Improving vaccination initiation and completion via vaccine indicator and reminder bands: a formative study in Nigeria

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About this formative study

This formative evaluation was submitted in partial fulfilment of the requirements of grant TW10.1113 awarded under the Innovations in Increasing Immunisation Evidence Programme. 3ie is publishing this report on our website as we received it from the authors. It has not been copy-edited.

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Summary

Interventions to increase routine immunization (RI) coverage and equity, in particular timeliness and completion of vaccinations are important in Nigeria. Till date, there is limited understanding of what works to improve demand for RI especially, in rural and remote areas. A Vaccine Indicator and Reminder (VIR) band was designed as a constant reminder to parents/caregivers on the need to vaccinate their children in a timely manner. This study assessed the feasibility and acceptability of implementing VIR band to improve immunization timeliness and completion among infants in Kebbi State, Nigeria. The primary research questions were:

1. Will parents/caregivers and the community accept the VIR band?
2. Will parents/caregivers retain the bands on their infants' ankles for the duration of the study?
3. Is it feasible for health providers to incorporate the use of VIR band as part of routine immunization service?
4. Will healthcare workers follow the protocol for the appropriate use of the VIR band?

We employed a mixed methods design using qualitative and quantitative approaches to arrive at findings contained in this report.

The study was set in three out of the ten wards in Bunza Local Government Area (LGA) of Kebbi State. At study onset in May 2016, we conducted 28 in-depth interviews (IDIs) and 7 focus group discussions (FGDs) with parents, community leaders, health workers (HWs), program managers, and policy makers. Before the VIR bands were deployed, we conducted a baseline household survey in June 2017 in the study area. Using a stratified cluster sampling approach, a representative sample of 669 mothers with infant children were interviewed. In July 2018 at the end line, 18 IDIs and 7 FGDs, were conducted with parents, community leaders, health workers (HWs), program managers, and policy makers. Exit interviews were also conducted from July to August 2018 with parents of enrolled children who came back for penta 3.

Infants were eligible for enrollment in the study if they were delivered at the health facility (HF) or encountered in the community; if they were <2 weeks old and had not received BCG vaccination; if their parents were resident in the study area and agreed to participate in the study. Between August 14th 2017 and February 15th 2018, 503 eligible children were enrolled. The majority of children (86%) were followed up for 18 weeks as planned, while the others were followed for at least 22 weeks in total. The additional four weeks was due to service disruptions following a national health worker strike. Of the 503 enrollees, 155 (31%) returned for penta 3 vaccination. All but two of them who refused to be interviewed, were given an exit interview in the health facility or in their homes. Qualitative data was thematically analyzed and triangulated with the baseline survey findings and exit interviews.

For the intervention delivery, we trained and engaged community traditional birth attendants (TBAs) to sensitize and refer mothers to the HF for immunization and to receive VIR bands. Community gatekeepers were sensitized on the importance of vaccination and use of VIR band; and mobilized to advocate for immunization. From the baseline data we found that all stakeholders preferred the bands to be distributed

by health workers. Therefore, health workers were trained on the benefits and use of VIR bands and equipped to distribute and activate the band upon first contact with an eligible child during fixed or outreach sessions.

Among the 153 study parents who were interviewed at end line, most, 92% knew VIR band as a device that helps them remember when next to vaccinate their children, and nearly all, 97% perceived it as an effective vaccination reminder due to its ability to remind them constantly. 80%. Majority, 95% said they would recommend VIR band to others. Nearly all respondents, 99% were willing to allow their children wear VIR band; and most, 97% allowed their children wear the band on their ankle. In addition, most respondents, 94% said they would retain the band on the child's ankle "only for the duration of the study and as long as it is needed". We also found that respondents of age groups 26-35 years old and with no formal education were more likely to allow their children wear the VIR band.

Although vaccination knowledge and intentions were high at 91% and 100% respectively, and there were no stated socio-cultural impediments to vaccine uptake, motivation to vaccinate was low despite available health services and external reminders (TBAs and town announcers). At end line, penta 3 vaccination remained low at 9%. Reasons for under-vaccination were centered on complacency.

