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Evaluation of a Community-based Intervention to Improve Maternal Newborn and Child Health Coverage in the Rural and Hard-to-reach Communities of Adamawa State Nigeria

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Abstract

The healthcare inequities in hard-to-reach (HTR) areas of developing countries, such as Nigeria, have significant implications for disease prevention and control, particularly in maternal and child health. The aim of this study is to look at how well mobile outreach and health facility outreach programs work to improve health outcomes in rural, underserved, and hard-to-reach (HTR) areas in Adamawa State, Nigeria. The focus is on key indicators of maternal, newborn, and child health. The key interventions include antenatal care (ANC), family planning, routine immunization, vitamin A supplementation, deworming of children under 5 years, and Diarrhea treatment. The study applied a cross-sectional design using before-and-after assessments to assess the outcome of the mobile outreach interventions using quantitative health facility-level data from the District Health Information System (DHIS 2.0) on the intervention. Following a successful intervention, the coverage of these indicators prior to and following the intervention was compared using the data. The study shows a cumulative improvement in ANC (21%), institutional delivery (18%), and Penta 3 coverage (28%). Mobile and hard-to-reach strategies utilizing community health workers and volunteers from the LGA, and health facilities can be effective in improving coverage of MNCH services and hold promise for better maternal and child survival in rural, HTR, and under-resourced parts of Adamawa State, Nigeria, and Sub-Saharan Africa at large. In addition, the mobile outreach interventions have contributed to improving MNCH services in hard-to-reach communities, so scaling up the strategy is highly recommended.

Keywords: *Hard-to-reach, Interventions, Outreach, Communities, Adamawa State, Nigeria.*

Introduction

Maternal and child mortality remains a major health problem in low-resource settings due to weak health systems and poor health service delivery [1, 2]. One of the major contributing factors to maternal and child deaths in these settings is the inequalities in health services due to low access to healthcare services, especially in rural areas, underserved communities, and HTR communities [3]. Maternal and child's services, such as ANC, delivery, use of modern contraceptives, routine immunization, and vitamin A supplementation, provide an opportunity for prevention and early detection of maternal and child's conditions such as anemia, malaria, hypertension, malnutrition, and other medical conditions affecting maternal and child's health, thereby improving pregnancy outcomes and child's health. Delay and poor access to services are associated with increased maternal, fetal, infant, and child mortality and morbidity [4]. Access is therefore an important aspect of service delivery and has been receiving increased attention due to its importance in

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health policy [5]. Despite the improvement in access to maternal and child health services in Africa over the years, it has remained relatively low in rural and hard-to-reach parts of Nigeria compared to other countries in the region [6]. Nigeria's maternal and child mortality indices are poor. Its maternal mortality rate (MMR) is 512/100,000 and the percentage of women having ANC at least once is 65. 8% of skilled birth delivery is 2%; under-five-year-olds (U5) have a mortality rate of 120/1000 live births [7]. This is an indication that more effort is required for the country to achieve universal access to maternal healthcare services. To reduce the barrier of access inequalities in the HTR communities, outreach services have been shown to improve mother and child health services [8]. The services are intended to lessen avoidable access disparities to healthcare that are unfair in rural and HTR regions. Inequalities in wealth, power, and income, as well as geographic location and access to amenities, contribute to health inequalities [9].

The provision of medical outreach services to rural and underserved areas or people of a nation is one strategy to assure enhanced and ongoing access to healthcare, both in terms of human resources and service delivery [10]. Outreach services provide benefits to populations, depending on the nature of the service provided. Directly, they provide the people with services not available to them, preventing fatal outcomes and complications from occurring. It provides disease awareness, increases healthcare demand, and increases confidence in the health system. Indirectly, it frees rural populations from the isolation of skilled healthcare delivery services, gives closer surveillance of the population, and continues the education of health workers [11].

Commitment is therefore needed among both government and non-governmental institutions to identify best practices for reducing maternal mortality in rural and HTR communities in Adamawa State, Nigeria.

Methods

Study Setting/Sites

The study was undertaken in some selected local governments of Adamawa State, Nigeria, which is located in the north-east of Nigeria. The selection of study L.G. As was based on the baseline assessment for MNCH indicators. Five (5) LGAs indicated poor performance following an analysis of data sets on 2021 DHIS 2.0 [12]. Two densely populated, hard-to-reach communities were selected from each LGA. The details of the LGAs selected are described in Table 1 below:

Table 1. Selected LGAs, Their Senatorial Zones and Number of PHCs

Senatorial Zone	LGA selected	Ward	Catchment Area HF	Community	Total Population	No of WCBA	No. of children < 5 Years	No. of Pregnant women	No. of children 6-11 Months	No. of Children 12-59 Months
Adamawa Central	Girei	Modire	Njobbore PHCC	Tudun Wada	502	110	100	25	20	80
				Lamonga	378	83	75	19	15	60
	Gombi	Muchalla	Muchalla PHCC	Mayo Zamba	1,327	292	265	66	53	212
				Garfite	1,451	319	290	73	58	232
Adamawa North	Michika	Dzah	Buppah PHCC	Mampi	1,655	364	331	83	66	265
				Karasudi	2,068	455	414	103	83	331
Adamawa South	Mayo-belwa	Gangfada	Gangfada PHCC	Beleri noppi	1,308	288	262	65	52	210
				Pola kanoki	789	174	158	39	32	126
	Guyuk	Bobini	Bobini PHCC	Gwalam	9,930	2185	1986	496	397	1588
				Jauro Jalo	2,340	515	468	117	94	374
Total	5	5	5	10	21,740	4783	4348	1087	870	3474

Source: 2021 REW Micro plan

Study Design

The study uses a before-and-after design involving quantitative interventional research methods. The specific methods that were used to achieve the aim of the proposed study are matched to each specific objective (Table 2). Two interventions were designed to ensure accessibility to qualitative maternal, newborn, and child health services in the selected communities.

Table 2. Matching Objectives with Methods

Specific objectives	Method
1. To Implement the selected MNCH interventions for improving coverage in the selected hard to reach communities in Adamawa State	Mapping of HTR for implementation
	Co-creation workshops
	Training workshops
	Conduct interventions in the selected communities
	Targeted Supportive supervision of health workers during the intervention
2. To determine the outcome of the interventions carried out at the selected hard-to-reach communities in Adamawa State.	Administration of quality checklist
	Survey of community beneficiaries, health facility managers and other staff at LGA level
	Comparing pre-post intervention data.

Intervention Design

Two packages of interventions were designed, namely, the mobile HTR intervention and the HF outreach intervention. The details of the designs are discussed below: mobile HTR intervention team comprising of 5 health workers (team lead/supervisor, child welfare focal person, maternal welfare focal person, HTS focal person, and a community mobilizer). The health facility outreach team, on the other hand, is comprised of 4 health workers (facility manager/supervisor, health facility RI focal person, ANC focal person, and a community mobilizer). The team is drawn from the catchment area heath facility. Each team visits the selected community once every month.

Reliability and Validity of Research Instrument

In this study, the method of triangulation was used to validate the reliability of the data obtained. This was tested using multiple techniques, such as observation, interviews, and questionnaires, to compare the responses of the respondents. Also, a pilot study was conducted to pre-test the study schedule, which was subsequently validated in the process.

Data Analysis Methods

Quantitative Data

This data was collected using the health registers and sent to an open data kit server. The data was downloaded into a Microsoft Excel spreadsheet and analyzed using descriptive statistics. Data for 2022 from district health information system 2.0 [13] was downloaded into a Microsoft Excel spreadsheet and was descriptively analyzed. Data on the DHIS portal contains tools that validate the accuracy and reliability of the data in the system.

