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Samuel Bawa et al.

Primary care for hard-to-reach communities, Nigeria

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Using the polio programme to deliver primary health care in Nigeria: implementation research

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Abstract

Objective To evaluate a project that integrated essential primary health-care services into the oral polio vaccine programme in hard-to-reach, underserved communities in northern Nigeria.

Methods In 2013, Nigeria's polio emergency operation centre adopted a new approach to rapidly raise polio immunity and reduce newborn, child and maternal morbidity and mortality. We identified, trained and equipped eighty-four mobile health teams to provide free vaccination and primary-care services in 3176 hard-to-reach settlements. We conducted cross-sectional surveys of women of childbearing age in households with children younger than 5 years, in 317 randomly selected settlements, pre- and post-intervention (March 2014 and November 2015, respectively).

Findings From June 2014 to September 2015 mobile health teams delivered 2 979 408 doses of oral polio vaccine and dewormed 1 562 640 children younger than 5 years old; performed 676 678 antenatal consultations and treated 1 682 671 illnesses in women and children, including pneumonia, diarrhoea and malaria. The baseline survey found that 758 (19.6%) of 3872 children younger than 5 years had routine immunization cards and 690/3872 (17.8%) were fully immunized for their age. The endline survey found 1757/3575 children (49.1%) with routine immunization cards and 1750 (49.0%) fully immunized. Children vaccinated with 3 or more doses of oral polio vaccine increased from 2133 (55.1%) to 2666 (74.6%). Households' use of mobile health services in the previous 6 months increased from 509/1472 (34.6%) to 2060/2426(84.9%).

Conclusion Integrating routine primary-care services into polio eradication activities in Nigeria resulted in increased coverage for supplemental oral polio vaccine doses and essential maternal, newborn and child health interventions.

Introduction

The World Health Organization (WHO) has called for universal health coverage (UHC) to be available for all people and communities, emphasizing the need for promotive, preventive, curative, rehabilitative and palliative health services that do not expose the user to financial hardship.¹ Achieving UHC, including quality essential service coverage and financial protection for all, is a target of sustainable development goal (SDG) 3 to ensure healthy lives and promote well-being for all at all ages.² Furthermore, the Global Vaccine Action Plan also seeks to realize a world in which all individuals and communities enjoy the full benefit of immunization, including use of immunization systems for delivery of other primary health-care programmes.³ Given their global reach (98.8 of 116.2 million infants receiving three doses of diphtheria–tetanus–pertussis vaccine), immunization programmes provide a platform on which to strengthen UHC.⁴ Notably, Nigeria's national polio eradication programme's emphasis on reaching every household is an opportunity to reduce inequities in health by reaching the most vulnerable groups of the population.⁵

According to the milestones of the Polio Eradication and Endgame Strategic Plan 2013–2018, poliovirus transmission was to be stopped globally by the end of 2014.⁶ In 2013, Nigeria was one of three remaining polio-endemic countries worldwide.⁷ However, challenges remained in achieving adequate polio vaccine coverage in Nigeria, putting the polio eradication goal at risk. The country reported 53 people with poliovirus that year, 46 (86.8%) in the northern states of Bauchi, Borno, Kano and Yobe, and five people with vaccine-derived poliovirus isolated from Borno and Adamawa states.⁸ Most were children from poor, rural families living in areas deemed hard-to-reach due to distance or geography.

People in hard-to reach settlements generally experience low coverage of basic public health services including routine immunization and maternal, newborn and child health services. In 2013, Nigeria had made progress in maternal and child health but continued to record high estimates of newborn, under-five and maternal mortality.⁹ The country also had the 10th highest under-five mortality rate globally and the 15th highest maternal mortality of 560 per 100 000 live births (contributing to 14% of global maternal deaths, with 40 000 estimated deaths).¹⁰ For each of the indicators, the rates in the northern zones where polio transmission continued were as much as twice as high or more than the national figures.¹¹

