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ORIGINAL RESEARCH ARTICLE

Knowledge and observance of vaccination norms and standards among vaccine managers in an urban health district of Yaoundé, Cameroon, during the COVID-19 pandemic

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Abstract

Annual reports have indicated a progressive decline in immunization coverage in Yaoundé. This study aimed to identify knowledge gaps and organizational deficiencies in the implementation of routine immunization in health facilities (HFs) in the Efoulan health district (HD) of Yaoundé. A descriptive cross-sectional study was conducted in Efoulan, an urban HD of Yaoundé, the capital of Cameroon, in May 2022. A self-administered questionnaire and an observation grid were used to collect knowledge-related data. A total of 46 healthcare workers (HCWs) providing vaccinations in the nine health areas of the HD were enrolled in the study. Almost all participants (93.5%) were unable to name all the diseases that the pentavalent vaccine protects against. More than half of the respondents (59%) were aware of the 15-month booster dose of the measles-rubella (MR) vaccine included in the Expanded Program on Immunization (EPI). Half of the respondents were aware of the type of antigen contained in the Bacillus Calmette–Guérin vaccine (52%). More than two-thirds of the respondents (72%) had not identified the 6-month MR vaccine as recommended for HIV-positive children. Almost all the respondents (87%) had poor knowledge of vaccination norms and standards. Most of the visited HFs did not follow the monthly EPI monitoring curve (87%), did not store vaccines according to standards (80%), or lacked an EPI case reporting form (93%). There are still significant deficiencies in the implementation of routine immunization in most HFs in Efoulan HD, which correlate with the staff's lack of knowledge of EPI norms and standards. Strengthening the capacity of HCWs through ongoing training and supervision is necessary.

Keywords: Expanded program of immunization; Knowledge and observance; Vaccination norms and standards; Healthcare workers; Yaoundé; Cameroon

1. Background

Routine childhood immunization remains a highly cost-effective public health intervention (Zhou *et al.*, 2024). Immunization has contributed to significant reductions in morbidity and mortality from vaccine-preventable diseases worldwide (WHO, 2024a). Global immunization efforts have saved approximately 154 million lives over the past 50 years, corresponding to six lives saved every minute. Most of these lives saved were children (65%) (WHO, 2024a; Shattock *et al.*, 2024). These efforts have also increased coverage of the third dose of the diphtheria–tetanus–pertussis vaccine from near zero in 1974 to an impressive 84% today. This progress, which reached a peak of 86% in 2019 before the COVID-19 pandemic, demonstrates the effectiveness of global vaccine programs (WHO/UNICEF, 2024).

Vaccination activities for children aged 0 – 11 months and pregnant women, led by the Expanded Program on Immunization (EPI) under the Ministry of Public Health, are a priority in Cameroon's national health strategy (Amani *et al.*, 2023). The vaccination schedule in Cameroon initially consisted of seven contacts, beginning at birth and concluding at 15 months. With the introduction of the malaria vaccine, the standard vaccination schedule has been extended to 24 months. These expanded vaccination programs include multiple vaccines, supplements, and dewormers designed to improve Cameroonian child health and reduce healthcare costs by preventing more than 15 infectious and parasitic diseases (Cheuyem *et al.*, 2025; Chiabi *et al.*, 2017; WHO, 2025). These vaccine-preventable diseases include tuberculosis (Bacillus Calmette– Guérin vaccine [BCG]), polio (oral and injectable polio vaccines), diphtheria, whooping cough, tetanus, hepatis B, and *Haemophilus influenzae* type b (pentavalent vaccine: DTwP-HepB-Hib), viral diarrhea (rotavirus vaccine), pneumonia (13-valents pneumococcal conjugated vaccine [PCV 13]), malaria (RTS, S/AS01), yellow fever (yellow fever vaccine), measles and rubella (MR vaccine), and meningitis (meningococcal vaccines: men A/ACYW135) (Amani *et al.*, 2024; Amani *et al.*, 2022; Murhabazi Bashombwa *et al.*, 2025; Ndoula *et al.*, 2024; Njoh *et al.*, 2023, 2025).

In the Centre Region, study reports revealed that the coverage of tracer antigens declined over a 5-year study period (from 93% to 84% for the pentavalent vaccine), falling below the national target of 90% in 2022. Similar trends were observed for the BCG vaccine. However, these coverage rates remained above the national average throughout the study. While coverage for the MR vaccination was initially low, it demonstrated a progressive increase from 8.7% in 2018 to 27.9% in 2022 (Cheuyem *et al.*, 2024).

The Efoulan health district (HD) of Yaoundé, with its 54 vaccination centers spread across all health sectors, regularly performs routine and mass vaccination campaigns to meet targets set by health authorities (WHO, 2017). However, in recent years, annual reports have indicated a progressive decline in vaccination coverage in the Efoulan HD. This decline was characterized by a decrease in coverage of the third dose of the pentavalent vaccine from 85.8% to 72% between 2020 and 2021 (a decrease of 15.4%), as well as an increase in the dropout rate between the first and third doses of the pentavalent vaccine from –1.5% to 1.8% (Cheuyem *et al.,* 2024; Baguune *et al.,* 2017).

In addition, in resource-limited countries such as Cameroon, the emergence of COVID-19 significantly affected the health system and disrupted the implementation of EPI activities by diverting attention and health resources to the COVID-19 response (Amani *et al.*, 2022; Cheuyem *et al.*, 2025; Yoo *et al.*, 2023).

Reports from the coordination meetings involving EPI focal points, HD officers, and health facility representatives highlighted several challenges. These included COVID-19-related constraints that reduced parental uptake of immunization services, failure in technical and organizational components, and issues related to the quality and management of human resources, especially in health facilities (HF) identified as problematic within the HD.