Our study found community leaders (traditional and religious leaders) as a strong and lasting influence on social norms surrounding vaccination; whose strong support promoted acceptability of RI and VIR band intervention. Also, engaging TBAs contributed to the success of RI uptake in the community, as they are usually the first contact for mothers and mostly took children to the HF for vaccinations. Furthermore, incorporating the VIR band messages and its activation as part of RI services provided at the HF was not an added workload for our study HWs. An observation of HWs implementing the intervention revealed that four out of the five trained HWs from our study HFs adhered to the study protocol in all 23 areas observed.

The VIR band intervention was a felt need to increase demand for RI, complement the existing reminder system, and ease HW's workload. All participants agreed that VIR band raised awareness about RI in the community and motivated parents/caregivers to vaccinate their children. Most importantly, there was general acceptability of the band among community members who likened it to a "*wristwatch*" that will constantly remind mothers on when next to vaccinate their children. In addition, children who wore the band were perceived to be "*active*" and "*healthier*" than those who did not.

While the strong support from community leaders, TBAs and HWs who were actively involved in sensitizing and educating community members on the importance of VIR band and vaccination increased acceptability of the band; the band's colorful design, safety and durability also contributed to its acceptability. However, there were concerns about wearing accessories on the ankle, the red color of the indicator dye, and most bands not reaching the end point of the indicator strip at determined time.

Having proved its ability to create community demand for vaccination, there is need to assess the effectiveness of the band in increasing immunization uptake and coverage. Likewise, we need to investigate gaps between intention and action to vaccinate to enable better design and evaluation of demand interventions.

Contents

List of figures and tables

Abbreviations and acronyms

BMGF	Bill and Melinda Gates Foundation
CDC N-STOP	Center for Disease and Control National Stop Transmission of Polio
CHEWs	Community Health Extension Workers
CHWs	Community Health Workers
DC	Data Clerks
DCL	Direct Consulting and Logistics Limited
DH	District Head
GoN	Government of Nigeria
HF	Health facility
HSDF	Health Strategy & Delivery Foundation
JHU/IVAC	Johns Hopkins International Vaccine Access Center
LGA	Local Government Area
LHE	Local Health Educator
LIO	Local Immunization Officer
MPHC	Matseri Primary Health Care
NDHS	Nigeria Demographic and Health Survey
NHREC	National Health Research Ethics committee of Nigeria
PDRA	Precision Development Research and Advocacy
PHC	Primary Health Care
RI	Routine Immunization
SAG	Study Advisory Group
SIO	State Immunization Officer
SPHCDA	State Primary Health Care Development Agency
TBAs	Traditional Birth Attendants
VH	Village Head
VIR	Vaccine Indicator and Reminder
VPDs	Vaccine Preventable Diseases
WDC	Ward Development Committee
WHO	World Health Organization

1.0 Introduction

Since 1990, the number of under-five deaths (from 12.6 million in 1990 to 5.6 million in 2016) and the rate of under-five mortality (from 93 deaths per l,000 live births in 1990 to 41 deaths per l,000 live births in 2016) have decreased by more than half globally (Unicef, 2018a). Remarkably, 50 million children under the age of five have been saved since 2000 (Unicef, 2018a). Despite this significant progress in improving child survival globally, there are huge disparities in under-five mortality across regions and countries. Sub-Saharan Africa and South Asia account for about 80% of these deaths (Unicef, 2018a), with Sub-Saharan Africa being the highest- where 1 child in 13 dies before his or her fifth birthday compared to the world's high-income countries where the ratio is 1 in 189 (Unicef 2017a). And among the six countries accounting for half of the global under-five deaths, India and Nigeria alone contribute almost 32% of these deaths. Although Nigeria has reduced under-five deaths by 15% (from 862,000 deaths in 1990 to 733,000 deaths in 2016) (Unicef, 2017b), and under-five mortality rate by 51% (from 213 deaths per 1,000 live births in 1990 to 104 deaths per 1,000 live births in 2016) (Unicef, 2017c), an estimated 733,000 children under the age of five died in 2016 (Unicef, 2017c). Vaccine-preventable diseases (VPDs) remain a major cause of morbidity and mortality among these groups. An estimated 1.5 million deaths among under-five children are due to VPDs, which translates to approximately 28% of the total child mortality globally (World Health Organization (WHO), 2018). In Nigeria, about 34% of these deaths are caused by VPDs such as pneumonia, diarrhea, meningitis, tetanus, and measles (WHO, 2018).

