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Community Engagement in Strengthening Health Systems and Vaccination of Zero-Dose Children in the Central African Republic: The Case of the Kemo-Carnot-Paoua Districts; Challenges and Impacts

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Abstract

Vaccination is one of the most effective and cost-effective public health interventions, saving millions of lives each year. However, its benefits are not evenly distributed, as there are disparities in coverage that leave vulnerable populations in poor, marginalized, or conflict-affected regions with insufficient protection. For example, in the Central African Republic (CAR), where the health system is severely weakened by prolonged conflict and the COVID-19 pandemic, issues such as limited access to vaccination services, a lack of qualified personnel, an inefficient supply chain, and poor-quality health data have resulted in low vaccination rates. This situation highlights the urgent need for targeted strategies to increase vaccination coverage, especially for the 13 million "zero-dose" children who receive no vaccination protection each year. Community engagement could be an interesting solution by mobilizing local resources and encouraging greater participation, which could help overcome these challenges and improve vaccination outcomes in the CAR.

Keywords*: Awareness-Raising, Community Involvement, Childhood Vaccinations, Catch-Up Vaccination, Gender Inequality, Health Systems, Logistical Barriers, Penta3 Vaccination, Vaccination Coverage.*

Introduction

Vaccination is globally recognized as a highly effective and cost-efficient public health measure, saving millions of lives annually. From 2010 to 2018, measles vaccinations alone prevented around 23 million deaths, showcasing the significant impact of immunization in combating infectious diseases. Annually, over 116 million infants—86% of all newborns worldwide—are vaccinated against more than 20 life-threatening illnesses. Since 2010, 116 nations have introduced vaccines for major health threats including pneumococcal pneumonia, rotavirus, cervical cancer, typhoid, cholera, and meningitis.

Yet, despite these successes, vaccination benefits are not uniformly distributed worldwide. Stark differences in vaccination rates reveal that vulnerable groups—often in impoverished, marginalized, or conflict-ridden areas—receive fewer benefits from vaccination efforts. Each year, about 20 million infants miss out on complete routine vaccinations, with over 13 million of these being "zero dose" children who get no vaccinations at all.

The Central African Republic (CAR) provides a stark example of these disparities. Its health system has been compromised by long-standing conflicts and further strained by the COVID-19 pandemic, leading to limited vaccination access, a shortage of skilled and motivated healthcare workers, supply chain inefficiencies, and poor health data quality. These factors contribute to CAR's low vaccination rates, underscoring the critical need for customized approaches to increase vaccination demand.

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Community engagement presents a viable solution to address these issues and improve immunization coverage. By leveraging local resources and boosting community involvement, it may be possible to mitigate some of the systemic weaknesses in the health system. This research focuses on the state of community engagement in CAR, particularly in ZIP districts, exploring the major obstacles to effective engagement, how successful initiatives have navigated these challenges, and the direct effects of community involvement on immunization rates among zero-dose children.

The following research questions will steer this detailed investigation:

1. What is the current state and scope of community engagement in enhancing health systems and vaccinating zero-dose children in CAR?
2. What specific challenges obstruct effective community engagement in this setting? How have successful efforts surmounted these obstacles to effectively mobilize the community?
3. What quantifiable impact has community engagement had on increasing vaccination rates among zero-dose children?

This study aims to yield both academic and practical insights to enhance the efficacy of vaccination efforts in settings with limited resources, highlighting the essential role of community involvement in strengthening health systems.

Definition of Key Terms Community Engagement

Community Participation: This involves the active involvement of community members in initiatives or programs that directly affect them. It is based on the principle that those impacted by a decision have the right to participate in making that decision.

Health Systems: According to the WHO, a health system includes all actors, institutions, and resources that interact to improve, maintain, or restore the health of the population. This encompasses a variety of components such as healthcare, policies, infrastructures, and health personnel.

Zero Dose Children: This term refers to children who have never received a vaccine. Vaccination is one of the most cost-effective health interventions and has a direct impact on infant mortality and morbidity. Zero-dose children are particularly vulnerable to many vaccine-preventable diseases.

Materials and Methods

Methodological Approach: Given the complex dynamics of community participation and its effects on vaccination rates, a mixed-methods approach is deemed most suitable. The quantitative elements of this approach will measure the direct impacts of community involvement on vaccination rates. Simultaneously, the qualitative components will delve deeper into community perceptions, experiences, and the specific challenges faced.