In addition, data management issues related to EPI inputs were identified, prompting an operational research study to understand the root causes and promote evidence-based decision-making. This study was designed to identify knowledge gaps among immunization stakeholders and to describe the organizational pattern in the implementation of routine vaccination in underperforming HFs in this urban HD of Yaoundé.

2. Methods

2.1. Study type

An institution-based cross-sectional study was conducted in the Efoulan HD.

2.2. Study period

The study was conducted throughout the month of May 2022.

2.3. Study site

The Efoulan HD is one of the 32 districts of the Central Region. It comprises nine health areas (eight urban areas and one rural). In 2021, the population was estimated at 453,047 inhabitants, covering an area of over 67 km^2 (a density of 6,761 inhabitants/km^2). The HD includes 117 HFs: seven public, three denominational, and 107 private facilities (Geomatic Strategy, 2019).

2.4. Study population

The study included healthcare workers (HCWs) employed in HFs of the Efoulan health district (HD).

2.5. Sampling unit

HCWs who provided vaccination services and consented to participate in the study were included. HFs identified as problematic were also included for assessment.

2.6. Sampling

HCWs were enrolled via a purposive sampling technique to ensure representation across all nine health areas. For observational analysis, 15 HFs identified as problematic were visited (one public and 14 private).

2.7. Operational definition

Problematic HFs were defined as those demonstrating poor performance in implementing immunization programs (characterized by low vaccination coverage for the third dose of the pentavalent vaccine [<50%] and inadequate data management related to timeliness, completeness, and coherence of data recorded in the District Health Information Software during 2021, and which also exhibited difficulty in addressing challenges following HD supervision.

2.8. Data collection tool and procedures

A pretested, self-administered questionnaire was developed for the study. It included 28 questions covering sociodemographic information, knowledge of priority targets, vaccination schedules, techniques, and input management (see Appendix). The questionnaire was administered to participants during coordination meetings and field visits. An observation grid comprising 20 pre-registered questions in Google Forms was used to collect observational data from the 15 sampled HFs.

2.9. Data processing and analysis

Each participant received a score based on a knowledge assessment comprising 16 questions, with one point awarded for each answer. The results were then classified into three categories: Good (≥75%), average (50 – 74%), and poor (<50%) (Zia *et al.*, 2022). The data were entered into Google Forms and exported for analysis using SPSS version 26 (IBM, USA). Charts were generated using Microsoft Office Excel 2016. Proportions were compared using Fisher's exact tests, with a $p < 0.05$ considered statistically significant.

3. Results

3.1. Study participant profile

A total of 46 HCWs from HFs providing vaccinations in the nine health areas of the HD were enrolled in the study. Participants ranged in age from 27 to 53 years, with half aged between 27 and 36 years. Most participants were female (84.8%) and had tertiary or higher educational levels (63%) (Table 1).

Half of the respondents were nurses (58.7%). Half of the participants had spent more than 2 years working in the immunization service and at their respective HFs (Table 2).

Half of the participants (50%) had received training on the EPI. For almost two-thirds (65.2%), this training had taken place more than a year prior.

Over half of the participants reported having been supervised as part of their EPI activities. For most of them (70.4%), this supervision had taken place <1 year ago.

3.2. Knowledge of immunization

Fewer than one-third of the participants (26%) correctly identified active artificial immunity as the type of immunity provided by vaccination. More than one-third (40%) had no knowledge of this concept (Figure 1).

Almost all participants (93.5%) were unable to name all the diseases that the pentavalent vaccine protects against. *Haemophilus influenzae* type b was the least known antigen. Notably, nearly one-third of the respondents (30.1%) had no knowledge of the antigens contained in this EPI vaccine (Figure 2).

More than half of the respondents (59%) were aware of the 15-month booster dose of the MR2 vaccine included in the EPI schedule (Figure 3).

Half of the respondents were aware of the type of antigen contained in the BCG vaccine (52%) (Figure 4).

3.3. Knowledge of priority target populations

A small proportion of participants (15%) were aware of the current proportion (2.7%) of children aged 0 – 11 months within the total population in the Efoulan HD. Slightly more than half of the respondents (59%) had no knowledge of this figure, two-thirds of whom (66.7%) had

Table 1. Sociodemographic characteristics of participants from the Efoulan health district, May 2022 (*n*=46)

Characteristics	Count (*n*)	Frequency (%)
Health area		
Afanoyoa	5	10.9
Ahala 1	3	6.5
Ahala 2	4	8.7
Efoulan	4	8.7
Ngoa-ekelle	1	2.2
Nsimeyong 1	8	17.4
Nsimeyong 2	9	19.6
Nsimeyong 3	9	19.6
Obili	3	6.5
Age		
18 – 24	3	6.5
25 – 34	26	56.5
35 – 44	11	23.9
45 – 49	3	6.5
50+	3	6.5
Gender		
Female	39	84.8
Male	7	15.2
Educational level		
Primary	1	2.2
Secondary	16	34.8
Tertiary or higher	29	63.0

Table 2. Socioprofessional characteristics of participants from the Efoulan health district, May 2022 (*n*=46)

Characteristics	Count (*n*)	Frequency (%)
Grade		
Assistant nurse	13	28.3
Assistant laboratory technician	1	2.2
Nurse	27	58.7
Midwife	3	6.5
Senior laboratory technician	2	4.3
Position in the HF		
Head of health center	5	10.9
Health area manager	1	2.2
Healthcare worker	14	30.4
VPD focal point	1	2.2
Head of vaccination unit	25	54.3

Abbreviations: HF: Health facility; VPD: Vaccine-preventable disease.

never received EPI training (p=0.020). In addition, more than half of the respondents were unaware of the expected proportion (2.5%) of pregnant women within the total population of the Efoulan HD (Table 3).

