Goals ; VPD: Vaccine Preventable Disease

## INTRODUCTION

Cameroon health system has not yet reached an optimal level of performance, as illustrated by the primary health indicators. Indeed, despite a gradual decreased over the past decades, under-5 mortality rate in Cameroon remains unacceptably high. In 2020, under-five mortality was estimated at 72-82 per 1000 live births in 2020 [1,2]. In the same year, Infant Mortality Rate (IMR) stood at 48-53 per 1000 live births in 2020 [3]. The main causes of death in this paediatric population are malaria and conditions such as meningitis, acute lower respiratory tract infection, measles, diarrhoea and malnutrition [4-8].

To reduce childhood mortality, the government of Cameroon has developed and implemented several health developments plans. For several decades, these plans focused on reducing childhood mortality via four interventions, notably: Nutrition (breastfeeding, vitamin A supplementation), integrated management of childhood diseases, prevention of mother-to-child HIV transmission and vaccination [9-12].

Vaccination is recognized as one of the most effective measures to prevent mortality, morbidity and complications from infectious diseases during childhood and contributes to almost 25% of the reduction in infant and child mortality [13-17]. Over the past four decades, immunization has been at the centre of Cameroon national public health strategies. Cameroon established its Expanded Program on Immunization in 1976 as a pilot, which went into scale in 1982. At inception, the goal of the program was to and since then, the program was to reduce less than five morbidity and mortality from Vaccine Preventable Diseases (VPD) via the delivery of a full series of basic paediatric vaccines to eligible targets so as to provide the recipients with maximum protection against VPDs. Since inception, the Cameroon EPI has remarkably contributed to the reduction infant morbidity and mortality, an achievement which clearly portrays good program organization and delivery, relentless political commitment, equity and social justice [18]. Although far from achieving its ambitious goals, the EPI has made good progress in strengthening immunization service delivery and accelerating efforts to achieve VPD control over the past 40 years. This remarkable progress can partly be attributed to the support the program has been receiving from GAVI, The Vaccine Alliance, which has enabled the program to successfully introduce several new vaccines as well as scale up the used of old and underutilized vaccines [19-21].

With financial support from GAVI, the Expanded Program on Immunization (EPI) in Cameroon provides vaccination services to prevent the occurrence of 13 fatal ailments, namely Tuberculosis, Poliomyelitis, Diphtheria, Tetanus, Pertussis, Hepatitis B,

Fever, Rubella, Measles, and Cervical Cancer. To facilitate the efficient and effective administration of vaccines to all eligible individuals, the Cameroon Expanded Program on Immunization (EPI) has formulated and executed five-year strategic plans, referred to as comprehensive Multi-Year Plans (cMYPs). Thus far, three such plans have been developed, encompassing the periods from 2007-2011, 2011-2014, and 2015-2019. These plans are congruent with various international guidelines, including the Immunization in the World: Vision and Strategy 2009-2013, the 2011-2020 Global Action Plan for Vaccines, and Regional Vaccination Strategic Plans. The 2015-2019 cMYP objectives aligned with the goals set by the Global Vaccine Action Plan (GVAP) 2011-2020 and aimed to achieve national coverage of at least 88% for all antigens [22,23]. The multi-year plan for immunization concluded in 2020, which coincided with the commencement of a new decade for vaccination aimed at ensuring that no one is left behind. The implementation of this initiative will be directed by the 2030 Immunization Agenda [24]. Despite achieving noteworthy progress towards its immunization objectives during the "Decade of Vaccines," Cameroon's Expanded Program on Immunization (EPI) recognized the need to take stock of its accomplishments and capitalize on its achievements and insights to inform future strategies. This process should be underpinned by existing evidence, epidemiology, policies, and current social trends to enable health authorities to consolidate gains and confront new challenges that may impede the attainment of immunization targets aligned with the Sustainable Development Goals (SDGs) [25]. To attain this objective, the Sub-Directorate for Vaccination has been tasked with conducting a study to assess the performance of the Expanded Program on Immunization (EPI) and establish whether the program is poised to achieve the vaccine-specific targets outlined in certain Sustainable Development Goals (SDGs) by 203.

## METHODS

### Design, study site and period

This study employed a mixed-method approach that involved a cross-sectional qualitative analysis conducted in March 2021 and a quantitative analysis of the Expanded Program on Immunization (EPI) performance in Cameroon from 2006 to 2019. The qualitative analysis utilized open-ended interviews and focus group discussions to gather subjective data on stakeholders' perspectives regarding the EPI's performance, strengths, weaknesses, and opportunities for improvement. On the other hand, the quantitative analysis relied on statistical data obtained from the EPI's routine reports, which were used to evaluate the program's vaccination coverage rates, timeliness, and completeness of reporting. By integrating both qualitative and quantitative data, this mixed-method study aimed to provide a comprehensive understanding of the EPI's current status and identify the factors contributing to its successes and challenges.

### Participant

For the qualitative analysis, the study population included various stakeholders at the central and operational levels of the Ministry of Public Health (MPH), as well as technical and financial partners involved in immunization and civil society. For the quantitative analysis, children aged 0-11 months represent the target age group for EPI in the country.

### Sampling and inclusion criteria

All key immunization stakeholders and actors in Cameroon who agreed to participate were purposively included in the study. All

children who visited the EPI service in the country between 2006 and 2019 and whose data were available in the EPI database were included.