Immunization remains the most cost-effective public health tool used globally for the prevention of infectious diseases, disability, death, and inequity (Andre et al., 2008). The routine immunization (RI) program offers a primary prevention strategy in the global fight and management of VPDs, especially in reducing under-five mortality. For instance, polio is near eradication today as a direct result of immunization. Deaths from measles declined by 79% globally and by 86% in sub-Saharan Africa between 2000 and 2015; and as at March 2017, all but 15 countries have eliminated maternal and neonatal tetanus (Unicef, 2018b). Evidence has also shown that vaccination currently saves between 2 and 3 million lives every year (WHO, 2016a). Beyond saving lives and preventing specific diseases, vaccination has both economic and social benefits. A study found that a dollar invested in vaccine programs stands to yield for countries, between 16 and 44 dollars return on investment (Ozawa et al., 2016). These benefits however, are optimized when children received all the recommended doses as and when due. In addition, vaccination meets the need to care for the weakest members of societies, thus redressing inequity (Andre et al., 2008).

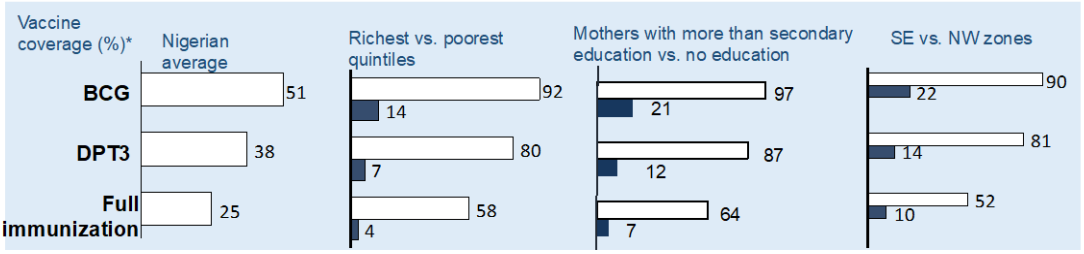
Recognizing the importance of immunization and acknowledging the remarkable progress made in immunization, the 65th World Health Assembly in May 2012 endorsed the Decade of Vaccines—Global Action Plan for Vaccine (GVAP) that provides the global framework for achieving equity in coverage and expanding the benefits of vaccines to all by 2020 (WHO, 2013). The GVAP set five targets, including the achievements of 90% national coverage and 80% in every district or equivalent administrative unit with DTP3 (three doses of diphtheria–tetanus–pertussis-containing vaccine) by 2015; and reaching 90% national coverage and 80% in every district or equivalent

administrative unit with all vaccines in national immunization programmes, unless otherwise recommended by 2020 (WHO, 2013).

Nigeria also recognizes RI as the most cost effective intervention in child survival and has called for the need for stronger emphasis on strengthening RI at sub-national levels to progressively reduce child mortality deaths in the country (Federal Ministry of Health (FMoH), 2010). This has been underscored in the National Strategic Health Development Plan: 2010-2015 (NSHDP) and the government is committed to its vision: "*To reduce the morbidity and mortality rates due to communicable diseases to the barest minimum; reverse the increasing prevalence of non-communicable diseases; meet global targets on the elimination and eradication of diseases; and significantly increase the life expectancy and quality of life of Nigerians*" in order to significantly improve the health status of Nigerians through the development of a strengthened and sustainable health care delivery system (Federal Ministry of Health, 2010).