Most of the participants (87%) did not identify all the vaccines (PCV, pentavalent, and MR) that can be given to an unvaccinated individual aged 1 year or older. The most frequently cited vaccine was the MR vaccine (Figure 5).

More than two-thirds of the respondents (72%) did not identify the 6-month MR vaccine as recommended for HIV-positive children (Figure 6).

Fewer than half of the respondents (44%) identified the optimal 28-day interval between two doses of an EPI vaccine (Figure 7).

Fewer than half of the respondents (43%) were aware of the correct angle for intramuscular injection during vaccination, with more than a quarter (26%) having no knowledge of this standard (Figure 8).

Fewer than one-third of the HCWs knew that an advanced vaccination strategy should be implemented for communities located more than 5 km away. In contrast, more than half of the respondents (52%) did not know the correct distance (Figure 9).

3.4. Logistic component of vaccination

When asked to identify the EPI tracer antigen, more than half of the participants correctly named pentavalent 3 (41%), while more than a quarter (28%) had no idea (Figure 10).

Most of the respondents were unaware of the various components of EPI input management, particularly the management of opened non-lyophilized vials (50%), the calculation of the wastage factor (89%), and the calculation of vaccine requirements (98%). Participants who reported having received training were significantly more knowledgeable about input management than untrained HCWs (Table 4).

3.5. Global score of knowledge

For the 16 questions assessed, the global score ranged from 1/16 (6%) to 11/16 (69%). Half of the participants scored below 25%. The modal score was 3/16 (19%). Almost all the respondents (87%) had poor knowledge of vaccination norms and standards (Table 5).

3.6. Observance of EPI norms and standards

The effective implementation of EPI norms and standards was observed in both public and private HFs of the Efoulan HD, including those previously identified as problematic (Table 6).

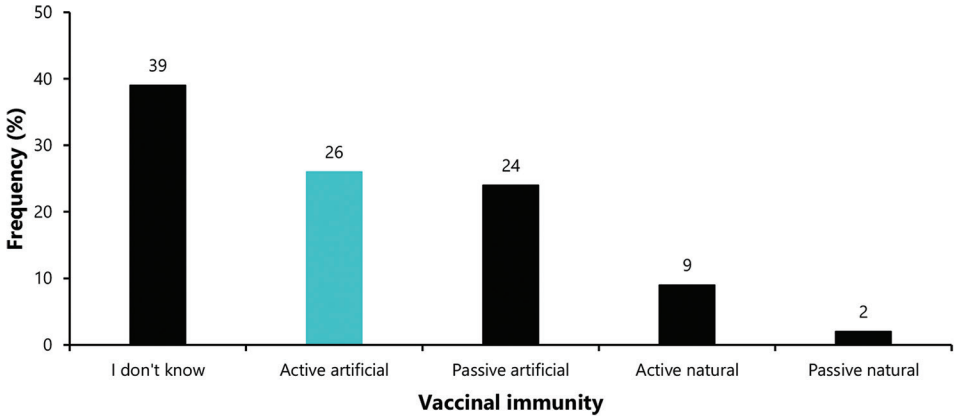

Figure 1. Knowledge of the type of immunity provided by vaccination among healthcare workers from the Efoulan health district, May 2022 (n = 46)

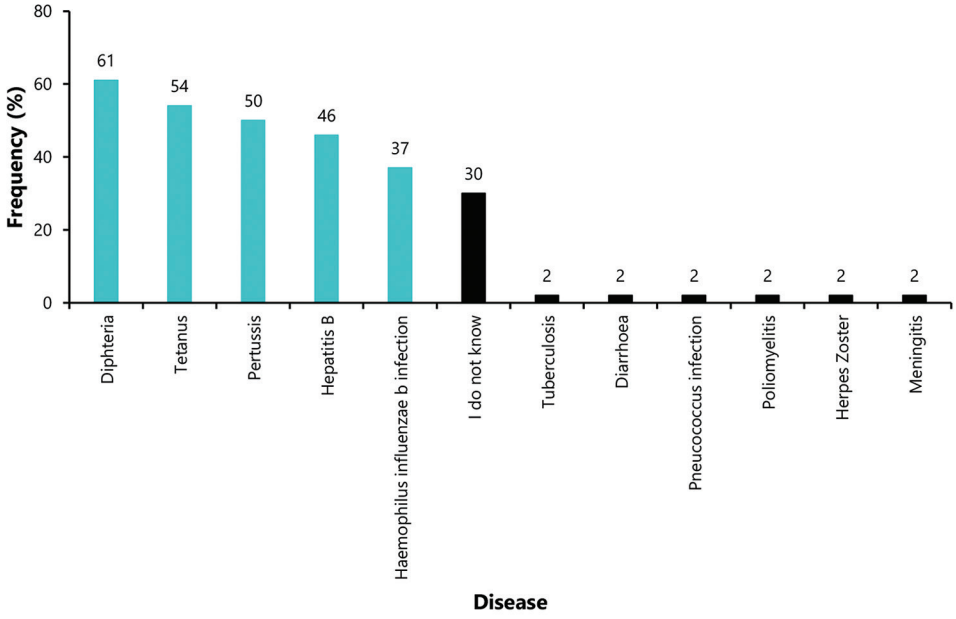

Figure 2. Knowledge of diseases prevented by the pentavalent vaccine among healthcare workers from the Efoulan health district, May 2022 (n = 46)