Nigeria had been implementing traditional polio eradication strategies, including increasing immunity through routine immunization, regularly scheduled house-to-house oral polio vaccine supplemental immunization activities and sensitive surveillance for acute flaccid paralysis. Additionally, through the polio emergency operations centre, the polio programme had been continuously innovating to improve vaccine coverage (e.g. through use of satellite mapping and vaccine carrier trackers to identify unreached areas).^{12,13} Monitoring data showed that these efforts were achieving good results and that campaigns were reaching more children with every vaccination round. However, there were still a high number of unvaccinated children, especially in underserved communities and hard-to-reach areas, demonstrated by monitoring data and the presence of polio cases.¹⁴ In late 2013, to address this problem, the polio emergency operations centre adopted a new approach with technical and financial support from its partners: the WHO, the United Nations Children's Fund (UNICEF) and the Bill & Melinda Gates Foundation. The aim was to reach more children with routine immunizations, including oral polio vaccine, while also providing maternal and child health survival interventions during mobile outreach sessions in six priority northern states of Nigeria. This integrated approach became known as the Hard to Reach communities project. The project aimed to raise population immunity to polio and enable hard-to-reach and vulnerable communities to access essential primary health-care services including maternal, newborn and child health care.

This manuscript presents the evaluation of the project. We aimed to measure the project's effectiveness by assessing changes in immunization coverage, basic public health knowledge and access to and use of public health services in the selected communities.

Methods

Project implementation

We implemented the project for 18 months between 1 June 2014 and 30 September 2015. The project proposed to expand on an existing mobile outreach strategy for routine immunization that was part of Nigeria's national policy but not consistently implemented. The enhanced strategy provided routine immunization together with a basic integrated package of primary health-care interventions focused on maternal, newborn and child health.

The emergency operations centre selected a total of 3176 settlements in six northern states (Bauchi, Borno, Kaduna, Kano, Katsina and Yobe). Hard-to-reach settlements were communities that had geographically difficult terrain with any local or state border, scattered households, nomadic populations, waterlogged or riverine areas, or where it was difficult to access the health-care facilities due to insecurity. UNICEF managed implementation in Kano and Katsina, and WHO managed implementation in Bauchi, Borno, Kaduna and Yobe.

Each of the 84 mobile health teams comprised at least one nurse or midwife, a community health extension worker and a health records assistant. Staff were identified, trained and equipped with weighing scales, stethoscope, health commodities (e.g. essential drugs and consumables as contained in the UNICEF Emergency Health Kit) and recording tools. The 3-day training was provided within each state by facilitators using materials adapted from the Integrated Management of Childhood Illnesses and the Maternal, Neonatal and Child Health Week modules, with opportunities for refresher sessions during regular, monthly review meetings. Each team was assigned a specific number of settlements. Teams conducted mobile outreach visits to three to four settlements each week, and were expected to visit their assigned settlements once every 3 months. Their salaries were paid directly by UNICEF and WHO under non-staff consultancy contracts.

The teams coordinated closely with local health-care personnel and the community. They worked directly with the routine immunization focal person of the health facility in the settlement catchment area. Volunteer community mobilizers, usually women from the settlements, were engaged and paid a small stipend to announce the outreach dates and promote basic public health behaviours. These volunteers were trained in their respective wards of residence on community engagement and defaulter tracking.

The project also provided funds and transportation to the teams depending on route conditions (e.g. four-wheel drive vehicle, motorcycle or boat). Team movements were monitored by local government facilitators, using checklists and mobile devices (a geographical information tracking system), which showed real-time movements for the

purposes of monitoring settlement coverage and team security. Supervisors from partner organizations and the government project focal persons made supervisory field visits. There was an established programme review through monthly and quarterly review meetings at the state and subnational levels, respectively.

We summarized the records generated during each outreach session (numbers of children vaccinated, vitamin A provided, children dewormed and nutritional screenings done; numbers of people seen and treated for ailments) and sent them via mobile devices to a server domiciled with an independent geographical information system provider. Weekly summaries were collated to monitor the sessions conducted and coverage of services; and transmitted to the local and state government levels.