Inclusion Criteria

Intervention LGAs/communities which implemented the interventions for a minimum of three rounds and data sets from the DHIS 2.0.

Exclusion Criteria

Intervention LGAs/communities which have not implemented an intervention and any data sets apart from the DHIS 2.0.

Ethics Approval and Consent to Participate

Written informed consent was obtained from all study participants. All experimental protocols were approved by the Ethical Committee (HREC) of the Adamawa State Ministry of Health, reference number **S/MoH/1131/I/23.** The collected data was only accessed by the research team, and it was always kept under lock and key. Research assistants signed confidentiality agreements in a bid to protect the data from leaking to the public. All methods were carried out in accordance with relevant guidelines and regulations.

Results

Maternal Services Provided During Intervention at the Intervention LGAs

Table 3 below shows the maternal services and the number of people reached during the intervention in the five selected Local Government Areas (L. G. As), namely: Mayo-Belwa, Guyuk, Girei, Gombi, and Michika LGAs. Fifty-one (51%) pregnant women (PW) received tetanus toxoid (TT) vaccination, 68% received folic acid and intermittent preventative treatment (IPT) for malaria, 99% received counseling on EBF, 16% received family planning pills, and 14% received injectable family planning methods in Mayo-Belwa LGA. Nine (9%) PW received TT vaccination, 49% PW received folic acid, 6% received IPT for malaria, 49% PW were counseled on exclusive breast feeding (EBF), 1.5% of WRAG received family planning pills, and 2% of WRAG received injectable family planning methods in Guyuk LGA. Forty-three (43%) PW received TT vaccination, 53% received folic acid, 66% received IPT for malaria, 52% were counseled on EBF, and 43% of women within the reproductive age group (WRAG) received family planning pills and injectable family planning methods, respectively, in Girei LGA. Seventy-eight (78%) PW received TT vaccination, 30% received folic acid, 26% received IPT for malaria, 30% were counseled on EBF, 19% received family planning pills, and 18% were provided with injectable family planning methods in Gombi L.G.A. Nineteen (19%) PW received TT vaccination, 94% PW received folic acid, 39% received IPT for malaria, 94% PW were counseled on EBF, 85% WRAG received family planning pills, and 13% were provided with injectable family planning methods in Michika L.G.A.

Table 3. Percentage of Beneficiaries of the Intervention provided for Women across the Intervention LGAs

Intervention LGAs	**Maternal RI**	**Antenatal Care (% of PW who)**			**Family Planning (% of WRAG who)**	
	PW who received TT (%)	**Received Folic acid (%)**	**Recieved IPT**	**PW councelled on EBF (%)**	**Received Pills (Excluton and Microgynon) (%)**	**Received Injectable (NORIS AND DEPO) (%)**
Mayo-Belwa L.G.A	51	99	68	99	16	14
Guyuk L.G.A	9	49	6	49	1.5	2
Girei L. G. A.	43	52	66	52	43	43
Gombi L. G.A	78	30	26	30	19	18
Michika L.G.A	19	94	39	94	85	13

Data source: Health facility register

Coverage of Child's Services Provided During Intervention at the Intervention LGAs

The data presented in tables 5 and 6 shows the child services component of the intervention and the number of children less than 5 years old reached during the intervention in the 5 selected LGAs, namely: Mayo-belwa, Guyuk, Girei, Gombi, and Michika LGAs.

The coverage of children younger than 2 weeks who received BCG, OPV 0, and HBV ranges from 0.2 to 7% across the five intervention LGAs. Girei LGA, for example, has the highest coverage across the three indicators (7%, 5%, and 6%), respectively. The lowest performance is noticed in Guyuk LGA, with 0.2%, 0.4%, and 0.3%, respectively. On the percentage of children who are at least 6 weeks old receiving OPV1, PCV 1, Penta 1, Rota 1, and IPV 1, the coverage ranged from 0.2% in OPV 1, Rota 1, and Penta 1 in Guyuk to 16% in OPV 1 in Girei LGA. LGAs that showed better coverage in these indicators are Gombi LGA and Mayo Belwa LGAs.

The coverage of children aged 10 weeks with OPV2, PCV2, Penta 2, and Rota 2 ranges from 0.1 to 15% across the five intervention LGAs. Girei LGA has the highest coverage across the four indicators (15% in OPV 2, PCV 2, Penta 2, and 13 in Rota 2). The least performance was noticed in Guyuk LGA, with 0.2% in OPV 2, PCV 2, Penta 2, and 0.1% in Rota 2, respectively. The percentage of children at 14 weeks who had OPV 3, PCV 3, Rota 3, and IPV 2 ranged from 0.2% in Penta 3 and IPV 2 in Guyuk to 13% in all the indicators in Girei LGA. Gombi and Mayo-belwa LGA showed better coverage in these indicators. Furthermore, the coverage of 9-month-old children that had measles 1, yellow fever, and menta A ranged between 0.2% for measles 1, yellow fever, and menta A. Finally, measles 2 coverage ranged from 0.4% to 11%, with the lowest coverage observed in Guyuk and the highest observed in Girei LGA.

Table 4. Coverage of Child's Services Provided During Intervention at the Intervention LGAs

Intervention L.G.As/Indicators	Mayo-Belwa	Guyuk	Girei	Gombi	Michika
% of children < 2 Weeks who received BCG	6	0.2	7	4	2
% of children < 2 weeks who received OPV 0	4	0.4	5	3	0.5
% of children < 2 weeks who received HBV	3	0.3	6	3	1
% of children 6 weeks who received OPV 1	4	0.2	16	7.4	1.2
% of children 6 weeks who received PCV 1	3.3	0.3	15	8	1.2
% of children 6 weeks who received Penta 1	4	0.2	16	7.4	1.2
% of children 6 weeks who received Rota 1	4	0.2	16	7	1.2
% of children 6 weeks who received IPV 1	4	0.2	16	7	1.2
% of children 10 weeks who received OPV 2	3	0.2	15	2.5	1.5
% of children 10 weeks who received PCV 2	3	0.2	15	3	1.5
% of children 10 weeks who received Penta 2	3	0.2	15	3	1.5
% of children 10 weeks who received Rota 2	3	0.1	15	3	1.5
% of children 14 weeks who received OPV 3	3	0.3	13	4.9	0.5
% of children 14 weeks who received PCV 3	12	0.3	13	5	0.5
% of children 14 weeks who received Penta 3	3	0.2	13	5	0.5
% of children 14 weeks who received Rota 3	3	0.3	13	5	0.5
% of children 14 weeks who received IPV 2	3	0.2	13	5	0.5
% of children 9 months who received MenA	2.4	0.2	11	6	4

% of children 9 months who received measles 1 vaccine	2.4	0.2	11	6	4
% of children 9 months who received Yellow fever	2.4	0.2	11	6	4
% of children 15 months who received Measles 2	3	0.4	11	4	0.5

Source: Routine immunization register

Other Child's Services Provided During Intervention at the Intervention LGAs

The coverage of vitamin A supplementation in the LGAs for children 6–11 months is as follows: Mayo-belwa (51%), Guyuk (3%), Girei (102%), Gombi (50%), and Michika (56%). Furthermore, the coverage for children aged 12-59 months is Mayo-belwa (36%), Guyuk (2.3%), Girei (141%), Gombi (50%), and Michika (170%). Deworming and diarrhea management using ORS indicated that 29, 2, 118, 40, and 136% of children < 5 years received Albendazole deworming tabs in Mayo-Belwa, Guyuk, Girei, Gombi, and Michika Local Government Areas, respectively. The highest coverage was seen in Michika, followed by Girei with 118%, and low coverage was noticed in Guyuk LGA with 2%. The coverage of children less than 5 years who were managed for diarrhea using zinc tablets and ORS is 10% in Mayo-Belwa, 1% in Guyuk, 10% in Girei, 0.1% in Gombi, and 3% in Michika (Table 5).