### Data collection and procedure

Secondary data collection was through desk research, relevant EPI-related documents on annual documentary review of vaccination coverage data, comprehensive multi-year plan 2007-2011, financial report 2011, EPI-Central Technical Group reports, periodic population surveys to measure vaccination coverage, data from independent coverage surveys/demographic and health survey/multi indicators cluster Survey 2014, bilateral and multilateral partners for vaccination reports. Joint Reporting from 2006 to 2019 was read and analyzed, and relevant pieces of information were extracted. All data were anonymized. The primary data collection followed four main steps: (1) formulation of the problem; (2) selection of experts chosen according to their knowledge of the topic and in such a way as to cover the diversity of key stakeholders; (3) development of a self-administered questionnaire consisting of open-ended questions on human resources, communication, logistics, service delivery, and others; (4) administration of the questionnaire sent by mail (e-mail) to experts to obtain their assessment of the performance of EPI in Cameroon from various stakeholders.

### Data processing and analysis

Thematic analysis was manually applied to the data. After that, we organized related ideas without changing the participants' original words. With careful reading, emerging themes were discovered and categories created. The final set of themes and categories was used to present and discuss the findings after further refining them. The ratings were applied to order the suggestions. With the help of this tactic, we were able to pinpoint the areas of consensus and those where we were at odds or unsure. The analysis includes a number of quotes from the original transcripts, most of which are from key informant interviews. From secondary aggregated data taken from annual reports, Microsoft Office Excel Version 2016 was used to produce trend analysis over the years.

## RESULTS

### Qualitative analysis

A total of 11 individuals successfully completed a questionnaire, which served as the basis for the following analysis. Among the participants, two were identified as belonging to the national level, corresponding to 18% of the overall participant pool. Additionally, three individuals were classified as operating at the operational level, representing 27% of the total number of respondents. Another three participants were identified as EPI partners, also constituting 27% of the sample. One member of civil society represented 9% of the participant pool, while two individuals from another professional group represented 18% of the overall sample size.

### Main weaknesses of the EPI

The Expanded Program on Immunization (EPI) has been instrumental in increasing access to life-saving vaccines in low-income countries. However, the program is not without its challenges. In this study, respondents identified several main weaknesses of the

EPI. One key weakness cited by respondents was the insufficient human resources at the operational level. Respondents highlighted the lack of qualified staff within vaccination services, with only 40% of providers trained in vaccination in practice. They also pointed to a lack of formal training for program staff at the operational level, with the last training dating back to 2009. Furthermore, less than 20% of staff in charge of vaccine management at district and health facility level is trained in vaccine stock management.

Another weakness highlighted was ineffective communication for vaccination, leading to increasingly strong reluctance among certain populations. Respondents noted a lack of generation of demand among populations, low adherence to vaccination, and multiple anti-vaccination messages in social media.

Funding was also identified as a significant challenge, with key stakeholders identifying inadequacy with needs, meager fund mobilization rates and low mobilization of resources to finance routine EPI, and weak financing leading to demotivation of actors in the field. Respondents also noted strong dependence on external financing.

Logistic management was another area of weakness, with concerns about the insufficient vaccine supply chain, cold chain not being developed, breaks in the vaccine supply chain, lack of refrigerators in some health facilities, and ineffective management of stocks. Outdated rolling stock to carry out advanced strategies was also noted as a concern. Respondents also pointed to insufficient service offerings, with not all operational health facilities offering vaccination, poor accessibility to vaccination services in certain areas, and a fragile operational base with community health workers prioritizing other programs. Finally, respondents mentioned suboptimal coordination at all levels of the program and a lack of good planning as additional challenges.

Overall, the EPI faces multiple challenges that need to be addressed to ensure effective delivery of vaccines to all populations in need.

### EPI effectiveness

The technical efficiency of the health system is the extent to which resources used by the system have achieved the maximum output, according to the availability of resources and current technology.

Regarding the effectiveness of the programme, six out of 11 of the key actors (54%) found the EPI "effective." in its current state and specified, "Yes, but could do better.", "Yes, even if the performances are not optimal.", "Yes, despite the shortcomings decried above.". However, five out of 11 (46%), found the program not very effective or not at all effective, explaining their assessments as "No, because of the operational level. The coronavirus has further weakened the EPI, and vaccination coverage objectives have not been achieved. Several vaccine-preventable diseases epidemics reappear because of the insufficient immunity of the populations."

### EPI performance assessment over the past ten years

The technical efficiency of the health system was evaluated based on the extent to which the resources used by the system have achieved maximum output, given the available resources and

current technology. The results showed that the effectiveness of the EPI program was perceived differently by the key actors involved.

Approximately 54% of the respondents considered the program to be effective in its current state, with some stating that it could still improve. They acknowledged the program's achievements despite some shortcomings, which they had previously mentioned. However, the remaining 46% of the respondents considered the program to be ineffective or not very effective. These respondents attributed their negative assessment to the operational level, stating that the program's effectiveness had been further weakened by the coronavirus pandemic. They also cited the failure to achieve vaccination coverage objectives and the reemergence of vaccine-preventable diseases epidemics due to insufficient population immunity.

These findings reveal a split in perceptions regarding the effectiveness of the EPI program, with some acknowledging its achievements and others highlighting its shortcomings. While the program has made strides in improving vaccination rates, the coronavirus pandemic and other factors have presented new challenges. As such, there is a need for ongoing evaluation and improvement of the program to ensure that it continues to meet the changing needs of the population it serves.