Study Population and Selection Criteria: The study targets community members in areas of the Central African Republic (CAR) with low vaccination rates. Eligibility criteria include parents of zero-dose children, community leaders, and local health professionals. A stratified sampling technique will be utilized to ensure representation across different community segments.

Data Collection Tools and Techniques: Data was gathered using Kobo Collect, a versatile tool from Kobo Toolbox, which is often used in humanitarian settings for its offline capabilities and data security. Custom forms were developed for comprehensive data collection, and the field staff, including healthcare professionals and community leaders, were trained in ethical data collection practices using tablets.

Qualitative Tools: Semi-structured interviews and focus groups were conducted with various stakeholders to capture a wide

range of experiences and views on vaccination and community health efforts. Participatory observations were made to understand the practical implementation of community health programs. Audio and video recordings were used to document interviews and focus groups, with participant consent, for detailed analysis.

Quantitative Tools: Surveys were administered to gather data on attitudes toward vaccination and to assess vaccination coverage. Public health records and vaccination data were analyzed to evaluate the vaccination status among unvaccinated and under-vaccinated children. Data Analysis and Management: Preliminary analysis was initiated quickly to identify trends; Regular communication was maintained with participants for feedback and to address any emerging issues; Data collection was meticulously documented and conducted within a defined period to align with the research timeline; Rigorous checks were performed regularly to ensure data integrity and validity.

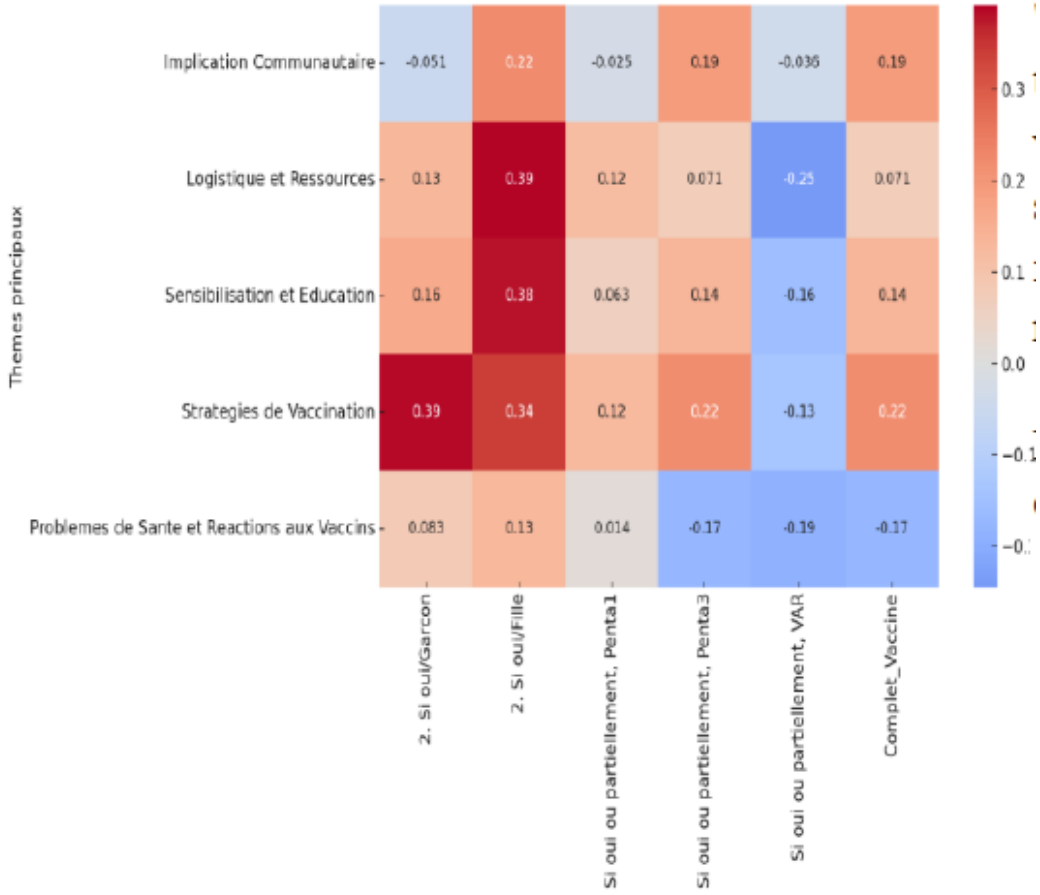

Figure 1. Corrélation entre les thèmes principaux (Variables qualitatives) et les variables quantitatives de l'enquête

Results

The chart above presents an analysis of the correlations between the primary and secondary variables related to community involvement and the vaccination rate of zero-dose children. The level of "community involvement" shows a positive correlation with the vaccination rate of zero-dose children, particularly with Penta3 (r = 0.19) and VAR (r = -0.03). This suggests that a high level of community involvement is significantly associated with better vaccination coverage. However, vaccination completeness also depends on other factors.