Other Curative Services Provided During Intervention at the Intervention LGAs

Treatment of other ailments was provided during the intervention at the intervention LGAs, as contained in Table 6. These include the treatment of infections in women, the management of ulcers, fungal infections, typhoid fever treatment, eye care, and malaria diagnosis and treatment. Two hundred and forty-four (244) women received nystatin pastries, nystatin cream, and doxycycline tabs; 1,149 people received either cimetidine or magnesium trisilicate; 69 people were reached with antifungal tablets (Ketoconazole) and cream; 167 were treated for typhoid fever using ciprofloxacin; 41 persons received eye drops (Gentamycin and ciprofloxacin); and 1132 persons were diagnosed and treated for malaria using ACT and Artesunate injections.

Table 5. Number of Beneficiaries Per Intervention for other Child Services Provided Across the Intervention LGAs.

Intervention LGAs	**Vitamin A Suplementation**		**Deworming**	**Diarrhoea management**
	% of children < 12 Months who received Vitamin A	**% of children between 12 - 59 Months who received Vitamin A**	**% of children < 5yrs who received Albendazole deworming tabs**	**% of children < 5yrs who received Zinc tablets and ORS**
Mayo-Belwa	51	36	29	10
Guyuk	3	2.3	2	1
Girei L. G. A.	102	141	118	10
Gombi L. G.A	50	50	40	0.1
Michika	56	170	136	3

Data Source: Health facility registers

Table 6. Number of Beneficiaries Per Intervention for the Treatment of Other Ailments Provided Across the Intervention LGAs

Intervention LGAs		**Mayo-Belwa**	**Guyuk**	**Girei L. G. A.**	**Gombi L. G.A**	**Michika**	**Total**
Treatment for infection in women	No. of Women who received Nystatine pesteries	8	12	14	9	7	50
	No. of women who received Nystatine cream	6	8	1	2	2	19
	No. of women who received Doxycycline tabs	63	47	15	33	17	175
Ulcer treamnet	No. of persons who received antiacids (Cimetidine).	223	318	118	127	0	786
	No. of persons who received antiacids (Geolosile).	7	11	38	50	257	363
Treatment for Skin infection	No. of Persons who were treated for infection using ketoconazole Tablets	8	5	8	8	10	39
	No. of women who received Ketoconazole cream	4	6	7	7	6	30
Typhoid fever treament	No. of Person treated for typhoid fever	17	27	40	42	41	167
	No. of persons who were treated for tyhoid fever using Ciprofloxacin	3	0	0	1	2	6
Eye treatment	No. of persons treated for eye disease using Gentamycin eye drop	4	7	4	4	2	21

	No. of person Given ciprofloxacin Eye drop	6	2	3	3	6	20
	No. of persons who received Viatamin A (Adults)	20	16	30	38	163	267
Malaria diagnosis and treatment	No. of persons who were tested for malaria using RDT	115	143	243	353	278	1132
	No. of persons who were treated for malaria ACT 1	53	50	24	24	52	203
	No. of persons who were given ACT 2	502	572	33	43	47	1197
	No. of persons whoreceived ACT 3	14	25	15	16	38	108
	No. of persons who received ACT 4	33	36	42	52	39	202
	No. of persons who who received paraceutamol tablets	56	119	140	157	230	702

Data source: Health facility registers

Quantitative Endline Assessment

The indicators selected for the quantitative assessment in this study include the following: MCH indicators from 2021 DHIS 2.0 Antenatal Care Visit 1 (ANC1), Fourth Antenatal Care Visit (ANC 4), Eight Antenatal Care Visit (ANC 8), Institutional Delivery Rate, and Contraceptive Prevalence Rate (CPR) Penta 3 coverage, Penta 3 dropout, measles coverage, and vitamin A supplementation coverage. The endline assessment involves comparing the 2021 baseline with the 2022 DHIS 2.0. The details of the results are described below:

Percentage Improvement of the Intervention LGAs on Maternal Indices

The percentage coverage presented in Figures 1 and 2 compares the performance of the intervention LGAs on ANC 1 and 4. The result indicates improvement on both ANC 1 and 4 in Girei, Gombi, Mayo-belwa, and Michika with 28.6%, 9.3%, 67.1%, and 13.6%, 7.6%, and 32.5%, respectively. For example, the highest improvement of 98.7% as against the baseline coverage of 31.6% was recorded in Mayo-Belwa. However, a decline in performance of -24.6% was reported in Guyuk LGA, with 24.6 and 28.8%, respectively.