### EPI impact on vaccine-preventable diseases

According to the majority of stakeholders who responded to the questionnaire, although the assessment of the performance of the Expanded Program on Immunization (EPI) over the last decade appears suboptimal, the long-term impact of the EPI seems to be globally positive. Several stakeholders expressed that vaccination has had a positive impact on several Vaccine-Preventable Diseases (VPDs). The program has also introduced new vaccines, while others are currently in progress. Additionally, stakeholders highlighted that the country has obtained the status of elimination of Maternal and Neonatal Tetanus (MNT), achieved the status of a country free of polio, and other VPDs such as measles and yellow fever are under control.

Moreover, the EPI has had great success in eliminating neonatal tetanus, stopping the circulation of wild poliovirus, reducing the prevalence of hepatitis B, and wiping out certain vaccine-preventable diseases. A measurable impact of the program has been observed in the elimination of wild poliovirus circulation in Cameroon, controlling meningitis and other outbreaks, reducing the burden of rotavirus diarrhea and pneumococcal infections, as well as eliminating neonatal tetanus. In addition, the analyses indicated a certain decline in under-five mortality attributable to VPD, which is largely linked to prevention with the vaccine, both in terms of the occurrence of the number of cases and the reduction in serious forms. Moreover, diseases preventable by vaccination are globally in marked decline.

However, one respondent found that the impact of the EPI is low, citing that more than 66,000 children lost their sight in 2017. Despite this, the majority of respondents believe that the EPI has had a positive impact on public health by reducing the incidence and severity of several VPDs.

### Suggestions for EPI improvement

Key actors were surveyed on ways to improve the performance of the Expanded Program on Immunization (EPI) in Cameroon. The respondents identified several areas that require strengthening to optimize the program's efficacy.

One of the areas highlighted was the strengthening of human resources. Respondents suggested continuous capacity building to compensate for the high turnover of personnel, investment in training of human resources and cold chain teams, and retaining operational actors by integrating them into all EPI programs. This approach could increase the knowledge and skills of staff at intermediate and operational levels and promote good vaccination practices, management, and leadership of programs.

Another area identified for improvement was communication. Respondents called for strengthening local communication in the community to optimize demand, investing more in community engagement, and adapting communication to the current context. The program should also sensitize health workers to become more involved in community engagement.

Sustainable funding was also considered crucial to improving the program. Respondents suggested finding more innovative and stable means of funding immunization in Cameroon, increasing funding to EPI, and ensuring that all activities can be implemented.

Strengthening logistics was also mentioned as a means of improving EPI's performance. Respondents suggested increasing vaccine stock capacity at the operational level, improving data systems, and strengthening EPI cold chain capacity.

Finally, the respondents suggested capitalizing on decentralization opportunities to make health districts viable. They also recommended documenting good practices and achievements of the EPI and promoting the EPI model to other programs to improve achievements.

Overall, the survey results indicate that to improve EPI's performance in Cameroon, there is a need for strengthening human resources, communication, funding, logistics, and capitalizing on decentralization opportunities. These recommendations could help increase the efficacy of the EPI program, leading to better immunization outcomes and a reduction in vaccine-preventable diseases.

### The capacity of the program to adapt to new demands

Overall, the stakeholders recognized that while the EPI has certain limitations, the program is characterized by agility, ease, and speed in executing interventions. The stakeholders attributed this strength to the program's structuring and mode of operation, which is based on procedures manuals. Specifically, some stakeholders mentioned that the program has a good ability to adapt because it has qualified staff that is capable of meeting the challenges. However, some other respondents mentioned that the adaptation capacities are minimal due to low material, human, and financial resources. The program has developed a comprehensive Multi-Year Plan (cMYP) and an annual work plan based on the strategic documents of the Ministry of Public Health, and each introduction of a new vaccine is preceded by the development of an introduction plan and a specific communication plan. The stakeholders noted that this vision of the program facilitates adaptations and could play in favor of the easy introduction of new vaccines despite the threats of social media. In addition, some respondents estimated that the program has 100% capacity for adaptation, and it responds quickly to changes in the health system and easily adopts new technologies.

While some stakeholders believed that the program is responsive and adaptable, others noted that there is still room for improvement. For instance, some respondents suggested that the program should invest in digital communication and get a head start on



innovations. Moreover, stakeholders emphasized the importance of exploring and considering mechanisms for adapting the existing program, rather than starting from scratch. They also highlighted that the EPI is a structured and supervised program at all levels, with an excellent ability to adapt to new demands. Monitoring and evaluation work well, and the program is constantly adapting to contextual dynamics, particularly the COVID-19 pandemic. Finally, stakeholders suggested that the EPI has operational procedures that allow for alignment and easy adaptation to all vaccination service offers.

### Relevant recommendations to achieve SDGs related to the EPI

Stakeholders have suggested various interventions that could improve the legal framework, human resources, community engagement, multi-sectorial integration, budget allocation, communication, and service delivery.

Regarding the legal framework, key stakeholders have suggested making vaccination acts compulsory in all health facilities and ensuring follow-up, increasing funding for surveillance, and including vaccination as a right in the constitution of Cameroon. They also recommended requiring a complete vaccination record before admission to nurseries and schools. These interventions could help strengthen the legal framework for immunization in Cameroon and ensure that all individuals have access to vaccines.