During the mobile outreach sessions, women and children in hard-to-reach settlements received a range of integrated health services. For example, pregnant women received antenatal care, malaria preventive therapy, iron folate, tetanus toxoid vaccine and treatment of illnesses (e.g. malaria and respiratory infections) or referral for care. Children aged 0–59 months received a full complement of routine immunizations (including oral polio vaccine), vitamin A supplements, deworming, diagnosis and referral for malnutrition, treatment of diarrhoea, pneumonia and malaria and additional referrals as required. In addition, all women attending outreach session were provided with health education on key household practices (hand washing, personal hygiene and infant feeding including exclusive breastfeeding).

Study design

To assess changes in coverage for polio immunization and maternal, newborn and child health services, we conducted cross-sectional surveys at the start (baseline, March 2014) and after the implementation of the project (endline, November 2015). We used a simple random sampling method to select 317 (10%) of the 3176 hard-to-reach settlements where the project was implemented.

Data collection

A cross-sectional survey was made of women of childbearing age (15–49 years) in households containing at least one child aged 0–59 months (10 households in each settlement). In selected settlement with 10 or less households, all the households in the settlement were sampled and if 10 eligible mothers were not obtained, the surveyor moves to the nearest settlement within the same local government area and completed the process. In

selected settlements with more than 10 households, the surveyor randomly selected the first household to be sampled and continued in a systematic way until 10 eligible mothers were obtained.

A total of 206 independent, trained surveyors administer the standardized questionnaires. The questionnaire asked about the women's demographic characteristics; knowledge of common preventable diseases; household's access to services and coverage; and household member's use of the mobile health sessions in their communities. The women were also asked about vaccinations for children younger than 5 years old in the household. Interviewers asked to see the vaccination card and records of polio vaccinations, asked the reason why any child had not been vaccinated and verified children's tuberculosis vaccine scars. Surveys were administered over a period of 7–10 days at baseline (15–24 March 2014) and endline (3–16 October 2015). Due to population dynamics, for example nomadic populations and displacement due to insecurity, the survey participants were not the same at baseline and endline. Households and respondents were not included in our second survey if they had not lived in the community for more than 6 months. Similarly, the settlements were not always the same, but must have been in the sampling frame, i.e. the selected settlements where the intervention was implemented.

We also collected data from the project records on the services provided during the mobile outreaches session, which included summaries of children vaccinated, numbers of clients seen and the diseases treated.

Data analyses

Analysis for the baseline and endline surveys were conducted separately to determine outcomes and to evaluate the integration of services. Analyses included comparisons of reported data across the six states during the studied periods. Descriptive analyses were used to compare information across the selected variables.

Ethical considerations

The surveys formed part of the monitoring and evaluation activities of the Hard-to-Reach communities project, that was not intended as research work, but instead as an intervention to improve vaccination uptake among hard-to-reach communities. However, the government of Nigeria approved the project as part of the Global Polio Eradication Initiative activities to achieve the goals of the national polio eradication emergency plans and granted permission for the activities in the project.

We obtained ethical clearance from the Bauchi state health research ethics committee. The survey assistants obtained informed consent from each survey participant after interpreting and explaining the consent section of the questionnaire in the participant's local language. Those who gave their consent continued with the interview.

Results

Project outcomes

During the project period, the mobile outreach sessions delivered 2 979 408 supplemental doses of oral polio vaccine to children younger than 5 years and 346 880 children were fully immunized (measles vaccine was used as a proxy for full immunization). More than 1.5 million children were dewormed; 676 678 antenatal care consultations were performed; 1 359 323 women were provided information on exclusive breastfeeding and more than 1.68 million illnesses among women and children were treated, including pneumonia, diarrhoea and malaria (Table 1).

Demographic characteristics

At baseline, we interviewed 3166 women with 3873 children younger than 5 years old. The endline survey included interviews with 2426 women with 4651 children younger than 5 years old.

Table 2 presents the demographic characteristics of the women. In the baseline sample, Fulani were the major ethnic group (1077; 37.1 %) and one-quarter of women (730; 25.1%) were from nomadic populations. At baseline, many women (1216; 41.8%) had no education and 1382 (47.6%) had Koranic rote learning only. Most of the women were crop farmers (1112; 38.3%). In the endline sample, the distribution of occupational characteristics was similar, but there was a lower proportion of women with no education (912; 37.6%) and Hausa were the majority ethnic group (987; 40.7%).