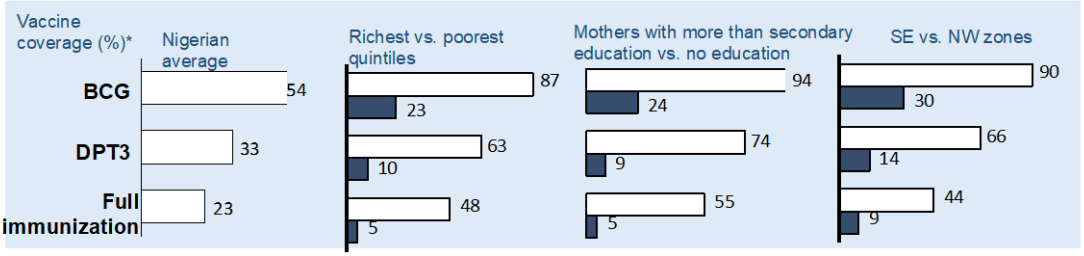
In recent times, Nigeria has recorded significant progress in her RI program, but immunization coverage and equity, especially, timeliness and completion of vaccinations still remain low (Nigeria Demographic Health Survey (NDHS), 2013; Multiple Indicator Cluster Survey (MICS) 2016-17). In 2013, the coverage rate for the third dose of pentavalent vaccine and full immunization coverage were 38% and 25%, respectively. Coverage rates became lower in 2016 except BCG coverage, penta 3 coverage and full immunization coverage were 33% and 23%, respectively. Using penta3 coverage as a benchmark, significant coverage disparity exists by geography and socio-economic status. See Figure 1a & b. Therefore, achieving high coverage and equity of vaccine access is a key strategy to reducing child deaths in Nigeria.

Figure 1a: Vaccination coverage among children 12-23months in Nigeria, 2013



*Source: Nigeria Demographic and Health Survey, 2013

Figure 1b: Vaccination coverage among children 12-23months in Nigeria, 2016



*Source: Nigeria Immunization Coverage Survey, 2016-17

To address these problems and improve the RI system, the government and partners have, in the past five years, made considerable investments, with cold chain upgrades, new vaccine introductions, capacity building for immunization managers and providers, improved coordination at national and state level and un-interrupted funding for vaccines. The sum effect of these efforts is that the supply side problems have largely been addressed and health facilities no longer experience vaccine stock outs. But these recent improvements in the supply side of vaccination services has not resulted in commensurate increase in service uptake, particularly in Northern Nigeria. Demand-side interventions such as defaulter tracking, newborn identification and referral, are not applied systematically and at scale. A high proportion of children remain left out – i.e. receive no vaccine at all, or continue to drop out – i.e. fail to complete their immunization schedule. A study in Nigeria found that reasons for none or incomplete immunization of children have been attributed to health workers' negative attitudes (Renne 2006; Raji and Ndikom 2013, Fatiregun and Okoro 2012; Tagbo et al 2012); and mothers not remembering the time for the next immunization exercise (Oladokun et al. 2010). With improved service availability, there is now a need to focus on increasing demand for vaccines given that several years of unreliable service may have eroded confidence in the system, while more than a decade of door-to-door polio vaccination campaigns has made people complacent about seeking immunization services.

It is widely recognized that many factors affect vaccine coverage and equity. With the lens of an ecological model, one can describe factors that determine vaccine delivery (supply) and uptake (demand) at policy, community, interpersonal and individual levels. At the policy level, national, state and local government policies and practice around governance, funding, staffing and equipping different levels of the health system have significant impact on immunization service availability and access.

At the community level, several studies have shown that socio-cultural norms and beliefs exert a powerful influence on an individuals' attitude and decisions towards vaccination, and how they react to health promotion messages and interventions. (Sturm et al., 2005; Pandey et al., 2007; Antai, 2009; Chaturvedi et al., 2009; Monguno, 2013; Olawepo and Fashajba, 2014). In addition, socio-economic, environmental and cultural factors play a key role in the uptake of available health services including RI, in Nigeria (Odusanya et al., 2008; Ogwumike et al., 2013). One cultural practice prevalent in Northern Nigeria, where a woman remains indoors for 40 days after giving birth (Iliyasu, et al., 2006), may prevent mothers from accessing postnatal services for herself and immunization services for her newborn child. Although the communities adhere to this practice to varying degrees, individual characteristics such as parents' education has been shown to influence how strictly these cultural practices are observed. For example, the study in Kano State, Nigeria observed that mothers with formal education were significantly more likely to believe that postpartum practices were non-beneficial compared with those mothers without formal education (Iliyasu, et al., 2006). In addition, the level of education, not only influences the adherence of cultural practices, it also provides women with decision-making power in seeking for health services (Antai, 2009).