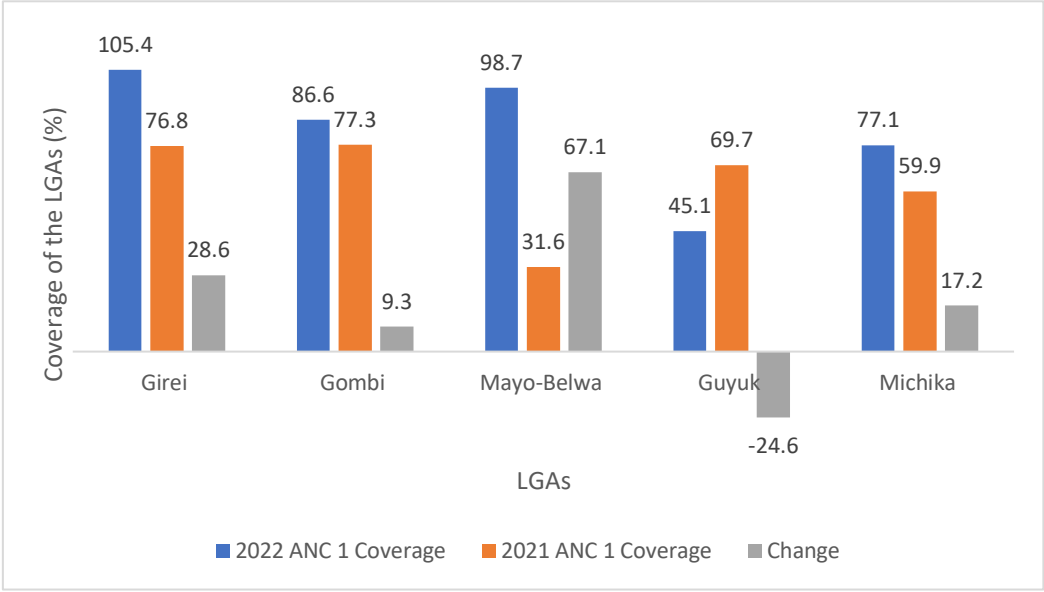

Figure 1. Comparison of ANC 1 for 2021 and 2022

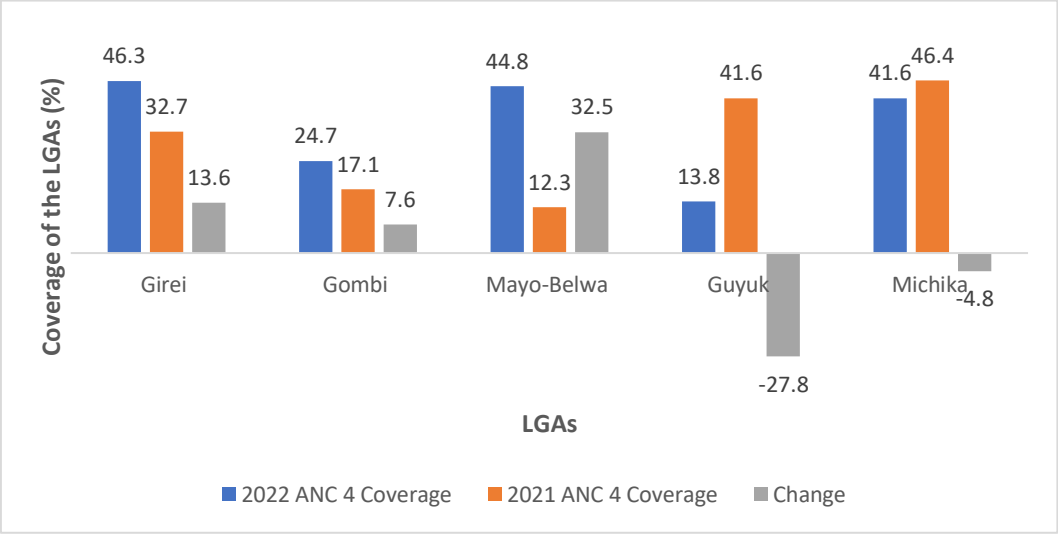

Figure 2. Comparison of ANC 4 for 2021 and 2022

Percentage of the Intervention LGAs on Maternal Indices

The result presented in Figure 3 compares the performance of the LGAs on ANC 8 for 2021 and 2022 in the five intervention LGAs. The result indicates improvement on both ANC 8 and institutional delivery in Girei, Gombi, Mayo-Belwa, and Michika with 13.8%, 11.6%, 9.3%, and 1.5%, respectively. More so, a decline in performance was noticed in Guyuk LGA with –1.8%. Girei, Gombi, Mayo-belwa, and Michika LGAs with 2.2%, 6.4%, 19.8%, and 3.9% on institutional delivery, respectively, and a decline in Guyuk LGA.

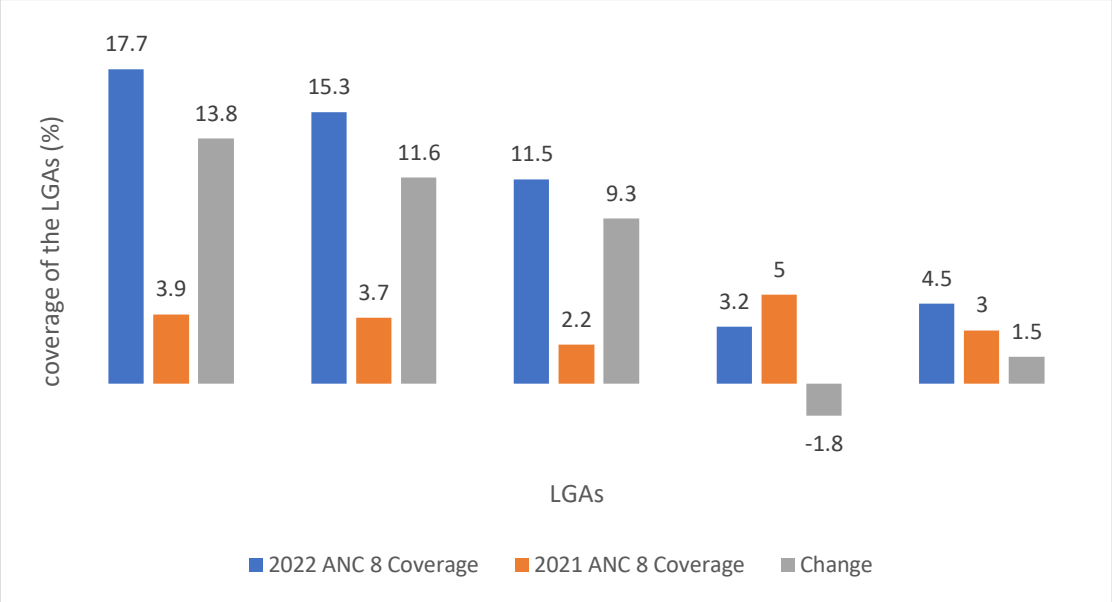

Figure 3. Comparison of ANC 8 for 2021 and 2022

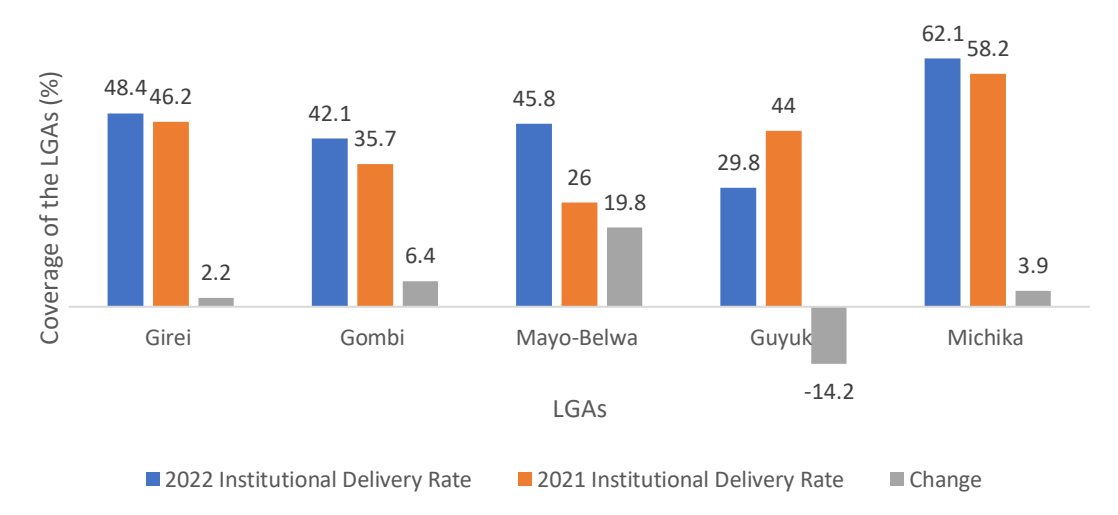

Figure 4. Comparison of Institutional Delivery for 2021 and 2022

Percentage Improvement of the Intervention on CPR

The intervention coverage presented in Figure 5 compares the performance of the intervention LGAs on CPR for 2021 and 2022 in the five intervention LGAs. The result indicated an improvement in CPR in Gombi and Mayo-Belwa from 5.7% to 18.1%. A decline in performance was reported in Gombi, Guyuk, and Michika LGAs with - 6.1%, 33.2%, and 1.6%, respectively.