Awareness of diseases

At endline there was higher awareness about vaccine-preventable diseases and use of mobile outreach services among household caregivers. In the baseline survey, of the 2204 (75.8%) women aware of vaccine-preventable diseases, 523 (23.7%) were aware of measles and 484 (22.0%) of polio. In the endline survey, of 2105 (86.8%) women aware of vaccine-preventable diseases, 1806 (85.8%) and 1544 (73.3%) were aware of measles and polio, respectively. The numbers of women aware of cerebrospinal meningitis were 18 (0.8%) at

baseline and 156 (7.4%) at endline. An increase in the mothers' level of awareness was also recorded for tuberculosis, yellow fever and pertussis (Table 3).

Immunizations

At baseline, 758 out of 3872 children in the sample (19.6%) had routine immunization cards and 690 (17.8%) children were fully immunized for their age. At endline, 1757 of 3575 children (49.1%) had routine immunization cards and 1750 (49.0%) were fully immunized. The number of children with zero doses of polio immunization decreased from 445 (11.5%) at baseline to 167 (4.7%) at endline. The main reason for zero doses was caregivers refusing vaccination, with numbers reducing from 152 (36.9%) to 23 (13.9%; Table 3).

Access to services

Table 4 shows that the reported provision of mobile routine immunization outreach services coordinated through the nearest health facility in the 6 months before the survey increased from 34.6% (509/1472) to 84.9% (2060/2426). There was also an increase in reported access to free health services in the 2 weeks before the survey from 8.4% (122/1447) at baseline to 75.9% (858/1130) at endline.

Discussion

The integration of the polio eradication platform with additional primary health services to underserved communities demonstrates how an integration of outreach services can increase coverage and knowledge, reinforcing efforts to attain UHC and SDG 3.^{1,15,16} The model could be applied in areas where polio vaccine and routine immunization mobile outreach programmes could reach normally hard-to-reach and vulnerable communities with maternal, newborn and child health services they might not otherwise access.

The project appeared successful in increasing polio vaccination coverage as well as routine immunization and basic maternal, newborn and child health services among the selected communities, some of whom may never had had contact with the health system. There have been no polio cases or poliovirus-positive environmental samples in any of the settlements since the project began.¹⁷ The inclusion of volunteer community mobilizers helped to foster community involvement and demand for polio vaccine and other health-care services.^{16,18} Communities accessed free primary health care at mobile services. Knowledge about public health practices and services and some disease conditions improved. However, knowledge about pertussis and yellow fever decreased. This may not be unconnected with the

fact that with the drive for polio eradication, sensitization on other disease conditions may have been down-played.

Critical to the success of the project was securing the resources needed to train, equip, transport, supervise and remunerate the workforce. Of course, the additional staffing, transport, community mobilizers and costs of maternal, newborn and child health supplies required more funds than would oral polio vaccine or routine immunization sessions alone. However, by packaging these additional services together with polio vaccines and routine immunization outreach, economies of scale may be achieved. This hypothesis would benefit from further cost–benefit and cost–effectiveness studies.¹⁹

Another key component was stakeholder engagement and national and state government involvement in project design, monitoring, supervision and reviews, together with community and traditional leaders. This is similar to Cambodia’s integrated immunization programme, which has planned a national level monitoring strategy aimed at provision of adequate management support to provinces and districts.¹⁹

A longer-term impact evaluation would be required to measure outcomes in terms of reduction in morbidity and mortality associated with the interventions offered.^{20,21}

We experienced some challenges, however, which may or may not arise if such an approach were applied in other country settings. Security, for example, proved to be a major challenge particularly in Borno and Yobe states where the Boko Haram militant group insurgency caused insecurity and population displacement.^{22,23} The project adjusted by using funds to deliver integrated services to camps of internally displaced persons. Armed robbery and intercommunal clashes were also concerns. In Kaduna state, for example, the project could no longer serve one local government area due to prolonged intercommunal clashes, and UNICEF had to select another local government area in its place. A lesson is that programme implementation should be reviewed regularly so it can be adjusted flexibly, especially where health systems are affected by protracted humanitarian crises.