Strengthening human resources is also essential. Respondents recommended continuous capacity building of actors through research, training, supervision, coaching, and mentoring. By building the capacity of national and district managers to select strategies adapted to their own context, Cameroon can ensure effective and sustainable immunization programs.

Community engagement is also critical. Respondents suggested strengthening outreach communication and community integration actions, involving all stakeholders like community and health workers to intensify and improve the quality and objectives of vaccination coverage, and supporting structured community health organization platforms in monitoring the implementation of vaccination activities at regional and district levels. These interventions could improve the uptake of vaccines and enhance community participation in immunization programs. Multi-sectorial integration is another area for improvement. Respondents suggested strengthening the synergies of multi-sectorial intervention to better pool resources to achieve the SDGs. They also recommended integrating the EPI into the PMA of each operational health facility, which could improve the quality of services offered by the program.

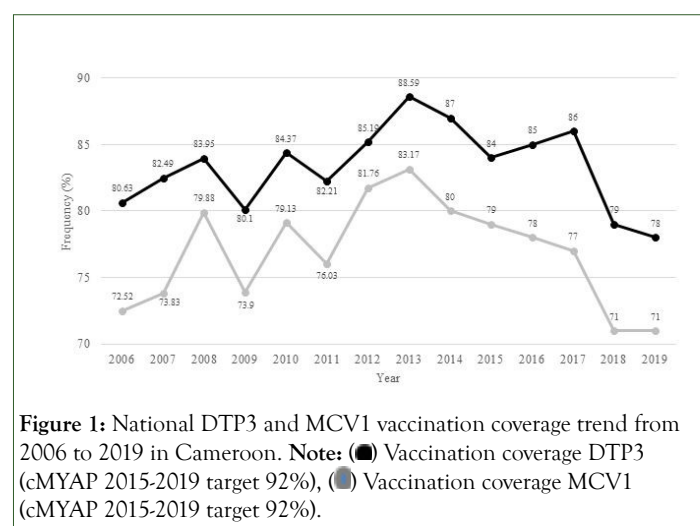
Increasing the budget allocated to the EPI is also critical. Respondents suggested focusing on innovative financing and planning for the withdrawal of GAVI, which could help ensure sustainable financing for immunization programs. Improving communication is also essential. Respondents suggested rebuilding the confidence of the population, emphasizing vaccination throughout the life cycle, and putting emphasis on all pathologies preventable through vaccination, including in adults. These interventions could increase awareness and understanding of the importance of immunization and promote better health outcomes.

Finally, improving service delivery is crucial. Respondents recommended betting effectively on routine EPI, improving coverage of currently available vaccines to an acceptable level,

introducing new vaccines such as HepB 0, implementing good supervision, and introducing a representation of the EPI at the operational level. By improving service delivery, Cameroon can ensure that vaccines are available and accessible to all individuals who need them.

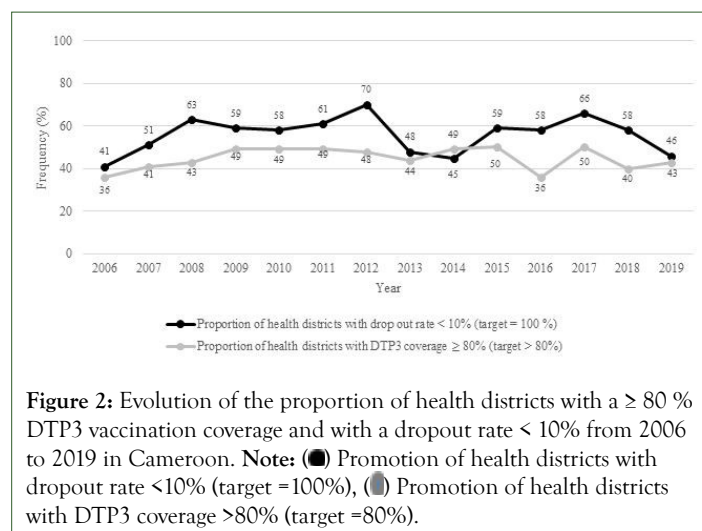
### Quantitative analysis

**National vaccine coverage for major indicators over time:** The success of the Expanded Program on Immunization (EPI) is measured by its two major tracer indicators, the Measles Containing Vaccine (MCV) and the Diphtheria, Pertussis, Tetanus (DTP3), or (Diphtheria, Pertussis, Tetanus, Hepatitis B virus, Haemophilus influenza. While there was some overall progress in national vaccination coverage for DTP3 from 80.63% in 2006 to a peak of 88.5% in 2013, there has been a concerning progressive drop to just 78% in 2019, failing to attain the cMYP target of 92% by 2019. As for MCV1, the annual vaccination coverage increased from 72.5% in 2006 to reach a peak of 83.2%, but has since continuously dropped to a mere 71.0% in 2019, also failing to attain the cMYP target of 90%. These trends are illustrated in Figure 1.

