

Original Research Article

Evaluation of the impact of an intervention programme to revamp cold chain system and improve childhood immunization in Egbedore, Nigeria: a retrospective study

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ABSTRACT

Background: In 2016, the immunization coverage in Nigeria ranged from 3% in Sokoto State to 80% Lagos State while the national coverage was 33.3%. This is lower than the world health organization's recommendation of over 90%. Immunization coverages in Osun State and Egbedore, Osun State (the study area) were 60% and 83% respectively. Immunizations for specific vaccine preventable diseases are given to reduce infant morbidity and mortality. An intervention programme to revamp cold chain system was conducted to increase the immunization coverage and reduce the proportion of unimmunized children in Egbedore. The intervention programme comprised of focus group discussion involving immunization teams and mothers of under-five children, cold-chain inventory, observation of normal routine immunization (RI) sessions and observation of immunization outreaches. The aim of this study is to evaluate the impact of the intervention programme toward improving childhood immunization and increasing child survival in Egbedore

Methods: The study utilized a retrospective design, purposive sampling technique and secondary data.

Results: The result showed that before the intervention the proportion of unimmunized children for oral polio vaccine-3 (OPV3) was 0.27 which reduced to 0.17 ($\chi^2=169.441$, $p<0.0001$) after the intervention while for pentavalent vaccine-3, the proportion of children unimmunized was 0.28 before the intervention and reduced to 0.19 after the intervention, ($\chi^2=171.059$, $p<0.0001$)

Conclusions: The study concluded that regular cold chain equipment (CCE) inventory, repair and supply are germane to ensuring functionality while at least five immunization outreaches are required to be conducted per political ward to enhance optimal immunization coverage.

Keywords: Immunization, Coverage, Unimmunized, Cold chain

INTRODUCTION

Routine immunization (RI) to all eligible children is the best method to protect children from dying from infections that can be prevented by administration of vaccines.¹ However various reasons have been implicated in the poor coverage of eligible children with RI in all regions of Nigerian federation that ranges between 3% in

Sokoto to 80% in Lagos. In Osun State, RI coverage was 60% while in Egbedore local government Area, Osun State, Nigeria the immunization coverage of the infants was 74% and 73% in August and September 2018 respectively.^{2,3}

In view of the increasing incidence of infant morbidity and mortality which are often attributable to inadequate

nutrition and non or incomplete immunization among other reasons in most of sub-Saharan Africa, there is increasing need now than ever before to invest resources and time and rededicate efforts to increase coverage of RI and reduce number of unimmunized children in Nigeria and particularly in Osun State, South-west Nigeria.⁴⁻⁷

An intervention programme was conducted in October 2018 with the objectives to increase immunization coverage by the end of November 2018 and to reduce the percentage of children unimmunized for Pentavalent-3 and OPV-3 and consequently increase infant-child survival.⁸ The well-being of the under-five children is crucial to the survival of any society as they constitute about 20 percent of the population of any human society.⁹

Evidence from CCE inventories revealed that many countries are struggling to maintain the required storage temperatures with 17-33% of CCE across four countries found to be inactive at the time of assessment.¹⁰ Temperature monitoring studies (TMS) have found that active CCE are often not functioning properly, with significant temperature control problems and unfortunately malfunctioning are common at the facility level where Clinton health access initiative (CHAI) discovered that between 10% to 46% (mean, 29%) of CCE are exposing vaccines to freeze risk.¹⁰ In Nigeria evidence abounds that functionality issues represent chronic gaps in CCE management.^{11,6} The average time to repair a fridge at the LGA level ranges between two months and two years. The poor cold chain situation is worsened by excursions; extended deviations from the temperature range of 2-8 degrees centigrade are failing to be detected and resolved. Clinton health access initiative (CHAI) and partners who supported temperature monitoring studies (TMS) have detected extended excursions at the facility level, 9% to 20% of CCE in study facilities maintain sub-zero conditions for longer than 24 hours while 12% to 13% in study facilities maintain greater than 8-degree centigrade conditions for longer than 5 days.¹⁰

The intervention comprised of focus group discussion involving immunization team and mothers of under-five children, cold-chain inventory in Egbedore LGA, observation of the normal RI sessions and observation of RI outreaches. It appraised the problem and prospects of immunization programme in holistic manner on the programmatic aspect as well as cold chain management system touching cold chain equipment inventory with a view to determining their functionality and using study result to proffer a lasting solution. The objectives were to increase immunization coverage and stem the ugly tide of unacceptable proportion of unimmunized children.