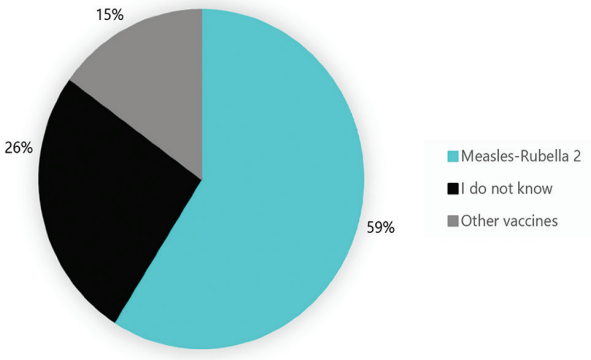

Figure 3. Healthcare workers' knowledge of the measles-rubella booster at 15 months in the Cameroon expanded program on immunization schedule, Efoulan health district, May 2022 (n = 46)

HFs providing vaccinations in the Efoulan HD exhibited several deficiencies in applying Cameroon's EPI norms and standards. Most of the assessed HFs did not follow the monthly EPI monitoring curve (87%), did not store vaccines according to standards (80%), or lacked an EPI case reporting form (93%).

With respect to surveillance, most of the consultants in the visited HFs were unfamiliar with the definitions of common vaccine-preventable diseases (e.g., poliomyelitis, yellow fever, measles) (Table 7).

4. Discussion

This study aimed to assess the implementation of vaccination programs in an urban HD in Yaoundé.

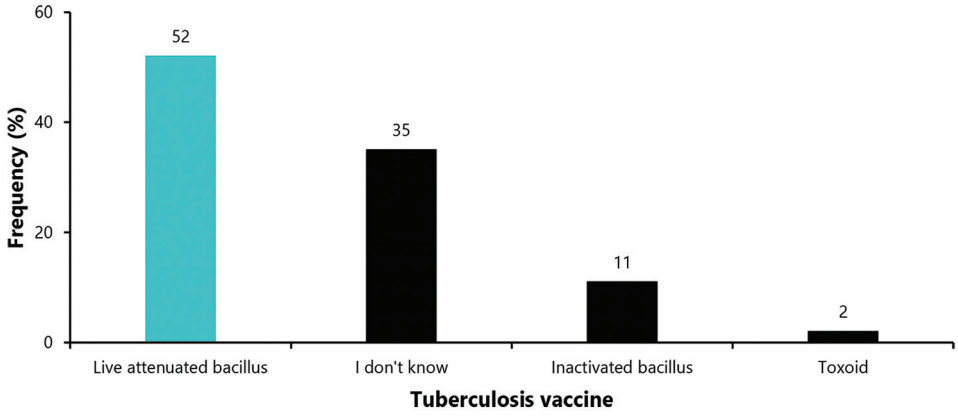

Figure 4. Knowledge of the type of antigen contained in the Bacillus Calmette– Guérin vaccine vaccine among healthcare workers from the Efoulan health district, May 2022 (n = 46)

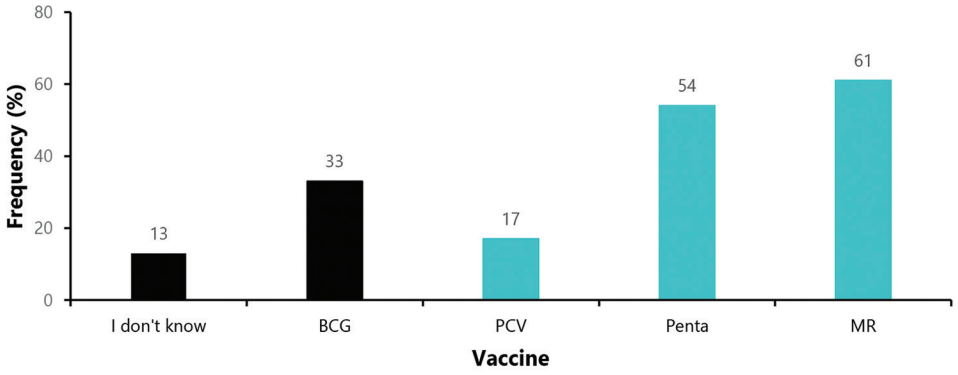

Figure 5. Knowledge of vaccines receivable by an unvaccinated child aged 1 year or older from the Efoulan health district, May 2022 (n = 46)
Abbreviations: BCG: Bacillus Calmette–Guérin; MR: Measles-rubella vaccine; PCV: Pneumococcal conjugated vaccine; Penta: Pentavalent vaccine.

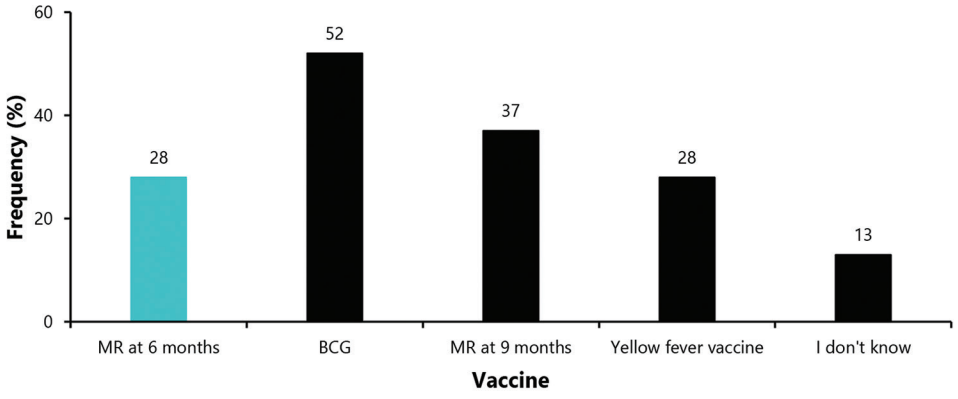

Figure 6. Knowledge of vaccines recommended without risk for HIV-positive children among healthcare workers from the Efoulan health district, May 2022 (n = 46)
Abbreviations: BCG: Bacillus Calmette–Guérin; MR: Measles-rubella vaccine.