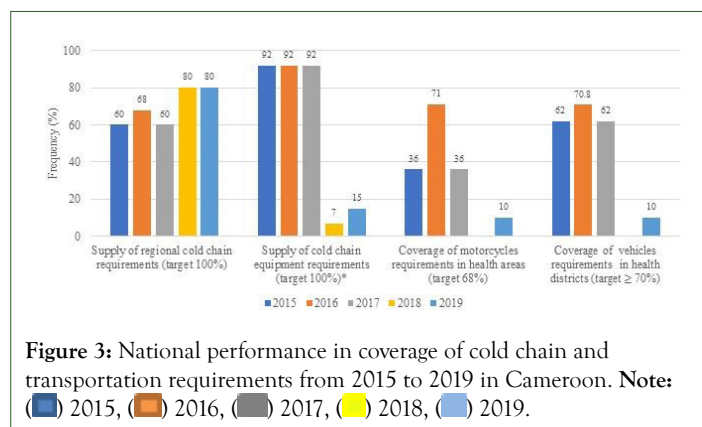


Over the past decade, the Expanded Programme on Immunization (EPI) has made considerable progress in achieving the objectives set forth by the Global Vaccine Action Plan (GVAP) for 2015-2019, with the successful introduction of several new vaccines. These include the 13-valent pneumococcal vaccine in 2011, Rotavirus in 2014, inactivated poliovirus vaccine in 2015, human papillomavirus vaccine, and the measles-rubella second dose, which were introduced in 2020. However, there were some setbacks as well, as the vaccine against meningococcal meningitis A (MenAfriVac®) was only introduced during a mass vaccination campaign in 2013 and was not subsequently integrated into routine immunization.

Geographical equity in DTP3 coverage, with a focus on the proportion of districts with DTP3 coverage of at least 80%, showed a steady increase from 36% in 2006 to 49% in 2009. However, this percentage remained unchanged until 2015, after which it gradually declined to 43% in 2019, failing to attain the CMYP target of 80%. The trend in the number of districts with a DTP1-DTP3 dropout rate of more than 10% between 2006 and 2019 remained consistently above 40, with peaks of 63%, 70%, and 66% in 2008, 2012, and 2017, respectively. The acceptable threshold for the cMYP is 100% of districts with a dropout rate of less than 10%, which was never achieved (Figure 2).



Efforts were made to optimize vaccine management, with a target of achieving 100% annual regional coverage of cold chain requirements by 2019. However, this target was never achieved, although there was overall progress from 60% (2015) to 80% (2019). The target for coverage of refrigerators, as per the WHO-UNICEF norms defined in the Cold Chain Equipment Optimization Platform (CCEOP), was initially set at 100% but remained at 92% from 2015 to 2017. The target was subsequently changed to 25% in 2018, with coverage at only 7%, which increased to 15% in 2019. Targets for coverage in motorcycles (at least 68%) and vehicles (at least 70%) were achieved only in 2016 (Figure 3).



As summarized by the study, "The EPI has made significant progress in introducing new vaccines over the past decade, but there have been some setbacks in achieving specific targets related to DTP3 coverage, dropout rates, and vaccine management optimization. These findings underscore the need for continued efforts to improve immunization programs in order to achieve the GVAP objectives and ensure equitable access to life-saving vaccines for all."

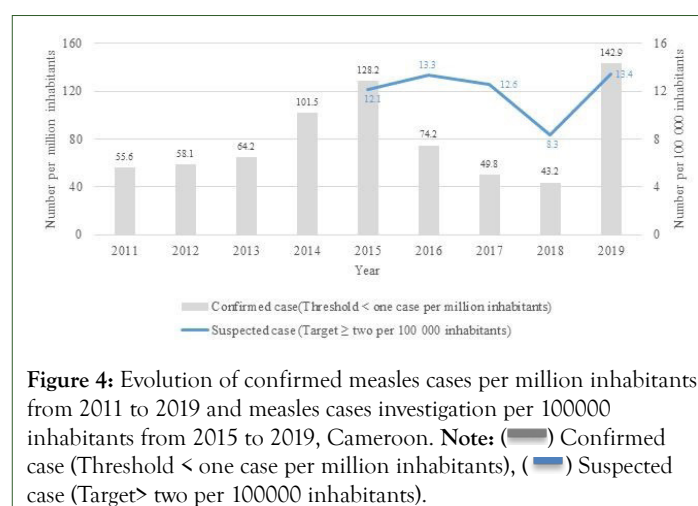
**Poliovirus surveillance and control:** In the context of achieving and sustaining polio certification indicators across all healthcare districts, the Global Polio Eradication Initiative has made significant strides. Notably, Cameroon was certified as free from wild poliovirus in 2020, a remarkable achievement that is indicative of the success of the Initiative's policies and strategies. However, despite this significant accomplishment, there are still instances of circulating Vaccine-Derived Poliovirus (cVDPV) outbreaks in the country, primarily caused by the cVDPV type 2 (cVDPV2) strains. This fact is clearly reflected in the EPI annual reports, which demonstrate that the country still faces significant challenges in

achieving total eradication of polio.

It is worth noting that while the certification of Cameroon as free from wild poliovirus is a significant milestone, it does not necessarily imply the complete eradication of polio from the country. Indeed, the presence of cVDPV outbreaks poses a significant threat to the sustainability of the progress that has been made so far. Therefore, it is critical to develop effective strategies for dealing with cVDPV outbreaks to ensure that the gains achieved in the fight against polio are not eroded.

Overall, while Cameroon has made commendable progress in the eradication of polio, there is still much work to be done to ensure that the country is entirely free from this debilitating disease. The EPI annual reports clearly demonstrate the existence of cVDPV outbreaks, which must be addressed to safeguard the achievements made thus far. It is essential to continue monitoring and implementing vaccination programs to prevent further outbreaks and ensure that Cameroon achieves total polio eradication.