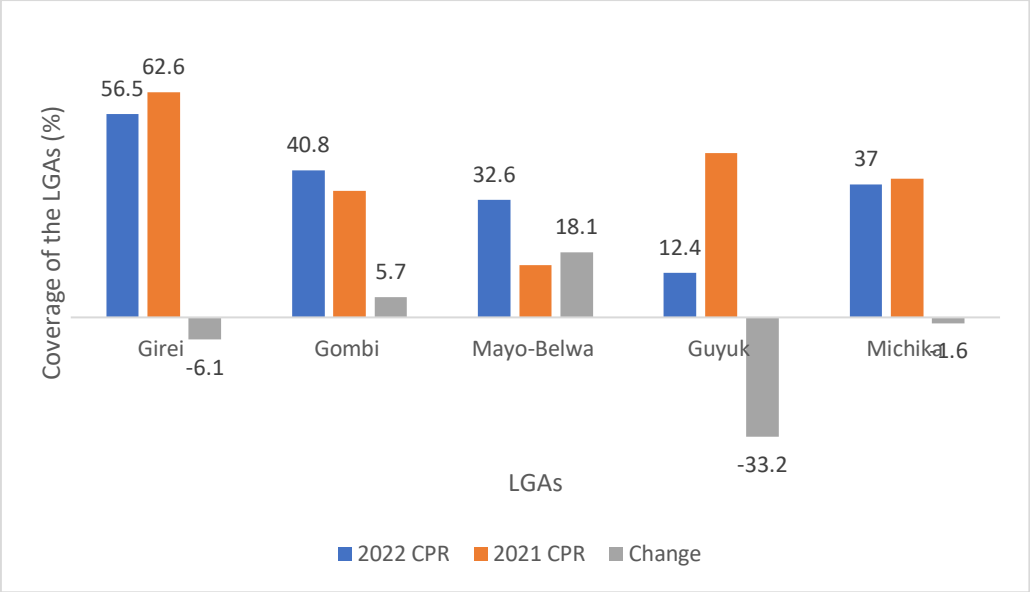

Figure 5. Comparison of CPR Coverage for the Baseline and the Intervention Periods; 2021 and 2022

Percentage Improvement of the Intervention LGAs on Childs Indices

The Penta 3 coverage presented in Figure 6 compares the percentage improvement of the Penta 3 coverage in the intervention LGAs. The result indicated improvement in Gombi, Mayo-Belwa, and Michika with 14.9%, 16.5%, and 5.8%, respectively. Negative improvement was noticed in Girei and Guyuk LGAs with – 4.4%, - 4.9%, and respectively. Furthermore, figure 7 indicates the dropout rate for Penta 3. The result indicated a general reduction in the dropout rate in Girei, Gombi, and Mayo-belwa. The dropout rate increased in Guyuk LGA.

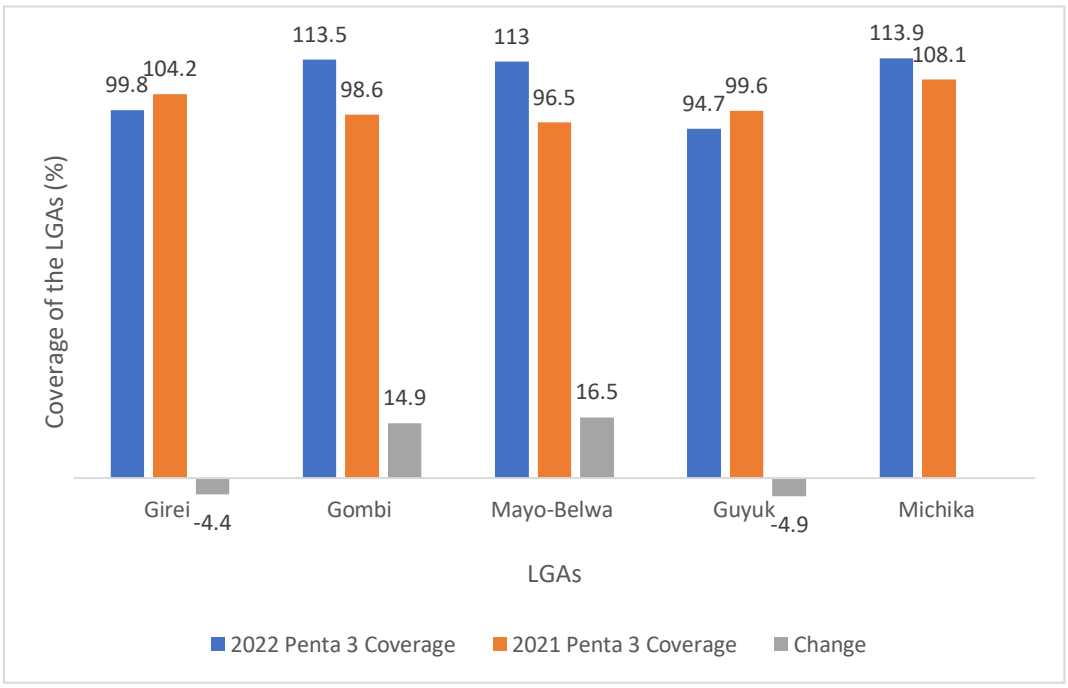

Figure 6. Comparison of Penta 3 for 2021and 2022

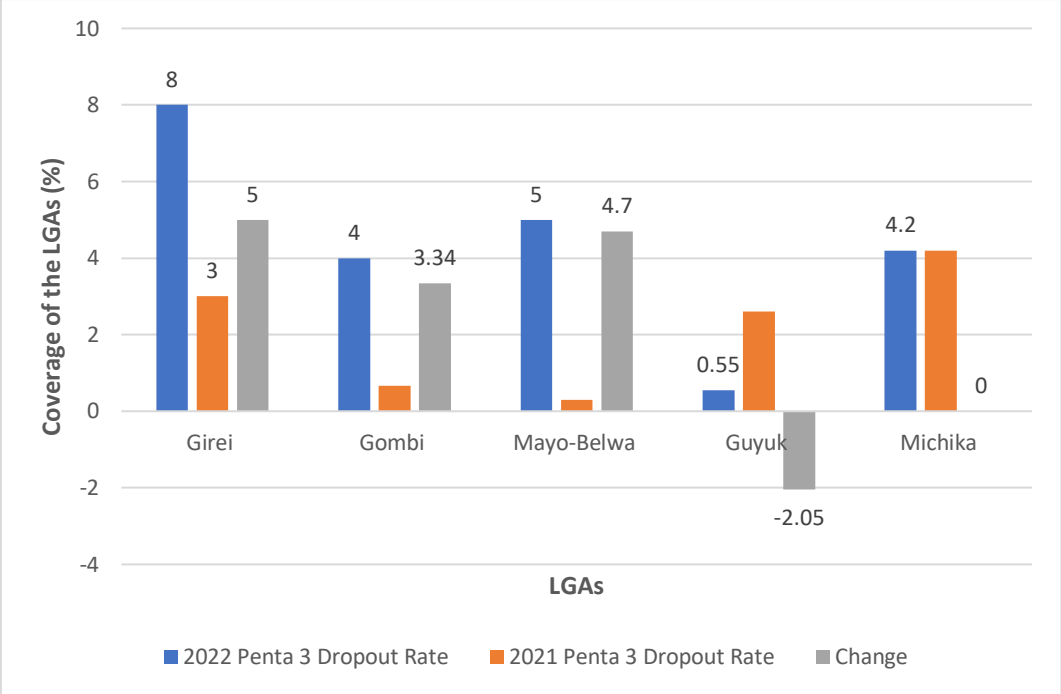

Figure 7. Comparison of Penta 3 Drop Out for 2021 and 2022

Coverage of Key Selected Childs Indices Across the Intervention LGAs

The selected child indices coverage presented in Figure 8 compares the percentage improvement for measles vaccination in the intervention LGAs. The result indicated slight improvement in Girei (0.8%), 11.7% in Gombi, 16.1% in Mayo-Belwa, and 32.4% in Michika. Negative improvement was noticed in Guyuk LGA (- 8.5%). Furthermore, figure 9 compares vitamin A supplementation. Five LGAs, including Girei, Gombi, Mayo-belwa, and Guyuk, improved with 237.7 %, 132.2%, 169.8%, and 86.4%, respectively. Michika LGA indicated a negative improvement of 34.9%.