It informs the current state of vaccination program implementation and identifies areas for improvement to enhance vaccination coverage and effectiveness in the Efoulan HD.

The geographical coverage of the study areas was satisfactory. Most of the HCWs visited had a designated immunization coordinator and a vaccine-preventable disease focal point. However, nearly half of the HCWs had <2 years

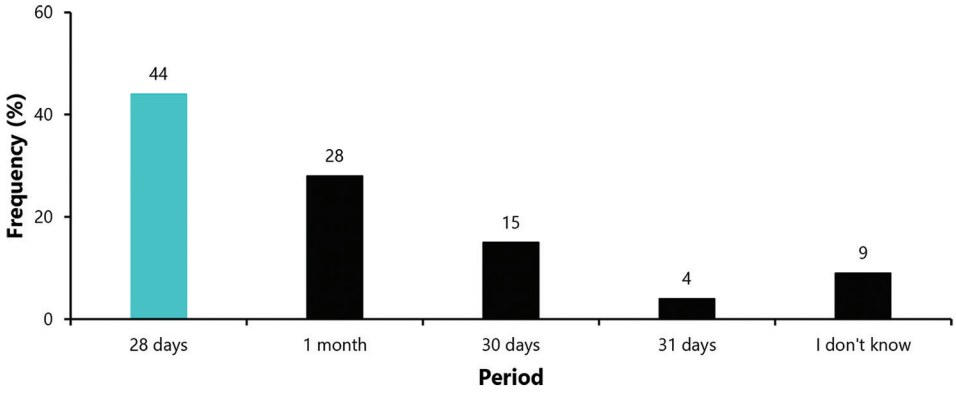

Figure 7. Knowledge of the optimal interval between two Expanded Program on Immunization vaccine doses, Efoulan health district, May 2022 (n = 46)

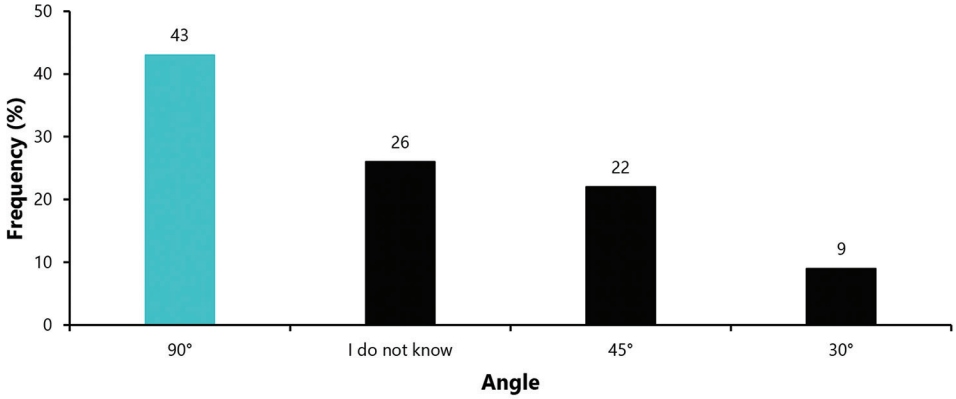

Figure 8. Knowledge of the ideal angle for intramuscular vaccination, Efoulan health district, May 2022 (n = 46)

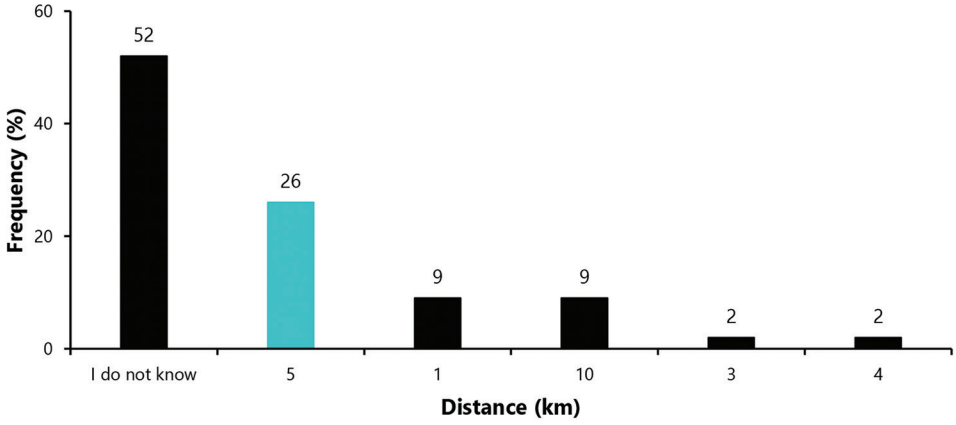

Figure 9. Knowledge of the distance requiring the organization of an advanced vaccination strategy, Efoulan health district, May 2022 (n = 46)

of experience in immunization services. This may be due to the high turnover of HCWs between HFs. The retention of skilled healthcare personnel remains a critical issue in the management of human resources for health in Cameroon (Goga & Muhe, 2011; Kufe *et al.*, 2019). HCWs, especially those in private HFs, frequently move between institutions in search of better offers and benefits, hindering the effective use of skills acquired through training and supervision.