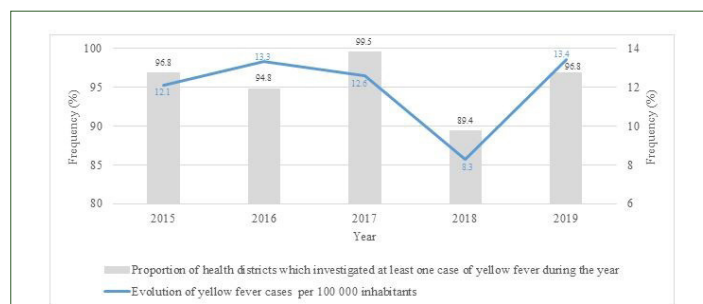
**Measles surveillance and control:** We investigated the attainment and maintenance of measles elimination indicators in Cameroon. The annual rates of measles cases investigated per 100,000 inhabitants from 2015 to 2019 consistently surpassed the threshold of at least two cases per 100,000 inhabitants. There was a plateau in these rates between 2015 and 2018, followed by a peak in 2019 at 14.3 per 100,000 inhabitants. This indicates that measles remained a public health concern in Cameroon during this period, despite efforts to control it. The rate of confirmed measles cases per million inhabitants per year was another important indicator used to measure the success of measles elimination efforts. The target was to maintain less than one case per million inhabitants annually. However, this target was never achieved in Cameroon, with the annual rate detected mostly above 40 per million inhabitants. There were peaks at 128.3 cases per million inhabitants in 2015 and 142.9 cases per million inhabitants in 2019, respectively (Figure 4).



These results indicate that there is a need to strengthen measles surveillance and control efforts in Cameroon to achieve the target of measles elimination. The high rate of confirmed cases per million inhabitants suggests that there may be a lack of adequate surveillance and reporting mechanisms in the country. It is important to improve these mechanisms to ensure that all cases are reported and investigated promptly. In addition, efforts to increase vaccination coverage and improve the quality of vaccination campaigns should also be intensified to reduce the number of cases.

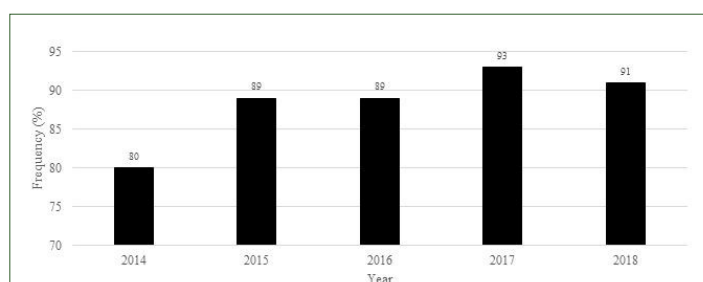
and achieve the goal of measles elimination in Cameroon.

**Yellow fever surveillance and control:** In regards to the surveillance and control of yellow fever, the maintenance of pre-elimination status was assessed through the proportion of health districts investigating at least one case of yellow fever annually. Despite the target of achieving 100% coverage, the proportion remained consistently high, above 90%, with the exception of 2018, which had a coverage of 89.4%. Additionally, the rate of detection of yellow fever cases per 100,000 inhabitants was monitored, with the target threshold set at 2 cases per 100,000. This target was consistently met, with the rate of cases mostly above 12 per 100,000 inhabitants, except for 2018 (Figure 5).



**Figure 5:** Proportion of health districts which investigated at least one case of yellow fever during the year and evolution of yellow fever cases per 100000 inhabitants in Cameroon from 2015 to 2019. **Note:** ( — ) Proportion of health districts which investigated at least one case of yellow fever during the year, ( — ) Evolution of yellow fever cases per 100000 inhabitants.

In terms of vaccination coverage for yellow fever, the annual target was achieved in 2015 with a coverage of 89%, which was maintained until 2018. The data for vaccination coverage is depicted in Figure 6. These results suggest that efforts to maintain pre-elimination status for yellow fever have been successful in Cameroon, with high levels of surveillance and adequate vaccination coverage. However, continued vigilance and efforts to maintain high levels of surveillance and vaccination coverage are necessary to sustain these achievements and prevent the re-emergence of yellow fever in Cameroon.

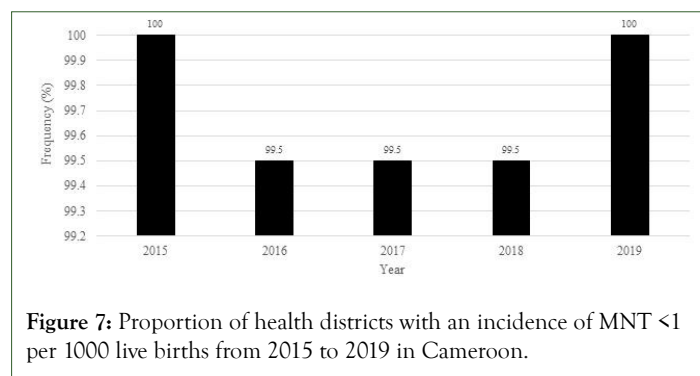


**Figure 6:** Annual yellow fever vaccination coverage from 2014 to 2018 in Cameroon.

#### Maternal and Neonatal Tetanus (MNT) pre-elimination status:

Achieving and maintaining pre-elimination status of Maternal and Neonatal Tetanus (MNT) is an important public health objective. To assess the progress towards this goal, we analyzed the incidence of MNT cases in health districts in Cameroon. Our results indicate that the target threshold of 100% of health districts with an incidence of MNT cases less than one per thousand live births was not continuously attained during the study period from 2015 to 2019 (Figure 7). The incidence of MNT cases remained