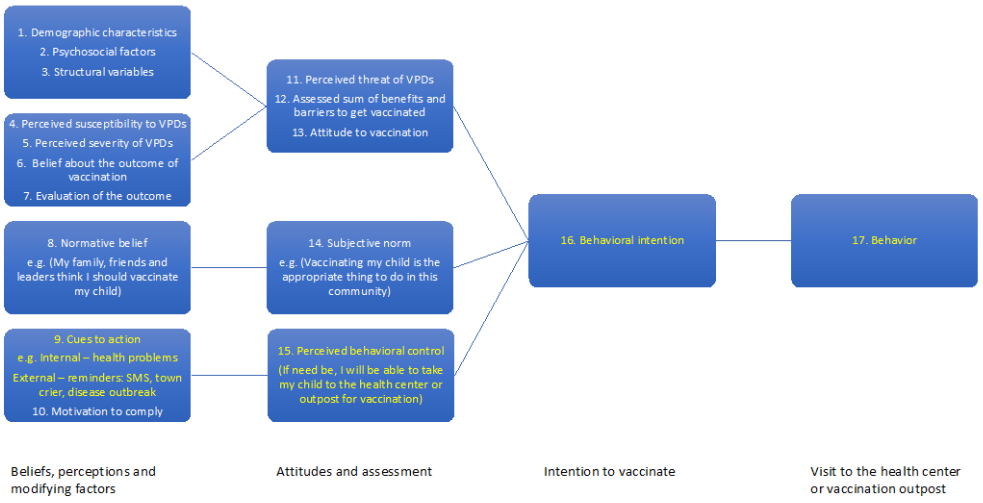
At the interpersonal level, the practice of certain behaviors by individuals is influenced to some extent by their close contacts and community they live in. Social networks, social support systems,

family relationships, and trust in institutions are the means through which these influences are transmitted (Babalola and Lawan, 2009). For instance, having babies at home is a common phenomenon in Nigeria, especially in the North-west region where 88% of deliveries are at home, and about 34% are attended to by traditional birth attendants (TBAs), (NDHS, 2013). In such situations, the opportunities for vaccination with BCG, OPV0 and Hep. B vaccines, which are given right after birth, may be missed or delayed (Ubajaka et al., 2012).

At the individual level, we used two theoretical models of health behavior - the Health Belief Model and Theory of Planned Behavior, to understand the drivers of parent's decisions to get their children vaccinated. Figure 2 below illustrates the adaptation of the two behavioral theories. The elements highlighted in yellow in Figure 2 represents they pathway of interest in this study.

The theories suggest that behavioral intention is a precursor to behavior change. Intentions are in turn influenced by perceptions, in this case, perceived susceptibility to, and perceived severity/threat of VPD. These perceptions vary in degree by the type of disease. For example, Ebola, a highly infectious and fatal disease may be perceived as a greater threat than measles, which is less infectious and less fatal. Also important is the perceived behavioral control or confidence in one's ability to enact a behavior. For example, if a parent is confident that they can access immunization services, they are more likely to go for vaccination. Beyond perceptions, individuals may need to be motivated or cued to act. Cues could be reminders, mass media campaigns, the illness of a close relative or the advice from significant others.

Figure 2: Adaptation of the Health Belief Model and Theory of Planned Behavior to explain vaccine uptake behavior



Although studies have demonstrated that the use of patient reminder or recall systems improved adherence to recommended immunization schedules (Jacobson VJC and Szilagyi P 2005; Hicks et al., 2007; Stinchfield, 2008; Vora et al., 2009), we do not know what works best in the Nigerian context especially in rural and remote areas. A recent study that explored mothers' experiences, preferences and perceptions towards receiving childhood immunization reminder/recall in Ibadan,

Nigeria found that mothers' preferred communication modes were cell phone calls (57.6%) or text messages/SMS (35.6%) (Brown et al., 2015). But the study was conducted in urban and sub-urban community health facilities and no rural community was involved thus, the findings may therefore not be generalizable to all populations.