Health workers also observed that people from non-targeted settlements routinely arrived to seek services from the mobile teams, suggesting strong community demand. However, this also made target populations more difficult to enumerate and created challenges for stock management.

Our evaluation was not without limitations. Data collection was not uniform across the implementing states as WHO and UNICEF managed their programmes slightly

differently, hindering comparative analysis across all data points. For instance, while the teams in WHO used registers to capture treatment of clients, the UNICEF teams used tally sheets. Project reviews found health workers were not uniformly aware of the package of services to be offered and at times lacked sufficient skills to deliver the full package. This was similar to other findings where coverage and other quality indicators of integrated services were not always disaggregated by the service delivery approach.²⁴ Future efforts should address the need for uniformity of data collection variables for comparison and more uniformity in training materials and supervision of the mobile health teams.

Given the demanding nature of the work and the scarcity of health-care workers in some areas, it was at times difficult to identify and retain qualified staff and ensure a full complement of services per mobile team. Finally, there was the challenge of not depleting the mainstream health personnel by employing health workers seeking additional income, also reported in other studies.¹⁹

While the project promoted referrals (arising from severe acute malnutrition, for example) these were not always possible if there was no referral centre nearby or if fees at the health facility were prohibitively costly for clients.

Overall, the project demonstrated how the polio platform could be used to deliver an integrated mobile health strategy that helps to achieve greater equity for marginalized and vulnerable populations. Funding a dedicated, trained and equipped team of health workers to target hard-to-reach communities will have an impact in improving equitable access to basic health services. As a polio legacy project, it has also demonstrated how an integrated routine immunization mobile strategy could be planned, implemented and monitored to achieve greater equity for marginalized and vulnerable populations living in hard-to-reach areas.

As the project in some of the states improved delivery of health care to underserved areas, some state governments (Kano and Yobe) are offering continued support to sustain funding for its delivery. Furthermore, WHO's emergency programme, with funding from Borno and Yobe states, are conducting ongoing outreach in those states. The Canadian government is funding an ongoing collaboration with UNICEF in Niger, Jigawa, Taraba and Zamfara states.

The polio eradication platform – which usually includes expertise in how to plan to reach every child younger than 5 years, including those in vulnerable communities – could be used to plan integrated delivery of primary health-care services. Furthermore, countries that

include outreach sessions in their immunization strategy can integrate essential maternal, newborn and child health services and deliver them together with routine immunization. These efforts will require additional resources and continued commitment from governments. The Hard-to-Reach communities project demonstrates that those resources can result in more equitable access to health care for the most vulnerable – a key to UHC and achievement of SDG 3.

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Competing interests:

None declared.

References

1. What is universal coverage? Geneva: World Health Organization; 2018. Available from: http://www.who.int/health_financing/universal_coverage_definition/en/ [cited 2018 Jan 23].
2. World health statistics – monitoring health for the SDGs. Geneva: World Health Organization; 2016. Available from: http://www.who.int/gho/publications/world_health_statistics/2016/en/ [cited 2018 Jan 23].
3. Global Vaccine Action Plan 2011–2020. Geneva: World Health Organization; 2015. Available from: http://www.who.int/immunization/global_vaccine_action_plan/Global_Vaccine_Action_Plan_doc_2011_2020/en/ [cited 2018 Jan 23].
4. 9 in 10 infants worldwide received vaccinations in 2017 [internet]. Geneva: World Health Organization; 2018. Available from: http://www.who.int/immunization/newsroom/2018_infants_worldwide_vaccinations/en/ [cited 2018 Oct 11].
5. Nigeria polio eradication emergency plan 2014. Abuja: National Primary Healthcare Development Agency; 2014. Available from: http://polioeradication.org/wp-content/uploads/2016/07/4.2_10IMB.pdf [cited 2018 Nov 2].
6. Global Polio Eradication Initiative. Polio eradication and endgame strategic plan 2013–2018. Geneva: World Health Organization; 2013. Available from: http://polioeradication.org/wp-content/uploads/2016/07/PEESP_EN_A4.pdf [cited 2018 Jan 23].