METHODS

This study utilized a retrospective design to evaluate the impact of the intervention programme to revamp cold chain system and improve childhood immunization in Egbedore, South West, Nigeria.

Data extraction tool was utilized to extract data of under five children attending PHCs in Egbedore from medical records from Jan-Nov 2018. Data was also collected on report of cold chain inventory and immunization service delivery before and after intervention.

A purposive sampling of 9,884 infants attending PHCs in Egbedore were surveyed pre-intervention (January to September 2018) while 11,841 were surveyed post intervention (January to November 2018) for cumulative OPV3 coverage using health records.

A purposive sampling of 9,914 infants attending PHCs in Egbedore were also surveyed pre-intervention (January to September 2018) while 11,731 were surveyed post intervention (January to November 2018) for cumulative Pentavalent-3 coverage using health records.

IBM SPSS statistical analysis software was used for entry and analysis of data. Simple descriptive statistics of surveyed participants age and sex using tables was done. Chi squared test was conducted to compare proportion of unimmunized children before and after intervention. Level of significance was fixed at 5%. Data on cold chain inventory and immunization service delivery were presented using tables.

RESULTS

The mean age of infants surveyed for OPV 3 before intervention was 9.1 with standard deviation of ± 1.1 while mean age of infants surveyed for OPV3 after intervention was 9.1 with standard deviation of ± 1.1

Mean age of infants surveyed for Pentavalent 3 before intervention was 9.1 with standard deviation of ± 1.1 while mean age of infants surveyed for Pentavalent 3 after intervention was 9.1 with SD of ± 1.1 (Table 1).

Table 1: Descriptive statistics of age of infants surveyed (OPV3 and Pentavalent 3 from January to September 2018 before and after intervention).

Intervention	Vaccine	Mean age (Months)	SD
Before	OPV3	9.1	± 1.1
After	OPV3	9.1	± 1.1
Before	Pentavalent 3	9.1	± 1.1
After	Pentavalent 3	9.1	± 1.1

The proportion of male infants surveyed for OPV3 was 48% before and after intervention while the proportion of female infants surveyed for OPV was 52% before and after intervention. The proportion of male infants surveyed for OPV3 was 48% before and after intervention while the proportion of female infants surveyed for OPV was 52% before and after intervention (Table 2).

Coverage of OPV3 was 73% and proportion of unimmunized children was 27% (pre intervention from

Jan-Sept 2018) while OPV3 coverage was 82% and proportion of unimmunized children was 18% (post intervention from Jan-Nov 2018). There is statistically significant difference ($p < 0.05$) in proportion of children unimmunized for OPV3 before and after intervention (Table 3).

Coverage of Pentavalent-3 was 73%, and proportion of unimmunized children was 27% (pre-intervention from Jan-Sep 2018) while Pentavalent-3 coverage was 81% and proportion of unimmunized children was 19% (post-intervention from Jan-Nov 2018). There is statistically significant difference ($p < 0.05$) in proportion of children unimmunized before and after intervention (Table 4).

Pre intervention, there were 12 geostyles, 1 freezer and 1 I/L refrigerator (CCE) which were functional while 1 I/refrigerator, 1 refrigerator and 4 solar CCE were non-functional. Post intervention 3 functioning meta fridges were added to the available CCE pre intervention (Table 5).

Pre-intervention, RI services were conducted at PHCs providing RI fixed sessions. There were only 2 fixed sessions of RI provided per PHC per week as a result of inadequate human resources for health, 60 outreach sessions were planned for the month of September 2018 but only 20 were conducted due to lack of funds to conduct community sensitization, movement of vaccines and transportation. CCE status was very poor with only 1 freezer, 1 I/L refrigerator and 9 geostyles were functional.

Post-intervention, RI services were conducted at PHCs providing RI fixed sessions. There were only two (2) sessions of RI provided per PHC per week as a result of inadequate human resources for health. Sixty (60) outreaches were planned for the month of November 2018 and all of them were conducted due to availability of funds from the Saving one Million Lives (SoML) programme. CCE status was sub-optimal with only 1 Freezer, 1 I/LRefrigerator, 9 Geostyl and 3 meta fridges functional.

Table 2: Sex distribution of infants surveyed (OPV3 and Pentavalent 3 from January to September 2018 before and after intervention).

Intervention	Vaccine	Male	Female	Total
Before	OPV3	4,725 (48)	5,119 (52)	9,844 (100)
After	OPV3	5,684 (48)	6,157(52)	11,841 (100)
Before	Pentavalent 3	4,759 (48)	5,155 (52)	9,914 (100)
After	Pentavalent 3	5,631 (48)	6,100 (52)	11,731 (100)

Table 3: Chi square test of difference in proportion of unimmunized children for OPV3 before and after intervention.