Poor demand for and uptake of vaccines is a major problem impacting negatively on immunization coverage in Nigeria. While demand-side interventions are not novel in Nigeria, there is little evidence of community-focused, demand-side approaches that work, are cost-effective and easy to implement at scale. Although some demand-side interventions such as SMS reminders, incentives to motivate mothers for vaccination and defaulter tracking have been implemented, these were one-off project-specific interventions. Furthermore, incentives such as diapers and mosquito nets, though effective, are expensive and have the un-intended effect of demotivating vaccine uptake when the incentives are no longer available. Thus, there is a need for an affordable yet effective intervention to improve uptake of vaccines. If proven acceptable and feasible, the VIR Band could provide a cheaper alternative to existing reminder approaches, it will target not only completion but also timeliness of vaccination.

The VIR band is a visible symbol of the intervention and may represent, to observers, a visible sign of vaccine acceptance. Thus, beyond its proposed operation as a cue to action for individuals, we hypothesized that it may have additional effects at the community level by triggering discussions about immunizations and its benefits, thereby promoting positive norms about vaccination. Subjective norms are important drivers of behavior change. People tend to abide by norms prevalent in their community and act in ways perceived as appropriate or acceptable by other members of the community. Evidence has shown that mothers living in a community that supports immunization activities are more likely to immunize their children than those who live in communities that shun immunization (Babalola and Lawan, 2009). Recognizing the importance of community engagement towards the uptake of vaccination among infants, the community mobilization component of the intervention addressed social norms that influence an individual's decision to be vaccinated. Social mobilization activities also addressed norms that foster community acceptability and positive behavior change around immunization and the VIR band.

Reminder bands are novel approaches to cue parents to take their children for vaccination. This report presents findings from the acceptability and feasibility of the Vaccine Indicator and Reminder (VIR) band designed to improve vaccination timeliness and completion. It describes the study context; the key intervention activities; the evaluation questions, design and methods; the timeline of the key activities; the findings, the study implications and recommendations; and concludes with the key challenges and lessons learnt.

2.0 Context

Health is a concurrent responsibility of the three tiers of government, so is routine immunization. The federal government pays fully for traditional vaccines, and co-pays for new vaccines with Gavi support. Through the National Primary Health Care Development Agency (NPHCDA), the federal government develops policy for primary health care (PHC), provides vaccines, immunization

guidelines, and technical support to the State Primary Health Care Development Agency (SPHCDA) and the Local Government Areas (LGA). The funding and actual implementation of immunization programs is the responsibility of the state and LGA levels. Delivery of immunization services to children is largely through government PHC facilities that are spread across the 36 states plus Federal Capital Territory. Although access to quality health care services still poses a challenge, there are on-going efforts by the government to implement one functional PHC per ward. Nigeria also implements the Reaching Every Ward (REW) strategy which aim to provide regular, effective, quality and sustainable RI in every ward to improve coverage and guarantee equitable access to immunization for every target age group.

Nigeria RI schedule for under-one children consists of nine vaccine formulations targeted against these diseases, namely tuberculosis, poliomyelitis, hepatitis B, diphtheria, pertussis, tetanus, *Haemophilus Influenza* type b (Hib), pneumococcal diseases, measles, and yellow fever. These vaccines are provided free of charge by the Federal Government of Nigeria, and should be completed by all children before their first birthday (see table 1).

Table 1. Nigeria Immunization Schedule

AGE	ANTIGEN
Birth	BCG, OPV0, HepB0
6 weeks	OPV1, Pentavalent 1, PCV1
10 weeks	OPV2, Pentavalent 2, PCV2
14 weeks	OPV3, Pentavalent 3, PCV3, IPV
6 months	Vitamin A
9 months	Measles, Yellow fever
12 months	Vitamin A

This study was conducted in Kebbi State, Nigeria. This state was selected because of the following:

1. Low immunization coverage of 2.8% compared to zonal coverage of 14%, and national coverage of 38% (NDHS, 2013) as at the time of selection;
2. Few partners supporting RI programs/interventions compared to other states like Kano and Kaduna State; and
3. Strong political support for maternal and new-born child health (MNCH). It is worth noting that as at the time of selection, there was a new government that has demonstrated strong commitment to MNCH.