7. Wassilak SGF, Oberste MS, Tangermann RH, Diop OM, Jafari HS, Armstrong GL. Progress toward global interruption of wild poliovirus transmission, 2010–2013, and tackling the challenges to complete eradication. *J Infect Dis.* 2014 Nov 1;210 Suppl 1:S5–15. <https://doi.org/10.1093/infdis/jiu456> PMID:25316873
8. Ado JM, Etsano A, Shuaib F, Damisa E, Mkanda P, Gasasira A, et al. Progress toward poliomyelitis eradication in Nigeria. *J Infect Dis.* 2014 Nov 1;210 Suppl 1:S40–9. <https://doi.org/10.1093/infdis/jiu318> PMID:25316862
9. Monitoring the situation of children and women. Nigeria: Multiple Indicator Cluster Survey 2011. Abuja: National Bureau of Statistics, United Nations Children’s Fund, United Nations Population Fund; 2011. Available from: https://www.unicef.org/nigeria/Multiple_Indicators_Cluster_Survey_4_Report.pdf [cited 2018 Jan 23].
10. Trends in maternal mortality 1990–2013. Estimates by WHO, UNICEF, UNFPA, The World Bank and the United Nations Population Division. Geneva: World Health Organization; 2014. Available from: <http://www.who.int/reproductivehealth/publications/monitoring/maternal-mortality-2013/en/> [cited 2018 Jan 25].
11. Mother, newborn and child health and mortality Nigeria – general facts. Key facts 1–2 (2013) [internet]. New York: United Nations Children’s Fund; 2013. Available from: https://www.unicef.org/nigeria/ng_publications_advocacybrochure.pdf [cited 2018 Aug 31].
12. Hamisu AW, Johnson TM, Craig K, Mkanda P, Banda R, Tegegne SG, et al. Strategies for improving polio surveillance performance in the security-challenged Nigerian states of Adamawa, Borno, and Yobe during 2009–2014. *J Infect Dis.* 2016 May 1;213 Suppl 3:S136–9. <https://doi.org/10.1093/infdis/jiv530> PMID:26655842
13. Touray K, Mkanda P, Tegegn SG, Nsubuga P, Erbetto TB, Banda R, et al. Tracking vaccination teams during polio campaigns in northern Nigeria by use of geographic information system technology: 2013–2015. *J Infect Dis.* 2016 May 1;213 Suppl 3:S67–72. <https://doi.org/10.1093/infdis/jiv493> PMID:26609004
14. Gidado SO, Oluabunwo C, Nguku PM, Ogbuanu IU, Waziri NE, Biya O, et al.; N-STOP Outreach Team. Outreach to underserved communities in northern Nigeria, 2012–2013. *J Infect Dis.* 2014 Nov 1;210 Suppl 1:S118–24. <https://doi.org/10.1093/infdis/jiu197> PMID:25316825
15. Chapman AR. Assessing the universal health coverage target in the sustainable development goals from a human rights perspective. *BMC Int Health Hum Rights.* 2016 12 15;16(1):33. <https://doi.org/10.1186/s12914-016-0106-y> PMID:27978827
16. Ongwae KM, Bawa SB, Shuaib F, Braka F, Corkum M, Isa HK. Use of Dedicated mobile teams and polio volunteer community mobilizers to increase access to zero-dose oral poliovirus vaccine and routine childhood immunizations in settlements at high risk for polio transmission in northern Nigeria. *J Infect Dis.*