Status	Before intervention	After intervention	Df	χ^2	P value
Unimmunized	2,699	2,131	1	169.441	<0.0001
Immunized	7,215	9,710			
Total	9,884	11,841			

Table 4: Chi square test of difference in proportion of unimmunized children for Pentavalent 3 before and after intervention.

Status	Before intervention	After intervention	Df	χ^2	P value
Unimmunized	2,698	2,228	1	171,059	<0.0001
Immunized	7,216	9,503			
Total	9,914	11,731			

Table 5: CCE inventory pre and post intervention.

Pre-intervention (Before October)			Post intervention (After October)		
Name	Frequency	Status	Name	Frequency	Status
Freezer	1	Functional	Freezer	1	Functional
Solar	2	Non-functional	Solar	2	Non-functional
Geostyl	12	Functional	Geostyl	12	Functional
Refrigerator	1	Non-functional	Refrigerator	1	Non-functional
Solar	1	Non-functional	Solar	1	Non-functional
I/LRefrigerator	1	Functional	I/LRefrigerator	1	Functional
I/LRefrigerator	1	Non-functional	I/Refrigerator	1	Non-functional
Solar	1	Non-functional	Solar	1	Non-functional
Solar	1	Non-functional	Solar	1	Non-functional
Meta fridges	0	N/A	Meta Fridges	3	Functional

Table 6: Immunization service delivery pre and post intervention.

Service delivery	Pre-intervention (Before October)	Post intervention (After October)
RI services delivery points	PHCs providing RI fixed sessions	PHCs providing RI fixed sessions
Number of RI fixed sessions per PHC per week.	2	2
Reason for low RI fixed sessions per PHC per week.	Inadequate human resources for health	Inadequate human resources for health
R services delivery points	10 communities providing RI outreaches sessions	10 communities providing RI outreaches sessions
Number of outreaches sessions planned for September 2018	60	N/A
Number of outreaches sessions conducted in September 2018	20	N/A
Number of outreach sessions planned for November 2018	N/A	60
Number of outreaches conducted in November 2018	N/A	60
Outreaches are conducted as planned	No	Yes
Reasons for outreaches not being conducted as planned or as planned	Lack of funds for community sensitization, movement of vaccines and transportation	Funds provided through saving one million lives (SoML) project
RI sessions are conducted as planned	No	Yes
Reasons for RI sessions not being conducted as planned or as planned	Sometimes lack of funds for movement of vaccines	Funds provided through saving one million lives (SoML) project
CCE status across the LGA	Very poor with only 1 freezer, 1 I/L refrigerator and 9 geostyles functional	Suboptimal with 1 freezer, 1 I/L refrigerator, 9 geostyles and 3 meta fridges functional

DISCUSSION

This study revealed that the coverage of OPV-3 was 73% and proportion of unimmunized children was 27% pre intervention while OPV-3 coverage was 82% and proportion of unimmunized children was 18% post intervention. There is statistically significant difference ($p < 0.05$) in the proportion of children unimmunized for OPV3 before and after intervention. This means that the intervention programme in Egbedore was effective in reducing the proportion of the children unimmunized for OPV-3 by 9%. Similarly, the coverage of Pentavalent-3 was 73% and the proportion of unimmunized children was 27% pre intervention while Pentavalent-3 coverage was 81% and the proportion of unimmunized children was 19% post-intervention. There is statistically significant difference ($p < 0.05$) in the proportion of children unimmunized for pentavalent-3 before and after the intervention. This infers that the intervention programme effectively reduced the proportion of children unimmunized for Pentavalent vaccine-3 by 8%. This finding is similar to that of another study which reported at endline assessment by card for children older than 9 months a significant increase in those fully immunized, from 60.7% at baseline to 90.9% ($p < 0.05$).¹³

The study also reported only one I/L refrigerator, freezer and nine geostyles CCE before intervention and one I/L

refrigerator, freezer, 9 geostyles and 3 meta fridges post intervention. Additional 3 meta fridges post intervention were provided to Egbedore because result of intervention programme (CCE inventory) informed the decision. All other CCE seen were out-rightly outdated. This means there is suboptimal CCE system for immunization services in Egbedore. This situation is a major hindrance to smoothness of vaccine management and immunization process, hence observed poor immunization coverage, and high rate of unimmunized children that actually prompted intervention programme. This is similar to findings observed in a study which reported that six states in Nigeria which had obsolete and non-functional CCE were contributory to poor immunization coverages.⁷