Significant gaps were identified in calculating target population sizes, determining wastage factors, and estimating vaccine requirements. These issues can result in either shortages or surpluses of vaccines in the cold chain,

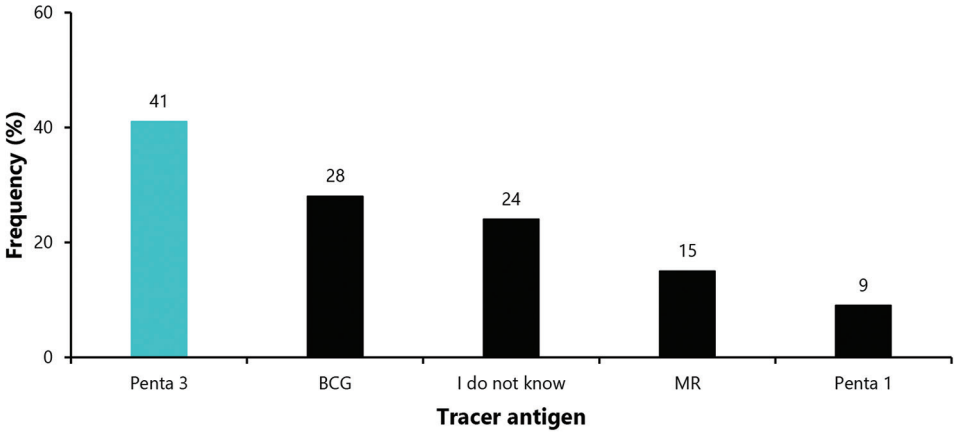

Figure 10. Knowledge of the expanded program on immunization tracer antigen among healthcare workers from the Efoulan health district, May 2022 (n = 46)
Abbreviations: BCG: Bacillus Calmette–Guérin; MR: Measles-rubella vaccine; Penta: Pentavalent vaccine.

Table 3. Knowledge of priority target proportions among healthcare workers from the Efoulan health district, May 2022 (n=46)

Expected proportion (%)	EPI training received n (%)		Total (100%)	p-value
	No (n=23)	Yes (n=23)		
Surviving children				
2.5	1 (33)	2 (67)	3	0.020
2.7 (Yes)	3 (43)	4 (57)	7	
3.4	0 (0)	6 (100)	6	
4.5	1 (33)	2 (67)	3	
I do not know	18 (67)	9 (33)	27	
Pregnant women				
2.5 (Yes)	1 (20)	4 (80)	5	0.289
2.7	1 (20)	4 (80)	5	
3.4	1 (50)	1 (50)	2	
4.5	2 (50)	2 (50)	4	
I do not know	18 (60)	12 (40)	30	

Abbreviation: EPI: Expanded program on immunization.

potentially leading to vaccine expiration and wastage. Consequently, stock management becomes challenging, and the overall quality of vaccination services is compromised. These findings are consistent with a study conducted in the Dschang HD in the west region of Cameroon, where inadequate immunization service delivery was associated with limited knowledge of vaccines and cold chain management among HCWs (Ebile Akoh *et al.*, 2016).

Most participants lacked knowledge about tracer antigens, general vaccine content (e.g., pentavalent vaccine), and safe vaccination techniques (e.g., the proper angle for intramuscular injection). This knowledge gap may affect the ability of HCWs to educate caregivers during immunization sessions and to retain mothers for follow-up doses. Incorrect routes of administration may also increase the risk of adverse events following immunization. As a result, parents may become more reluctant to continue vaccinating their children, potentially contributing to higher dropout rates, particularly for the third dose of the pentavalent vaccine. Beyond ensuring adequate vaccine supply, issues of missed or incomplete vaccinations could be overcome by improving social mobilization strategies aimed at sensitizing mothers and other stakeholders who may be reluctant to vaccinate their children, as reported in studies from Cameroon and other parts of the world (Félicitée *et al.*, 2016; Ngwa *et al.*, 2022; Wie *et al.*, 2023).

Most HCWs were unaware of the 5 km threshold beyond which advanced vaccination strategies must be implemented to bring services closer to the population. As a result, advanced vaccination sessions were poorly planned or not organized at all. However, it should be noted that most HFs in urban HDs are private, and advanced strategies are typically not incorporated into their operational culture. This justifies the need for targeted supervision of private HFs to raise awareness among managers and ensure that the benefits of advanced strategies are well understood and integrated into vaccination planning. Evidence has shown that advanced strategies bring immunization services close to the population, reduce the time parents spend to get their children vaccinated, and increase their adherence to vaccination (Domoina Ratovozanany, 2021; Guttman, 2023).

The observational analysis revealed significant deficiencies in cold chain management and immunization monitoring. Similar trends have been reported in Cameroon and Ethiopia (Bogale *et al.*, 2019; Yakum *et al.*, 2015).

Although the monitoring curves were present, they were not regularly reviewed, and most HFs did not store

Table 4. Knowledge of expanded program on immunization input management, Efoulan health district, May 2022 (*n*=46)

Variables	EPI training received (*n* [%])		Total (100%)	*p*-value[a]
	No (*n*=23)	Yes (*n*=23)		
Management of opened, non-lyophilized vials				
Should be discarded after the vaccination session	3 (30)	7 (70)	10	0.320
Should not be used after 28 days	11 (48)	12 (52)	23	
Could be used after 28 days	2 (67)	1 (33)	3	
I don't know	7 (70)	3 (30)	10	
Is the wastage factor well calculated?				
No	1 (11)	8 (89)	9	0.006*
Yes	1 (20)	4 (80)	5	
Did not know how to calculate	21 (66)	11 (34)	32	
Is the required dose well calculated?				
No	2 (13)	13 (87)	15	0.001*
Yes	0 (0)	1 (100)	1	
Did not know how to calculate	21 (70)	9 (30)	30	

Notes: [a]Fisher's exact test. *indicates $p<0.05$.
Abbreviation: EPI: Expanded Program on Immunization.