2017 Jul 1;216 suppl_1:S267–72. <https://doi.org/10.1093/infdis/jiw520>
PMID:28838155

17. Global Polio Eradication Initiative [internet]. Geneva: World Health Organization. Available from: <http://polioeradication.org/> [cited 2018 Jan 23].
18. Warigon C, Mkanda P, Muhammed A, Etsano A, Korir C, Bawa S, et al. Demand creation for polio vaccine in persistently poor-performing communities of Northern Nigeria: 2013–2014. *J Infect Dis.* 2016 May 1;213 Suppl 3:S79–85. <https://doi.org/10.1093/infdis/jiv511> PMID:26908717
19. Partapuri T, Steinglass R, Sequeira J. Integrated delivery of health services during outreach visits: a literature review of program experience through a routine immunization lens. *J Infect Dis.* 2012 Mar;205 Suppl 1:S20–7. <https://doi.org/10.1093/infdis/jir771> PMID:22315382
20. Luckow PW, Kenny A, White E, Ballard M, Dorr L, Erlandson K, et al. Implementation research on community health workers' provision of maternal and child health services in rural Liberia. *Bull World Health Organ.* 2017 Feb 1;95(2):113–20. <https://doi.org/10.2471/BLT.16.175513> PMID:28250511
21. Byrne A, Hodge A, Jimenez-Soto E, Morgan A. What works? Strategies to increase reproductive, maternal and child health in difficult to access mountainous locations: a systematic literature review. *PLoS One.* 2014 02 3;9(2):e87683. <https://doi.org/10.1371/journal.pone.0087683> PMID:24498353
22. Shuaibu SS, Salleh MA, Shehu AY. The impact of Boko Haram insurgency on Nigerian national security. *Int J Acad Res Bus Soc Sci.* 2015;5(6):254–66. Available from: http://hrmars.com/hrmars_papers/The_Impact_of_Boko_Haram_Insurgency_on_Nigerian_National_Security.pdf [cited 2018 Jan 23].
23. Emmanuelar I. Insurgency and humanitarian crises in Northern Nigeria: the case of Boko Haram. *Afr J Polit Sci Int Relat.* 2015 Jul;9(7):284–96. <http://dx.doi.org/10.5897/AJPSIR2015.0789>
24. Partapuri T, Steinglass R, Sequeira J. Integrated delivery of health services during outreach visits: a literature review of program experience through a routine immunization lens. *J Infect Dis.* 2012 Mar;205 Suppl 1:S20–7. <https://doi.org/10.1093/infdis/jir771> PMID:22315382

Table 1. Results of programme interventions in six states in the hard-to-reach communities project in Nigeria, June 2014 to September 2016

Variable	State						Total
	Kaduna	Katsina	Bauchi	Borno	Kano	Yobe	
Population of target communities^a	8 152 952	7 784 740	6 533 157	5 799 337	12 983 043	3 274 833	44 528 062
Key interventions delivered							
Total no. of doses of oral polio vaccine given	338 910	577 317	641 107	598 454	370 342	453 278	2 979 408
No. of children (aged 0–11 months) fully oral polio vaccine immunized	13 303	27 449	57 612	62 758	31 712	33 049	225 883
No. of children fully immunized (measles vaccination)	22 392	61 042	93 465	83 765	20 917	65 299	346 880
No. of children receiving growth monitoring	309 731	388 175	378 633	211 320	270 673	282 622	1 841 154
No. of children given vitamin A	204 987	371 362	359 743	209 850	220 256	288 786	1 654 984
No. of children dewormed	210 502	346 617	361 161	201 471	197 901	244 988	1 562 640
No. of women reached with message on exclusive breastfeeding	220 609	251 830	258 686	140 121	290 819	197 258	1 359 323
No. of adults reached with education on key household practices ^b and health promotion	236 799	385 656	293 861	164 018	315 849	210 345	1 606 528
No. of minor ailments treated	151 346	263 707	225 234	348 312	326 116	367 956	1 682 671
No. of antenatal consultations done	27 312	55 795	239 077	127 569	55 186	171 739	676 678
No. of tetanus toxoid vaccine doses given	42 458	57 156	130 354	129 980	36 823	91 128	487 899
No. of iron folate doses given	38 766	57 452	220 548	91 051	42 144	71 319	521 280
No. of malaria intermittent preventive treatment doses given	24 038	50 605	67 425	80 931	29 729	37 718	290 446

^a Projected population by states from Nigeria 2006 population census.

^b Key household practices of integrated management of childhood illnesses.