Figure 1: Nuage de mots des réponses qualitatives

The word cloud above highlights the terms most frequently used by the participants. It is observed that the most recurring words in the word cloud correspond well to the keywords of the survey topic ("Vaccination," "Health," "Community," and "Strategies"), indicating that the participant's responses are well aligned with the objectives of the survey. This also shows that the central themes of the survey are indeed those that concern the participants the most.

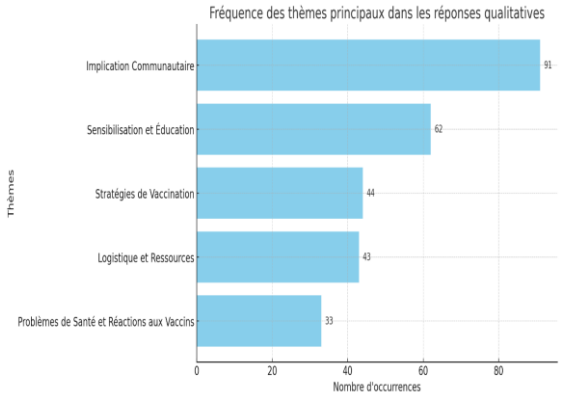

Figure 3: Frequency of Main Themes in Qualitative Responses

The graph above groups the terms frequently used by participants into main categories or themes. It appears that "community engagement" and "awareness/education" are the most often mentioned themes. These two main axes are the foundation of strengthening the health system and vaccination strategies in ZIP areas. This observation highlights a strong recognition of the importance of community engagement in the success of health/vaccination system initiatives.

Table 1: Frequency of Types of Community Referents Surveyed by Districts

PNC	Carnot	Kemo	Paoua	Total	Fréquence
Mères enfants	18	11	4	33	35.87
Chef de village	7	8	2	17	18.48
Chasseurs	1	14	0	15	16.30
Taxi-moto	5	6	2	13	14.13

Ardo	4	1	2	7	7.61
PEV/FOSA	4	0	0	4	4.35
Bouchers	1	1	1	3	3.26
Total	40	41	11	92	100.00

92 community referents were interviewed. Table 2 above shows their distribution across different social groups and districts. The sample used in this survey is representative of the various social categories (PNC) and the studied districts. The strong presence of mothers (35.87%), village chiefs (18%), hunters (16.30%), and motorcycle taxi drivers (14.13%), along with the inclusion of more modest groups (Ardo, Butchers, PEV/FOSA), ensures a diversity of perspectives. The types of PNC vary according to the districts. For example, the category of "Mother-Children" is the most represented in all localities, while hunters seem to be mainly present in Kemo (14 out of 15).

Table 2: Demographic and Vaccination Characteristics of Surveyed Children

	Garçon	Fille	12-23 mois	24-59 mois	Penta1	District	VAR	Complet Vacciné	% Complet Vacciné
Ca	12	7	15	4	18	12	19	12	63.2
Ke	3	38	28	9	39	28	35	28	68.3
Pa	1	10	9	2	11	11	11	11	100.0
Total	16	55	52	15	68	51	65	51	71.8

Table (3) above presents the demographic and vaccination characteristics of the children surveyed in the districts of Carnot, Kemo, and Paoua. Among the 92 caregivers interviewed, 71 have children aged 12 to 59 months.

These children were included in the study and categorized based on sex, age, and vaccination status. The sample is representative of the different age groups (12-23 months and 24-59 months) as well as the studied districts. The number of girls (55) is significantly higher than that of boys (16), revealing a specificity in the studied population and reflecting efforts in gender equity (GESI) in favour of vaccinating both girls and boys. The majority of the children are aged 12 to 23 months, a decisive period for catching up on vaccinations for zero-dose children.

The study focused on validating 92 survey forms distributed in the districts of Carnot, Kemo, and Paoua, capturing a diverse range of community referents. These included mothers of children, village chiefs, hunters, and motorbike taxi drivers, providing a comprehensive view of different segments of the local population. The distribution of community referents was as follows: the largest group consisted of mothers of children (35.87%), followed by village chiefs (18.48%) and hunters (16.30%). This careful selection ensured a balanced geographical and social coverage, allowing the sample to accurately represent various local realities. Interestingly, the demographic characteristics of the children included in the study highlighted a notable gender imbalance, with a majority of girls (55) compared to boys (16).