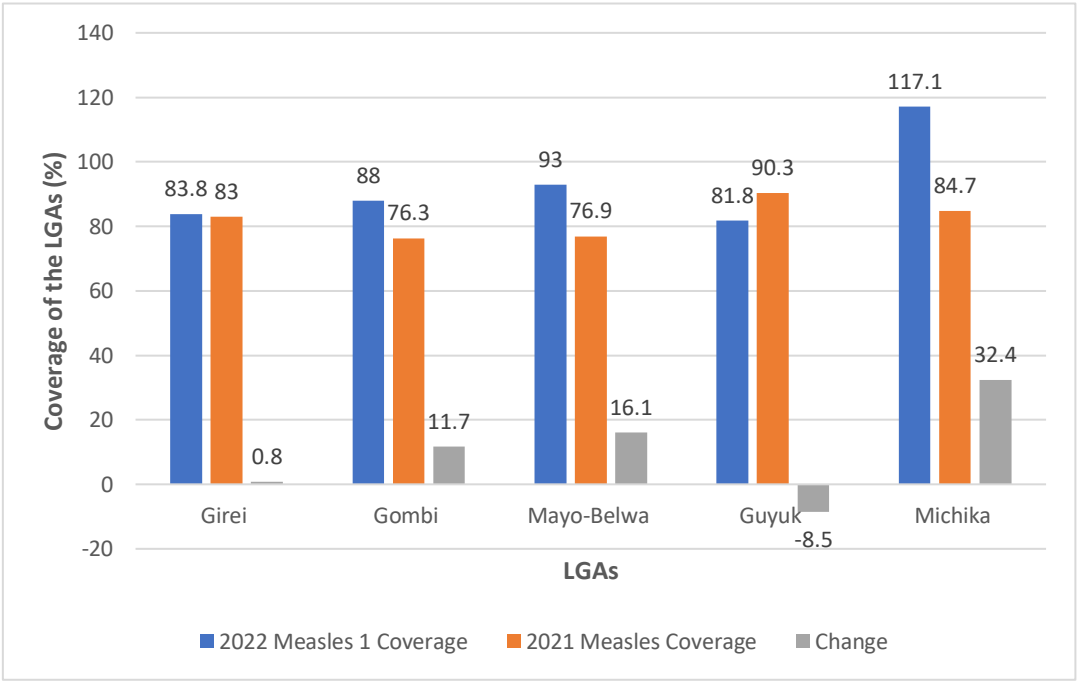

Figure 8. Comparison of Measles 1 for 2021 and 2022

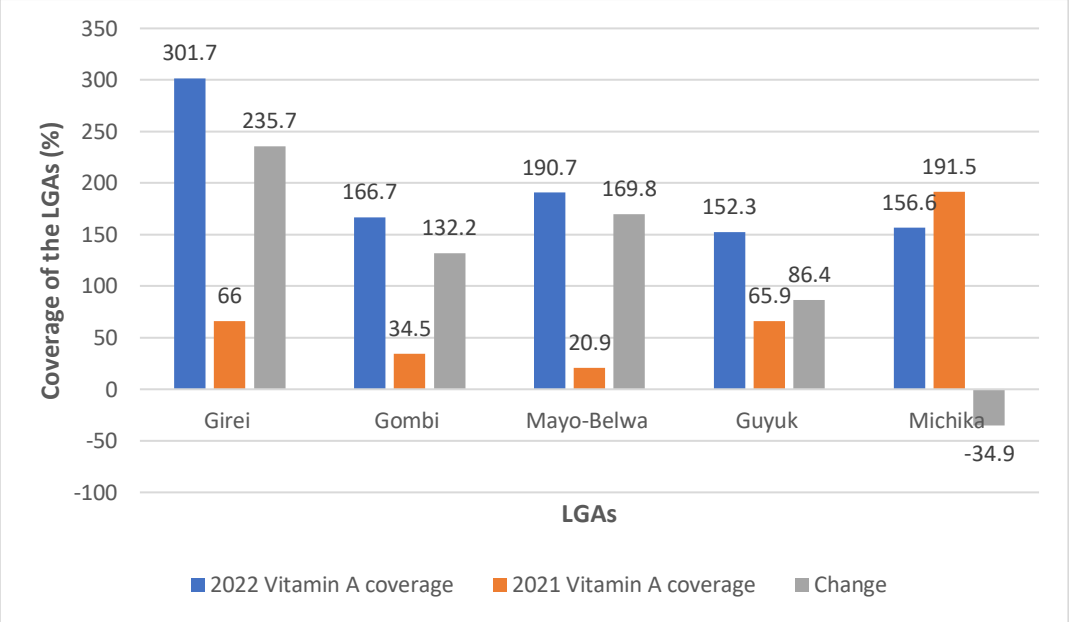

Figure 9. Comparison of Vitamin A for 2021 and 2022

Discussion

This study examined the outcome of two interventions (mobile outreach and health facility outreach interventions) conducted in rural, underserved, and HTR communities. These interventions focused on maternal, newborn, and child health care services. The maternal outcomes were RI, ANC 1, ANC 4, ANC 8, institutional delivery, and use of modern contraceptives. On the other hand, for child health care services, the study focused on routine immunizations and vitamin A supplementation. The findings indicated an average improvement in all the indicators examined. Furthermore, the data obtained re-iterates the continuous demand for such services in the communities. [8] indicated that integrated periodic outreach services (IPOS) have contributed immensely to the improvement of maternal and child health services in hard-to-reach communities. Therefore, a scale-up of the strategy is highly recommended.

On maternal services, our data showed a high coverage range of 2 to 99% across the 5 intervention LGAs (Mayo-belwa, Guyuk, Girei, Gombi, and Michika). The WHO recommends using Td for immunization against tetanus [14]. The package in this intervention includes Td vaccinations for pregnant women. This study indicated high coverage of TT vaccination in pregnant women. The high coverage of maternal RI (Tetanus toxoid injection) in this study is due to the increase in access to ANC services for all pregnant women. The data from this intervention is lower than the reported 81.97% by [15]. This is due to the effective mobilization conducted prior to the intervention. Furthermore, folic acid and IPT for malaria were also provided. The data indicated a high acceptance of both folic acid and IPT, which is higher than the 17.83% reported by [15]. According to the World Health Organization (WHO), specific maternal interventions such as folic supplementation for pregnant and postpartum women, as well as intermittent preventive treatment in pregnancy (IPTp), have helped improve maternal healthcare [16]. In addition, the acceptance of modern contraceptives among WRAG is generally low compared to but higher than the 23.87% reported by [17], 26.3% reported in Senegal by [18], and 15% reported by [19]. The possible reason for the discrepancies might be due to a difference in knowledge and awareness of modern contraceptive methods.