Table 2. Demographic profile of household caregivers surveyed in the hard-to-reach communities project in Nigeria, at baseline (March 2014) and endline (November 2015)

Category	No. (%) of respondents	
	Baseline n = 2906	Endline n = 2426
Ethnic group		
Fulani	1077 (37.1)	931 (38.4)
Hausa	981 (33.8)	987 (40.7)
Kanuri	540 (18.6)	172 (7.1)
Shuwa or Arab	34 (1.2)	2 (0.1)
Margi	47 (1.6)	0 (0.0)
Other	227 (7.8)	334 (13.8)
Residential status		
Nomadic	730 (25.1)	769 (31.7)
Settled	2126 (73.2)	1657 (68.3)
No response	50 (1.7)	0 (0.0)
Educational level		
None	1216 (41.8)	912 (37.6)
Koranic	1382 (47.6)	1312 (54.1)
Primary	143 (4.9)	158 (6.5)
Secondary	95 (3.3)	42 (1.7)
Post-secondary	13 (0.4)	2 (0.1)
No response	57 (2.0)	0 (0.0)
Occupation		
Home keeper	461 (15.9)	467 (19.2)
Animal product seller	600 (20.6)	511 (21.1)
Casual labourer	96 (3.3)	171 (7.0)
Civil servant	31 (1.1)	26 (1.1)
Crop farmer	1112 (38.3)	715 (29.5)
Trader	283 (9.7)	482 (19.9)
Other	304 (10.5)	54 (2.2)
No response	19 (0.7)	0 (0.0)

Note: Inconsistencies arise in some values due to rounding.

Table 3. Vaccination coverage for children younger than 5 years old and household caregivers' awareness of vaccine-preventable diseases in the hard-to-reach communities project in Nigeria, at baseline (March 2014) and endline (November 2015)

Variable	No. (%) of respondents	
	Baseline	Endline
Children's vaccination history		
Total children sampled	3872 (100.0)	3575 (100.0)
Age of children sampled, months		
< 6	518 (13.4)	330 (9.2)
6–8	275 (7.1)	330 (9.2)
9–23	1259 (32.5)	1271 (35.6)
24–35	572 (14.8)	575 (16.1)
≥ 36	1210 (31.3)	1069 (29.9)
No response	38 (1.0)	0 (0.0)
Children with routine immunization card	758 (19.6)	1757 (49.1)
Children fully immunized for age at the time of survey	690 (17.8)	1750 (49.0)
Children with visible BCG scar	904 (23.3)	580 (16.2)
Children given supplemental oral polio vaccine, no. of doses		
0	445 (11.5)	167 (4.7)
1–3	1045 (27.0)	742 (20.8)
> 3	2133 (55.1)	2666 (74.6)
Don't know	249 (6.4)	0 (0.0)
Reasons for zero dose of oral polio vaccine ^a		
Caregiver refused vaccination	152 (36.9)	23 (13.8)
Awareness of vaccine-preventable diseases		
Total caregivers interviewed	2906 (100.0)	2426 (100.0)
Caregiver aware of any vaccine-preventable diseases	2204 (75.8)	2105 (86.8)
Caregiver aware of specific diseases ^b		
Cerebrospinal meningitis	18 (0.8)	156 (7.4)
Tuberculosis	46 (2.1)	250 (11.9)
Yellow fever	40 (1.8)	619 (29.4)
Pertussis	101 (4.6)	843 (40.0)
Polio	484 (22.0)	1544 (73.3)
Measles	523 (23.7)	1806 (85.8)

BCG: bacille Calmette–Guérin.

^a The denominator for percentages is the number of children with zero doses of supplemental oral polio vaccine.

^b The denominator for percentages is the number of caregivers aware of any vaccine-preventable disease.

Note: Inconsistencies arise in some values due to rounding.

Table 4. Access to and use of health-care services reported by household caregivers in the hard-to-reach communities project in Nigeria, at baseline (March 2014) and endline (November 2015)

Variable	Baseline		Endline	
	Total respondents	No. (%) agreeing	Total respondents	No. (%) agreeing
Used mobile routine immunization service in the previous 6 months	1472	509 (34.6)	2426	2060 (84.9)
Aware of availability of free mobile health-care service	1830	396 (21.6)	2426	1975 (81.4)
Any member of the family accessed mobile health-care service in the previous 2 weeks	1447	122 (8.4)	1130	858 (75.9)