Table 5. Score of respondents by previous participation in EPI training, Efoulan health district, May 2022 (*n*=46)

Knowledge score	EPI training received *n* (%)		Total (100%)	*p*-value[a]
	No (*n*=23)	Yes (*n*=23)		
Poor	21 (53)	19 (47)	40	0.665
Average	2 (33)	4 (67)	6	

Note: [a]Fisher's exact test.
Abbreviation: EPI: Expanded program on immunization.

Table 6. Health facilities visited in the health areas of the Efoulan health district, May 2022

Health area	Count (*n*)	Frequency (%)
Afanoyoa	2	13.3
Ahala 1	1	6.7
Ahala 2	2	13.3
Efoulan	1	6.7
Nsimeyong 1	1	6.7
Nsimeyong 2	2	13.3
Nsimeyong 3	2	13.3
Obili	4	26.7
Total	15	100

vaccines properly or monitor temperatures daily. This is likely due to ignorance or negligence on the part of the individuals responsible for immunization in these facilities. Such shortcomings are attributed to a lack of motivation and poor supervision by operational and intermediate health system levels. These results corroborate the findings from the north west health region in Cameroon (Ateudjieu *et al.*, 2013; Yakum *et al.*, 2015).

Poor understanding of case definitions for vaccine-preventable diseases, combined with the limited involvement of health facility managers in surveillance, particularly the unavailability of notification forms, may explain the overall underreporting of vaccine-preventable diseases in the HD.

Overcoming these challenges will require a strong commitment and significant financial mobilization. The shift in healthcare priorities during the COVID-19 pandemic has led to secondary health crises, such as outbreaks of infectious diseases like measles. Restrictions due to COVID-19 impeded access to HFs for vaccination (Ngwa *et al.*, 2022). During such outbreaks, public health efforts tend to focus primarily on outbreak control, resulting in fewer children receiving vaccines. During periods of quarantine, immunization services for all age groups are often interrupted, delayed, reorganized, or suspended in many parts of the world (Hamid *et al.*, 2020). These challenges may have significantly affected the delivery of routine immunization services in the urban HD of Yaoundé.

To strengthen the immunization program in the Centre Region, our findings underscore the urgent need for continuous health education for HCWs (Adidja *et al.*, 2023). A robust national immunization program depends on a well-trained workforce (Cheuyem *et al.*, 2024). Many of the identified challenges, such as suboptimal, inadequate follow-up of vaccination coverage and data

Table 7. Health facility compliance with selected national expanded program on immunization guidelines, May 2022 (*n*=15)

Guideline	Frequency *n* (%)	
	No	Yes
Organization		
Availability of an immunization manager	0	15 (100)
Availability of a VPD focal point	1 (7)	14 (93)
Implementation and monitoring of the program		
EPI calendar posted	1 (7)	14 (93)
EPI monitoring curve available	7 (47)	8 (53)
Monitoring curve plotted and up to date	13 (87)	2 (13)
Vaccination registers available and correctly filled in	5 (33)	10 (67)
Lost to follow-up register available and completed	10 (67)	5 (33)
Cold chain		
Refrigerator available and functional	1 (7)	14 (93)
Contingency plan posted near the refrigerator	9 (60)	6 (40)
Fridge temperature records available	5 (33)	10 (67)
Fridge temperature record updated	11 (73)	4 (27)
Fridge temperature measuring device operational	6 (40)	9 (60)
All EPI antigens available	9 (60)	6 (40)
Vaccines stored according to standards in the cold chain	12 (80)	3 (20)
Tainted vaccines in cold chain	9 (60)	6 (40)
Surveillance		
Notification form of VPDs available	14 (93)	1 (7)
Definition of measles case known to consultant	10 (67)	5 (33)
Definition of AFP cases known to the consultant	12 (80)	3 (20)
Yellow fever case definition known to the consultant	9 (60)	6 (40)
VPD cases definitions available and displayed	4 (27)	11 (73)

Abbreviations: AFP: Acute flaccid paralysis; EPI: Expanded program of immunization; VPD: Vaccine-preventable disease.

management issues, stem from gaps in HCWs' knowledge and preparedness. We therefore recommend developing and implementing a regularly updated training curriculum focused on comprehensive immunization practices (Ewang *et al.*, 2020). This curriculum should cover not only the current vaccination schedule and specific vaccine characteristics (including the newly introduced malaria vaccine), but also the immunological basis of vaccines, their individual and collective health benefits, and effective communication strategies to address vaccine hesitancy (Cheuyem *et al.*, 2024; Starr, 2024; WHO, 2024b; Yakum *et al.*, 2022). Beyond training, sustained improvement requires a multi-pronged approach that addresses logistics, financing, and resource allocation to ensure HFs are adequately equipped. Furthermore, targeted health communication campaigns are vital to raise public awareness and drive demand for vaccination (Dodds *et al.*, 2023; Scott *et al.*, 2025). However, the success of these systemic improvements remains contingent upon a highly skilled and motivated healthcare workforce (Cheuyem *et al.*, 2024). Prioritizing their continuous professional development is paramount to achieving and sustaining high immunization coverage and, ultimately, better public health outcomes in Cameroon.

5. Limitations

The study has several limitations, particularly the small sample size. A multi-district study would provide a more comprehensive understanding of the issues in the Central Region. The interpretation of the results should take into account the dynamic environment (staff turnover, supervision, and training); therefore, the results may not accurately reflect the current situation in the HD. Furthermore, a qualitative research design might be helpful to identify the root causes of the deficiency highlighted in this study.