The coverage of the intervention LGAs on children's services provided indicated a general poor acceptance ranging from 0.2 to 16%. This

is, however, very low compared to studies conducted within and outside Nigeria, such as the 52.4% reported in southern Ethiopia by [20] and the 73.2% reported in Africa by [21]. The possible reasons for the drawback in children's immunization status could include the first model place of delivery, mother's education status, and living area, which are found to be the contributing factors for children's immunization status. Periodic vitamin A supplementation is a major intervention to reduce morbidity, mortality, and blindness among children in developing countries [22]. Our study indicated the acceptance of vitamin A in some of the LGAs, where most of the children between 6 and 59 months had over 100%. However, in some communities, poor acceptance was recorded at only 2.3%. Notwithstanding, the low coverage in these areas is perhaps due to the poor community mobilization during our intervention period in the affected LGAs. Another important factor in child health is helminth reduction. Preschool-age children are more vulnerable to soil-transmitted helminths (STH), which cause millions of morbidities. This is often associated with low socio-economic status and a lack of clean water and sanitation [23]. Our study indicated a higher acceptance of deworming for children less than 5 years old in some of the LGAs. This is in agreement with the 44.0% reported in Ghana by [24]. Diarrheal diseases remain the second leading cause of death among children under five years of age globally. On the other hand, we found out that the coverage of diarrhea in children younger than 5 years in this study ranged from 0 to 10%. This is lower than the reported 38% in a study conducted by [18]. The lower coverage in this study is associated with the increased awareness of people in the state of the need to use portable drinking water, particularly for children less than 5 years old.

The study's findings indicated improvements in both ANC 1, 4, and 8, institutional delivery, and use of modern contraceptives (CPR) in all the communities in 4 LGAs when compared with the baseline of 2021. This is similar to the work conducted in Ghana by [25]. The results obtained in this study are lower than the 77.89% reported in Ghana and Nigeria. 53.1% reported in the southern part of Nigeria by [26], 68.5% reported by [27], and similar to the 31.7% reported in rural Dembia District, northwest Ethiopia by [28]. Increased health education during outreach services implemented in rural communities may influence the need for institutional delivery in the LGAs. Antenatal care guarantees optimal health for both mothers and new-born babies. Appropriate care during pregnancy is essential for the health of the mother and the development of the unborn baby, the promotion of healthy behaviors and parenting skills, and establishing a link between the woman and the health system [27]. Our study further indicated a slight improvement in institutional delivery. This is lower than the 77.89% reported by [29]. Furthermore, low improvements are noticed in the use of modern contraceptives. The coverage of CPR in our study ranges between -33.2 and 38.6%. This is low compared to the 16.8% reported by [29]. The low improvement may be due to cultural inclination and fear of side effects [30, 31].

The study's findings further revealed low coverage of children younger than 5 years provided with child services including OPV, HBV, PCV, Penta, IPV, Men A, and Measles vaccinations. This indicated that most of the children in these communities have access to routine immunization. These children who accessed these services during this intervention generally missed opportunities that were hitherto not reached with these vital services across these communities, which may lead to increased chances of child mortality due to vaccine-preventable diseases. [32] reported that an estimated 29% of deaths among children aged 1–59 months were due to vaccine-preventable diseases. This intervention will reduce child morbidity and mortality in these communities and will help in the achievement of MDG5 and enhance UHC attainment [33] in Adamawa State. Our study's findings also indicated

improvements in routine immunization coverage, measles, vitamin A supplementation of children, deworming, and nutritional screening of children in hard-to-reach areas after the implementation of the interventions. This finding is in line with studies conducted in Bangladesh and Nigeria, where combined or integrated interventions improved child immunization coverage in rural, underserved, and hard-to-reach settlements. According to the results of a literature review of integrated outreach services, after the implementation of integrated outreach services for five years, the proportion of children aged 12–23 months who received full primary immunization increased by about 16 percentage points [34]. A study conducted in hard-to-reach areas in Nigeria documents the process and outcomes of conducting integrated mobile vaccination services. It also showed that oral polio vaccine 3 coverage among children under one improved from 23% at baseline to 61%, and penta 3 coverage increased from 22–55% [35]. Our intervention indicated a slight improvement in penta-3 coverage in some of the LGAs. Pena 3 rate in the study LGAs reduced tremendously. This indicated that the majority of the children less than 2 years old have received the penta-3 vaccine. Measles vaccination and vitamin A supplementation also improved in this study. The overall improvement in this child will help reduce child morbidity and mortality.

Conclusions

Overall, our intervention successfully improved maternal and child health indicators in the LGAs of Adamawa State, Nigeria. The implementation of this intervention (HF and mobile outreach) made significant contributions towards the improvement of both maternal and child health services among the hard-to-teach communities and has led to an improvement in maternal and child indices in Adamawa State. The key indicators improved are ANC attendance, CPR, institutional delivery, routine immunization, vitamin A supplementation, and deworming. Our study demonstrated that the community outreach program using health facilities and mobile outreach platforms has the capacity to improve maternal and child indicators and reduce maternal and child mortality. Furthermore, this study underscores the need to engage community gatekeepers in the planning and implementation of programs, which will increase the demand for services.

Outreach services are also noticed as the best strategy for ensuring MNCH services are delivered to the people in the HTR communities and will lead to a reduction of maternal and child morbidities and mortalities in rural, underserved, and HTR communities.

Intervention programs such as outreach services no doubt improve maternal and child health indices and will reduce maternal morbidity and mortality.

Recommendation

This study recommends the need for the government and all other stakeholders to provide more support to health workers and provide logistics to ensure continuous outreach services in the HTR communities. Also, Ensuring the sustainability and ownership of outreach services implementation by making it part of annual HF-based planning exercises is also recommended.

Community engagement and involvement are indispensable activities for the effective implementation of strategies that aim to address equity gaps and improve access to maternal and child services, which is also recommended by this study.

Conflict of Interest

No conflict of interest reported in this study.

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References

[1] Haruna, U., Dandeebo, G., & Galaa, S. Z. (2019). Improving access and utilization of maternal healthcare services through focused antenatal care in rural Ghana: a qualitative study. *Advances in Public Health*, *2019*.

[2] Esamai, F., Nangami, M., Tabu, J., Mwangi, A., Ayuku, D., & Were, E. (2017). A system approach to improving maternal and child health care delivery in Kenya: innovations at the community and primary care facilities (a protocol). *Reproductive health*, *14*, 1-18.

[3] Hanif, M., Khalid, S., Rasul, A. & Mahmood, K. (2021). Maternal mortality in rural areas of Pakistan: challenges and prospects. *Rural Heal*, *27*, 1040-1047.

[4] Blackwell, S., Louis, J. M., Norton, M. E., Lappen, J. R., Pettker, C. M., Kaimal, A., ... & Landis, R. (2020). Reproductive services for women at high risk for maternal mortality: a report of the workshop of the Society for Maternal-Fetal Medicine, the American College of Obstetricians and Gynecologists, the Fellowship in Family Planning, and the Society of Family Planning. *American Journal of Obstetrics & Gynecology*, *222*(4), B2-B18.

[5] McIntyre, D., Thiede, M., & Birch, S. (2009). Access as a policy-relevant concept in low- and middle-income countries. *Health economics, policy, and law*, *4*(Pt 2), 179–193. https://doi.org/10.1017/S1744133109004836

[6] Oluwadare, C. (2009). The social determinants of routine immunisation in Ekiti State of Nigeria. *Studies on Ethno-Medicine*, *3*(1), 49-56.

[7] DHS Program retrieved from: https://www.dhsprogram.com/pubs/pdfAssessed August 2023.