low, with values ranging from 99.5% to 100%. These findings suggest that while there has been considerable progress towards MNT elimination, there is still room for improvement in some health districts. Continued efforts are needed to maintain and improve the pre-elimination status of MNT in Cameroon. The implications of our findings underscore the need for strengthening immunization services, expanding access to vaccines, and ensuring effective monitoring and surveillance systems to achieve and sustain the MNT elimination targets in Cameroon.



**Figure 7:** Proportion of health districts with an incidence of MNT <1 per 1000 live births from 2015 to 2019 in Cameroon.

## DISCUSSION

The Cameroon Expanded Program on Immunization (EPI) has achieved significant milestones towards the attainment of specific objectives set in the regional strategic plan for immunization and the cMYP by 2020. However, the failure to achieve some of these objectives has exposed major weaknesses within the EPI system that may hinder the country's preparedness towards achieving the immunization agenda 2030 objectives.

Over the past decade, the introduction of targeted new vaccines to the EPI system has been successful, with the exception of the Hepatitis B birth dose. Notably, Cameroon was certified free from wild poliovirus in 2020, and the introduction of MenAfriVac® led to the absence of meningococcal meningitis A. The indicators for elimination and control of maternal-neonatal tetanus and yellow fever were also met by 2020.

Despite these achievements, there are major weaknesses within the EPI system that need to be addressed to enhance the country's implementation of the immunization agenda 2030. The provision of vaccination services remains a major challenge due to the failure to meet the target of covering all antigens, low vaccination coverage in some health districts, and insufficient quality of vaccination data. These shortcomings could be attributed to weaknesses or failures in managing vaccine supply, logistics, and cold chain.

Inadequate communication and demand generation are also major weaknesses that must be addressed. Insufficient attendance of immunization services, inadequate retention of parents to vaccination, and weak involvement of authorities and community leaders could all contribute to low vaccination coverage. Additionally, poor coordination of community approaches, insufficient involvement of community actors, especially community-based surveillance, and weak advocacy for source mobilization at the decentralized level could further limit the effectiveness of immunization efforts. Program management weaknesses, such as poor monitoring of EPI activities at all levels, insufficient micro-planning of activities at the operational level, and poor execution and monitoring of planned activities at different levels, also contribute to the inadequacies of the EPI system. Insufficient staff capacity in the field of vaccination further compounds these issues.



mobilization of funds for the implementation of activities, weak capacity of the EPI financial and accounting system to promptly produce and disseminate reliable financial information, and late justification of funds, pose additional challenges to the EPI system

The immunization agenda 2030 is a remarkable vision that aims to achieve universal access to vaccines and improve health outcomes worldwide. The agenda's ambitious goals and objectives align with the Sustainable Development Goals (SDGs) and are complementary to existing disease-specific goals that have not yet been met by the Global Vaccine Action Plan (GVAP) strategies. The vision of the immunization agenda 2030, "A world where everyone, everywhere, at every age fully benefits from vaccines for good health and well-being," is not only ambitious but also inclusive. The agenda recognizes the critical role vaccines play in ensuring good health and well-being for all, regardless of age, gender, or location. By aiming for universal access to vaccines, the agenda seeks to close the gap in vaccination coverage and address the disparities that exist in access to healthcare services. By complementing existing disease-specific goals that have not yet been met, the agenda provides a comprehensive framework for improving global health outcomes. The agenda also recognizes the importance of a holistic approach to health and well-being, incorporating immunization as part of a broader strategy to improve healthcare services. Achieving the goals of the immunization agenda 2030 will require collaboration and coordination across different sectors and stakeholders. The agenda recognizes the importance of partnerships and calls for a multi-sectorial approach to address the challenges that exist in the delivery of vaccines. By working together, stakeholders can leverage their collective resources and expertise to overcome the barriers that hinder the equitable distribution of vaccines [26-28].

Cameroon's Comprehensive Multi-Year Plan (cMYP) for immunization, which was informed by the Global Vaccine Action Plan (GVAP), aimed to provide a framework for improving vaccination coverage and access to vaccines in the country. However, one of the major weaknesses of the cMYP was its lack of flexibility in adapting responses to the challenges that arose during the decade from 2011-2020. These challenges included conflicts and social unrests, among others. Pandemics and the spread of misinformation about vaccines [29,30].

The two main conflicts of Cameroon include the Boko Haram Insurgency centered in the Far North Region and that between the government and separatists from the English-speaking minority in the North West and South West Regions [31]. These conflicts have led to the loss of health service infrastructure and shortages of trained health workers disrupting the delivery of immunization services [32]. Conflicts can have a significant impact on the delivery of vaccines and the provision of healthcare services. Therefore, it was essential for immunization programs to be flexible and adaptable to respond to these situations effectively. However, Cameroon's cMYP was not designed to be flexible in adapting responses to such situations. This inflexibility limited the ability of the immunization program to respond to the challenges that arose during the decade. As a result, the program may have failed to reach its full potential in improving vaccination coverage and access to vaccines.