6. Conclusion

Notable deficiencies were observed in the implementation of routine vaccination in most of the HFs visited. Significant gaps remained in the EPI-related knowledge of HCWs in the HD. Continued efforts are needed to improve adherence to EPI technical and organizational guidelines to ensure the safe and effective immunization of target populations. These efforts should include ongoing technical and practical training on EPI guidelines, as well as regular monitoring to ensure the effective application of the capacity-building initiatives provided to various stakeholders.

To address the challenges identified in this study, we recommend that HDs and regional-level health authorities enhance HCW training, improve the use of vaccination data tools, and strengthen cold chain management and disease surveillance. This can be achieved through the planned and systematic supervision of problematic or high-priority HFs. In addition, developing incentive strategies to retain experienced and trained HCWs is essential.

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Conflict of interest

The authors declare that they have no competing interests.

Author contributions

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Ethics approval and consent to participate

Ethical clearance for the present study was waived by the Ethical Review Board of the Faculty of Medicine of Yaoundé. Administrative approval was obtained from the Chief Medical Officer of the Efoulan HD. Additionally, participants provided signed informed consent for their responses to be used for research purposes. Confidentiality, anonymity, and autonomy of the participants were respected throughout the study. All methods were performed in accordance with the relevant guidelines of the Declaration of Helsinki. During field visits, the participants received practical training on the EPI norms and standards. As a result, the various gaps identified in both knowledge and application of the standards were addressed to the best of our ability.

Consent for publication

Participants consented on the publication of their data.

Availability of data

All data generated or analyzed during this study are included in this manuscript.

Further disclosure

This manuscript has been uploaded to and is available on medRxiv (doi: 10.1101/2024.11.07.24316922).

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Appendix

Healthcare personnel questionnaire

Please select the corresponding number for your response

1. Age: _____ years
2. Gender: 1. Male 2. Female
3. Educational Level: 1. Primary 2. Secondary 3. Higher Education
4. Highest Educational Attainment: _____
5. Professional Title: 1. Nurse 2. Midwife 3. Assistant nurse 4. Senior laboratory technician
   5. Assistant laboratory technician 6. Other (Please specify) _____
6. Administrative Status: 1. Health area manager 2. Head of health center
   3. Head of vaccination unit 4. VPD focal point 5. Healthcare worker
   6. Other (Please specify): _____
7. Time spent in vaccination services: _____ years _____ months
8. Time spent in the health center: _____ years _____ months
9. Vaccination best reflects which form of immunization: 1. Passive natural 2. Passive artificial 3. Active artificial 4. Active natural 5. I don't know
10. Please list the pathogens against which the pentavalent vaccine (PEV) protects: _____
    _____
    _____
11. According to new guidelines, which EPI vaccines are administered at 15 months? _____
    _____
12. The BCG vaccine contains: 1. Inactivated bacilli 2. Live attenuated bacilli 3. Anatoxins 4. I don't know 5. Other (Please specify): _____
13. The proportion of surviving children in the total population of Efoulan HD is:
    1. 2.5% 2. 2.7% 3. 3.4% 4. 4.5% 5. I don't know
14. The proportion of pregnant women in the total population is:
    1. 2.5% 2. 2.7% 3. 3.4% 4. 4.5% 5. I don't know
15. Which vaccines can be administered to an unvaccinated child over 1 year old?
    1. BCG 2. Penta 3. PCV 4. RR 5. I don't know
16. For an HIV-positive child, which vaccines can be administered without risk?
    1. BCG at birth 2. Measles-Rubella at 6 months 4. Measles-Rubella at 9 months
    5. Yellow fever at 9 months
17. The optimal interval between two vaccine doses is:
    1. 1 month 2. 28 days 3. 30 days 4. 31 days 5. I don't know
18. The ideal injection angle for intramuscular vaccines is:
    1. 30° 2. 45° 3. 60° 4. 90° 5. I don't know
19. The advanced strategy is recommended if the village/quarter is located more than _____ km from the health facility that provides vaccination.
19. What is the tracer antigen for the PEV?

1. BCG 2. Penta1 3. Penta3 4. RR 5. I don't know

20. A partially used non-lyophilized vial:

1. Should be used after 28 days 2. Could be used after 28 days

3. Should be discarded after vaccination session 4. I don't know

21. For a 25% loss rate, the resulting loss factor is:

a. 1.50 b. 1.33 c. 1.11 d. 1.24 e. I don't know how to calculate

22. Calculate the number of monthly doses of Pentavalent vaccine to order for a health facility with: Total population: 5000, Loss factor: 1.2, Desired vaccination coverage: 95%

a. 20 b. 30 c. 40 d. 50 e. I don't know how to calculate

1. Have you ever received training on vaccination? 1. Yes 2. No

22. If yes, when was your last training? 1. ≤ 1 year 2. 1 year

Thanks for your participation!

OBSERVATION GRID

Health Area: _____

Health Center: _____

Guideline	Answer	
	No	Yes
Organization		
Availability of an immunization manager		
Availability of a VPD focal point		
Implementation and monitoring of the program		
EPI calendar posted		
EPI monitoring curve available		
Monitoring curve plotted and up to date		
Vaccination registers available and correctly filled in		
Lost to follow-up register available and completed		
Cold chain		
Refrigerator available and functional		
Contingency plan posted near the refrigerator		
Fridge temperature records available		
Fridge temperature records updated		
Fridge temperature measuring device operational		
All EPI antigens available		
Vaccines stored according to standards in the cold chain		
Tainted vaccines in the cold chain		
Surveillance		
Notification form of VPDs available		
Definition of measles case known to consultant		
Definition of AFP cases known to the consultant		
Yellow fever case definition known to the consultant		
VPD cases definitions available and displayed		

Abbreviations: AFP: Acute flaccid paralysis; EPI: Expanded Program of Immunization; VPD: Vaccine-preventable disease.