[8] Tsegaye, Z. T., Sinamo, T., Desta, B. F., Beshir, I. A.& Abawollo, H. S. (2022). Integrated Periodic Outreach Strategy to Improve Maternal and Child health Service Access Among Hard-to-Reach Areas in Ethiopia.

[9] Garchitorena, A., Miller, A. C., Cordier, L. F., Rabeza, V. R., Randriamanambintsoa, M., Razanadrakato, H. T. R., ... & Bonds, M. H. (2018). Early changes in intervention coverage and mortality rates following the implementation of an integrated

health system intervention in Madagascar. *BMJ global health*, *3*(3), e000762.

[10] Roodenbeke, E. D., & World Health Organization. (2011). *Outreach services as a strategy to increase access to health workers in remote and rural areas*. World Health Organization.

[11] Mweemba, C., Mapulanga, M., Jacobs, C., Katowa-Mukwato, P., & Maimbolwa, M. (2021). Access barriers to maternal healthcare services in selected hard-to-reach areas of Zambia: a mixed methods design. *Pan African Medical Journal*, *40*(1).

[12] DHIS 2 retrieved from: https://www.dhis2.0.org. Assessed January 2022

[13] Mweemba, C., Mapulanga, M., Jacobs, C., Katowa-Mukwato, P., & Maimbolwa, M. (2021). Access barriers to maternal healthcare services in selected hard-to-reach areas of Zambia: a mixed methods design. *Pan African Medical Journal*, *40*(1).

[14] Partapuri, T., Steinglass, R., & Sequeira, J. (2012). Integrated delivery of health services during outreach visits: a literature review of program experience through a routine immunization lens. *Journal of Infectious Diseases*, *205*(suppl_1), S20-S27.

[15] Yaya, S., Komlan K., Amos B., and Ghose B. (2019). "Antenatal Visits Are Positively Associated with Uptake of Tetanus Toxoid and Intermittent Preventive Treatment in Pregnancy in Ivory Coast.": 1–12.

[16] Nuamah, G. B., Agyei-Baffour, P., Mensah, K. A., Boateng, D., Quansah, D. Y., Dobin, D., & Addai-Donkor, K. (2019). Access and utilization of maternal healthcare in a rural district in the forest belt of Ghana. *BMC pregnancy and childbirth*, *19*, 1-11.

[17] Tsegaw, Menen. 2022. "Modern Contraceptive Utilization and Associated Factors Among Married Women in Liberia: Evidence from the 2019 Liberia Demographic and Health Survey." (February): 17–28.

[18] Lun, C. N., Aung, T., & Mya, K. S. (2021). Utilization of modern contraceptive methods and its determinants among youth in Myanmar: Analysis of Myanmar Demographic and Health Survey (2015-2016). *Plos one*, *16*(10), e0258142.

[19] Hailu, S., Astatkie, A., Johansson, K. A., & Lindtjørn, B. (2019). Low immunization coverage in Wonago district, southern Ethiopia: a community-based cross-sectional study. *PloS one*, *14*(7), e0220144.

[20] Animaw, W., Taye, W., Merdekios, B., Tilahun, M., & Ayele, G. (2014). Expanded program of immunization coverage and associated factors among children aged 12–23 months in Arba Minch town and Zuria District, Southern Ethiopia, 2013. *BMC public health*, *14*(1), 1-10.

[21] Berihun, B., Chemir, F., Gebru, M., & GebreEyesus, F. A. (2023). Vitamin A supplementation coverage and its associated factors among children aged 6–59 months in West Azernet Berbere Woreda, Southwest Ethiopia. *BMC pediatrics*, *23*(1), 1-13.

[22] Belay, D. G., Kibret, A. A., Diress, M., Gela, Y. Y., Sinamaw, D., Simegn, W., ... & Chilot, D. (2022). Deworming among preschool age children in sub-Saharan Africa: pooled prevalence and multi-level analysis. *Tropical Medicine and Health*, *50*(1), 74.

[23] Forson, A. O., Abdul-Basit, S., Awusi, G. K., Taiwo, M. O., & Baidoo, I. A. (2023). A comparative study on the prevalence of intestinal hel-minths in dewormed and non-dewormed healthy persons in Ghana. *J Clin Images Med Case Rep*, *4*(3), 2322.

[24] Zegeye, B., Ahinkorah, B. O., Idriss-Wheeler, D., Olorunsaiye, C. Z., Adjei, N. K., & Yaya, S. (2021). Modern contraceptive utilization and its associated factors among married women in Senegal: a multilevel analysis. *BMC Public Health*, *21*(1), 1-13.

[25] Manyeh, A. K., Amu, A., Williams, J., & Gyapong, M. (2020). Factors associated with the timing of antenatal clinic attendance among first-time mothers in rural southern Ghana. *BMC pregnancy and childbirth*, *20*(1), 1-7.

[26] Ahuru, R. R. & Omon, I. J. (2019). Predictors of Antenatal Care Utilization in Primary Healthcare Centers in Eight Rural Communities in Delta State, Nigeria. *African Journal of Health Economics*, *8*, 1-2.

[27] Nuamah, G. B., Agyei-Baffour, P., Mensah, K. A., Boateng, D., Quansah, D. Y., Dobin, D., & Addai-Donkor, K. (2019). Access and utilization of maternal healthcare in a rural district in the forest belt of Ghana. *BMC pregnancy and childbirth*, *19*, 1-11.

[28] Debebe, S., Miteku A. L. and Belete, B. (2017). "Modern Contraceptive Methods Utilization and Associated Factors among Reproductive Aged Women in Rural Dembia District, Northwest Ethiopia: Community Based Cross-Sectional Study." *International Journal of Reproductive BioMedicine* 15(6): 367–74.

[29] Maxwell T. Kumbenia and Paschal A. Apangab. (2021). "Institutional Delivery and Associated Factors among Women in Ghana: Findings from a 2017 – 2018 Multiple Indicator Cluster Survey.": 1–7.

[30] Asekun O E, Adebimpe W, Bamidele J, Odu O, Asekun O I, Ojofeitimi E. Barriers to use of modern contraceptives among women in an inner-city area of Osogbo metropolis, Osun state, Nigeria. *Int J Women H.* 2013;11(5):647–655

[31] Durowade KA, Omokanye LO, Elegbede OE, Adetokunbo S, Olomofe CO, Ajiboye AD, Adeniyi MA, Sanni TA. Barriers to Contraceptive Uptake among Women of Reproductive Age in a Semi-Urban Community of Ekiti State, Southwest Nigeria. Ethiop J Health Sci. 2017 Mar;27(2):121-128.

[32] Haddrill, R., Jones, G. L., Mitchell, C. A., & Anumba, D. O. (2014). Understanding delayed access to antenatal care: a qualitative interview study. *BMC pregnancy and childbirth*, *14*(1), 1-14.

[33] Modibbo, U. M., Ali, I., & Ahmed, A. (2021). Multi-objective optimization modelling for analysing sustainable development goals of Nigeria: Agenda 2030. *Environment, Development and Sustainability*, *23*(6), 9529-9563.

[34] Galadima, A. N., Zulkefli, N. A. M., Said, S. M., & Ahmad, N. (2021). Factors influencing childhood immunisation uptake in Africa: a systematic review. *BMC Public Health*, *21*(1), 1-20.

[35] Nour, T. Y., Farah, A. M., Ali, O. M., & Abate, K. H. (2020). Immunization coverage in Ethiopia among 12–23-month-old children: systematic review and meta-analysis. *BMC Public Health*, *20*(1), 1-12.