The COVID-19 pandemic, which first emerged in late 2019, has persisted globally, with far-reaching impacts on various sectors, including healthcare. The pandemic has not only posed a threat to immunization services but has also negatively impacted the equity of vaccination coverage. Furthermore, it has exposed weaknesses

in the ability of the immunization system to adapt to emerging situations. The spread of misinformation related to vaccination has also emerged as a significant challenge, leading to a rising number of refusal cases encountered during mass vaccination activities [33]. The pandemic has also highlighted the need for immunization programs to be adaptable to emerging situations. The sudden emergence of COVID-19 caught many immunization programs off-guard, and they were ill-equipped to respond effectively. As a result, the pandemic has posed a significant challenge to the continuity of immunization services.

The past decade has been a mixed bag of achievements and shortcomings for Cameroon's immunization system. While the system successfully introduced targeted new vaccines to its Expanded Program on Immunization (EPI) by 2020, failed to meet coverage targets for all antigens, and struggled with data quality and vaccine supply chain management. The recent COVID-19 pandemic has further exposed the weaknesses of the system, with immunization coverage and equity negatively impacted, and misinformation leading to significant numbers of vaccine refusal cases. With Cameroon's graduation from GAVI support looming by 2025, and the immunization agenda 2030 deadline also on the horizon, it is imperative for the country to address the gaps in its immunization system. Failure to do so could hamper its ability to meet the objectives of the immunization agenda 2030 and sustain an efficient immunization system. Cameroon must capitalize on recent government initiatives, such as the establishment of universal health coverage, to bridge these gaps [34]. The immunization agenda 2030 has placed a high priority on the integration of immunization programs with primary health care and universal health coverage, which is reflected in its first strategy. This approach recognizes the important role that immunization services play in contributing to universal health coverage and emphasizes the need for equitable access to these services. By integrating immunization services into the broader framework of universal health coverage, there is a greater potential to address gaps in coverage equity and ensure that more people have access to the life-saving benefits of vaccines. This can also help to address the weaknesses in the EPI system that have been identified in Cameroon, and contribute to the successful attainment of immunization agenda 2030 objectives.

## CONCLUSION

Cameroon has made significant progress in immunization programs but faces challenges in achieving vaccination coverage and equity. To address these issues and graduate from GAVI support by 2025, Cameroon must prioritize immunization for primary health care and universal health coverage, address gaps in the immunization system, and strive towards meeting the targets of the immunization agenda 2030. Implementation of these recommendations will sustain a strong immunization system and improve the health and well-being of the population.

## LIMITATIONS

While this work does not strictly meet the criteria of an evaluation, it is an attempt to shed light on the performance of Cameroon's Expanded Program on Immunization (EPI) over the past decade. We acknowledge that all the necessary conditions for a comprehensive evaluation have not been met, but our intention was to demonstrate the importance of having a global vision of child and adolescent health to leverage the progress made by the EPI, identify areas that need improvement, and reconsider approaches to meet the needs of children for a better future.



It is critical to have a holistic perspective that considers various aspects of child health, such as immunization, to ensure the well-being of children and adolescents. This work aims to contribute to that perspective and encourage further research and analysis on this topic. It is important to note that the results presented in this work were generated before the COVID-19 pandemic was declared in the country. Therefore, the current situation may not be fully reflected in our analysis. The COVID-19 pandemic has significantly impacted health systems globally, including the EPI, and it is crucial to consider its effects when assessing the program's performance. Nonetheless, this work provides a foundation for future research that incorporates the pandemic's impact on immunization and child health in Cameroon.

## RECOMMENDATIONS CONSIDERING IMMUNIZATION AGENDA 2030

In light of the immunization agenda 2030, several recommendations can be made to address the gaps and weaknesses in Cameroon's immunization system. Firstly, a comprehensive external review of the Expanded Program on Immunization (EPI) performance should be conducted to identify areas that have not been adequately addressed in previous analyses. This will help to identify critical areas that need to be strengthened to improve the overall performance of the immunization system.

Secondly, the government of Cameroon should integrate immunization services into primary health services as part of its ongoing initiative for universal health coverage. This will help to increase access to immunization services and reduce inequity in vaccination coverage. This integration will require a robust health system, including adequate infrastructure, human resources, and logistics, to ensure that all primary health care services, including immunization, are available to all communities.

Thirdly, the government should develop strategies to assess local factors that contribute to vaccine hesitancy and design targeted interventions that will encourage greater use of immunization services. This will require a significant investment in community engagement and communication efforts to build trust in the immunization system and ensure that accurate information about vaccines is disseminated.

Lastly, with Cameroon set to graduate from GAVI support by 2025, the government needs to start planning to fill the financial and technical gaps that would be left behind. This will require strong political and financial commitments from health authorities to ensure that the immunization system remains sustainable and effective beyond 2025.

## ETHICAL APPROVAL STATEMENT

This EPI evaluation has received the authorization of the Minister of Public Health of Cameroon (N°D20-208/MP/MINSANTE/SG/DSF/SDV on 24 February 2021). Informed consent was obtained from all individual participants included in the study. The survey started with a consent statement, and participants who gave permission to participate in the survey clicked the "continue" button and were directed to complete the self-administered questionnaire. Respondents were free to terminate the survey any time, and no identifying information was captured.

## DECLARATION OF INTERESTS

We declare that we have no competing interests.

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