Additionally, vaccination rates were relatively high, particularly in Paoua where full vaccination reached an impressive 100%. However, there were slightly lower rates in Kemo (68.3%) and Carnot (63.2%), indicating some variation across the districts.

Statistical analyses conducted during the study revealed crucial correlations and disparities related to vaccination coverage. One noteworthy finding was the observation of gender inequality, with a clear disadvantage for boys, suggesting that vaccination rates

were lower among male children. Furthermore, gaps in catch-up vaccination were evident for children aged 24 to 59 months, indicating that more efforts were needed to ensure these older age groups received their complete vaccinations.

A concerning negative correlation was discovered between Penta3 vaccination and full vaccination status, indicating that despite the implementation of sequential vaccination, there were challenges in achieving complete vaccination schedules for certain children. These findings emphasized the need to address specific challenges and disparities in vaccination coverage based on age groups and gender.

Discussion

The interpretation and discussion of these results underscored the crucial role of community involvement in improving vaccination coverage, particularly for zero-dose children who had not yet received any vaccines. The strong representation of mothers of children and village chiefs indicated their pivotal role in community mobilization efforts aimed at increasing awareness and promoting vaccination.

However, the negative correlations observed, particularly those related to Penta3 vaccination and older children, indicated that additional efforts were necessary to effectively reach these groups and ensure the completeness of the vaccination schedule. Therefore, it became imperative to strengthen communication strategies and engage the community more comprehensively to bridge the identified gaps, with a particular focus on raising awareness about the importance of complete vaccination. Furthermore, qualitative analysis highlighted the need for improvement in logistics and available resources to effectively support vaccination campaigns.

There were concerns raised regarding Potential side effects and vaccine safety, emphasizing the importance of addressing these concerns to Enhance trust in health systems and pandemic preparedness.

To achieve complete and equitable vaccination coverage, future interventions should prioritize enhancing trust in health systems by addressing logistical barriers and improving resource availability. By focusing on community engagement, awareness-raising efforts, and strength in networking and partnerships, specific challenges related to age and gender disparities in vaccination coverage can be effectively addressed, leading to increased vaccination rates and improved health outcomes for all children.

In conclusion, the study findings indicated that future interventions should prioritize enhancing trust in health systems by addressing logistical barriers and improving resource availability to achieve complete and equitable vaccination coverage stance of community involvement in improving vaccination coverage, while also highlighting the need for targeted efforts to bridge identified gaps. By addressing gender inequalities, increasing catch-up vaccination for older children, and strengthening communication and logistics support, equitable coverage can be achieved, ensuring that every child has access to life-saving vaccines.

Conclusion

This study explored the complex dynamics that influence vaccination coverage for zero-dose children in the districts of Carnot, Kemo, and Paoua in the Central African Republic. Through a mixed-methods approach combining quantitative and qualitative analyses, it highlighted existing disparities in vaccination and the central role of community engagement in improving public health outcomes.

The results revealed that, despite efforts to achieve full vaccination coverage, inequalities persist, particularly regarding gender and

access to vaccination services for older children.

The analysis of correlations showed that sequential vaccination strategies are not yet optimized to ensure complete vaccination coverage, particularly for children aged 24 to 59 months. Additionally, the strong reliance on community involvement emphasizes the importance of mobilizing and integrating local actors into vaccination strategies to overcome logistical barriers and strengthen trust in health systems. This study concludes that to achieve universal and equitable vaccination coverage, it is essential to develop targeted interventions that address gender disparities, enhance logistical management, and support education and awareness within communities. These efforts, coupled with ongoing commitment from local stakeholders, are crucial for making significant advances in protecting children against vaccine-preventable diseases in the Central African Republic and beyond.

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Conflict of Interest

In research involving non-conventional partners for vaccinating zero-dose children in the Central African Republic, it's crucial to manage potential conflicts of interest. These might arise from the personal motivations of the partners or influences from funding sources and institutional partnerships. To maintain the integrity and objectivity of the research, implementing conflict of interest declarations, ensuring oversight by independent ethics committees, publishing data transparently, and training participants in conflict management are essential steps. These measures help ensure the research is reliable and equitable, benefiting the vulnerable populations it aims to serve.

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