Furthermore, the study found that RI activities are conducted in the PHC centres at only two sessions per week per centre as a result of inadequate human resources for health, pre and post intervention. An average of 60 outreaches were planned in September 2018 but only 20 (33%) were actually conducted due to lack of fund for community mobilization, vaccine movement and transportation. However, post-intervention the 60 outreaches per month planned for November 2018, were all successfully conducted in Egbedore because fund was provided by the Saving one million lives programme. This signifies sub-optimal immunization service delivery in Egbedore majorly resulting from inadequate human

resources and funding. The finding of inadequate funding contributing to poor coverage of childhood immunization is supported in a study which observed poor funding as one of the ten leading factors contributing to poor immunization coverage in Nigeria.⁶

CONCLUSION

This study demonstrated statistically significant differences in proportion of children unimmunized for OPV3 and Pentavalent-3 before and after the intervention confirming that the intervention programme effectively reduced the proportion of children unimmunized for OPV3 by 9% and proportion of children unimmunized for Pentavalent 3 by 8%. This shows that the intervention programme achieved its objectives of increasing immunization coverage and reducing the proportion of unimmunized children. In addition, the study revealed that status of CCE system improved from very poor before intervention to sub-optimal after intervention. However, the status of immunization service delivery improved slightly above sub optimal after intervention.

The limitation of this study is the use of cross-sectional study in the evaluation of intervention programmes which is lower in the hierarchy of evidence compared to experimental studies.

It is recommended that RI fixed sessions should be increased to at least four sessions per PHC per week while integrated services should also be encouraged. Immunization outreaches should be increased to further reduce the percentage of unimmunized children and enhance child survival. A sum of at least \$700 USD should be provided monthly for RI fixed sessions and outreaches. Government should recruit more health workers to replace those who have retired to resolve the problem of inadequate human resources for health. Also, there is need for urgent repair of all broken down CCE and the need to replace outdated CCE. RI education campaign specifically designed for mothers about the importance of presenting their children for all vaccinations and ensuring that each child gets all expected doses for various vaccine types should be conducted to engender full vaccination of all under-fives.

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REFERENCES

1. World Health Organization. Immunization coverage. Available at: <http://www.who.int/mediacentre/factsheets/fs378/en>. Accessed on 14 May, 2023.
2. UNICEF Website. Available at: http://www.unicef.org/immunization/index_2819.htm. Accessed on 4 May, 2023.
3. National Bureau of Statistics (NBS) and United Nations Children's Fund (UNICEF). Multiple Indicator Cluster Survey 2016-17, Survey Findings Report. Abuja, 2017
4. Kg E, Ro E. Perception of childhood immunization among mothers of under-five children in Onitsha, Anambra State, Nigeria. 2018;6(1):6.
5. Ophori EA, Tula M, Azih AV, Okojie R, Ikpo PE. Current Trends of Immunization in Nigeria: Prospect and Challenges. *Trop Med Health*. 2014;42(2):67-75.
6. Okon P, Tula MY, Azih AV, Okojie R, Ikpo PE. Ten problems affecting immunization in Nigeria. *Trop Med Health*. 2014;42(2):67-75.
7. Babalola S, Adewuyi A. Factors influencing immunization uptake in Nigeria: A theory-based research in six states, Abuja: PATHS. *Am J Publ Heal Res*. 2005;6(5):227-36.
8. GAVI, the Vaccine Alliance. Tried and tested. Available at: <http://www.gavi.org/about/value/tried-and-tested>. Accessed on 14 May, 2023.
9. Brieger WR, Salam KK, Ogunlade BP. Catchment Area Planning and Action: Documentation of the community-based approach in Nigeria. Arlington: Va: BASICS 11 for USAID. 2004
10. Shrivastava SR, Shrivastava PS, Ramasamy J. Strengthening cold chain mechanism to enhance effectiveness of immunization programme. *Int J Adv Med Health Res* 2015;2:63-4.
11. Yola AW. Report on child immunization cluster (CICS). 2003;4:1-3.
12. National Population Commission (NPC) Nigeria and ICF macro. NDHS 2008, NPC and ICF. 2009.
13. Akwataghibe NN, Ogunsola EA, Popoola OA, Agbo AI, Dieleman MA. Using participatory action research to improve immunization utilization in areas with pockets of unimmunized children in Nigeria. *Health Res Policy Systems*. 2021;19(2):1-4.

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