Kebbi State is located in the north-western part of Nigeria with its capital is Birnin Kebbi. The state shares territorial boundaries with Sokoto State in the North-East, Niger State in the south and the Republics of Benin and Niger in the west. It has an estimated landmass of 36,985 km^2 (NBS, 2010) thus, considered the 8^{th} largest state in the country. Using the 2006 census, Kebbi state has a projected population size of 4,440,050 million (NPC, 2016). The State is largely rural and is made up of 21 LGAs (with only five considered urban or semi urban), 225 political wards, four Emirate Councils (Gwandu, Argungu, Yauri and Zuru), and 35 districts. LGA populations range from 84,000 to 340,000. Major tribes in the state include Hausa, Fulani, Kabawa, Dakarkari, Fakkawa, Gungawa and Kambarawa, and among the people, their predominant economic activities are farming and trading. The State has 412 health facilities (HFs) comprising of 380 PHC facilities and 32 secondary HFs. (FMOH, 2012). Of the 380 PHC facilities, 375 are publicly owned and 5 are private PHC facilities.

Like most states in the zone, Kebbi has particularly low socio-economic indicators. Among individuals aged 15-49, literacy level (those that attended secondary school or higher and could read a whole or part of a sentence) was low at 13.2% for women and 40.3% for men, while current unemployment status in the preceding 12 months stood at 61.1% for women and 55.7% for men (NDHS, 2013). Households with improved source of drinking water were 21.9%[1], those with access to improved sanitary facilities were 52.3%, and those with electricity were 44.4% (NDHS, 2013). Compared to the national average of 36% deliveries in health facilities, Kebbi recorded only 8.5% facility deliveries, with 91% of pregnant women having their babies at home without skilled attendants. Only 5.2% of infants start the routine vaccination schedule by receiving BCG, and a mere 2.8% achieve completion (NDHS, 2013).

Bunza LGA in Kebbi State was selected for the formative study based on a set of criteria agreed on by the Study Advisory Group (SAG)[2]. Following this, a ward selection mapping was conducted to identify appropriate wards within the LGA for the study implementation. Findings from the ward selection mapping alongside specific criteria were used to select **Bunza Marafa**, **Maidahini** and **Raha** as the ideal study wards. *See Online Appendix A for wards characteristics using the ward selection criteria.*

Bunza LGA has a population of 339,435 (WHO 2016b), and a birth cohort of 13,577. The LGA is made up of 10 political wards (population size ranging from 18,253 to 48,811), of which 5, 2 and 3 wards are considered rural, urban and semi urban, respectively. It is worth noting that this urban categorization is in the context of Kebbi state, which is a predominantly rural state. In addition, there are 399 settlements within the wards, with the smallest ward having a total of 28 settlements and the highest, 66. Among these settlements 25 (6%) are hard to reach (mountainous, riverine, and sandy areas, as well as areas with low access to HFs i.e. >20km to the nearest health facility). Major tribes in the LGA are Fulani and Hausa, and about 99% of the population are Muslims. The predominant source of livelihood among the populace is farming, and they are popularly known to cultivate rice, guinea corn and millet. There are 34 health facilities (HFs) in the LGA, of which

[1] These sources include water piped into dwelling/yard/plot, public tap/standpipe, tube well or borehole, protected well/spring, rainwater, and bottled water

[2] A study advisory group (SAG) comprising of membership from the national, state, LGA and development partners was constituted to provide strategic and practical guidance on the study design and implementation.

21(61%) provide RI services to community members. Like most LGAs in the State, with the exception of Maiyama and Gwandu; Bunza LGA has no history of non-compliance towards RI programs and supplementary immunization activities; however, cases of missed vaccination are commonly reported in the community as well as low vaccination initiation. As at July 2016, administration coverage for BCG, Penta 3 and dropout rate was 37%, 87% and 4%, respectively.

Bunza Marafa, Maidahini and Raha are among the 10 wards in Bunza LGA. Bunza Marafa has a population size of 48,811 and birth cohort of 1,952 (WHO, 2016b). The ward is characterized as urban with 36 settlements and no hard to reach settlement. There are four health facilities in the ward, of which 50%(2) provide RI services to community members.

Maidahini is a rural ward with a population size of 30,626 and birth cohort of 1,225 (WHO, 2016b). There are 26 settlements in Maidahini ward of which two are hard to reach. The only two health facilities in the ward also offer RI services.

Raha, has the least population size and birth cohort among the three wards, 26,810 and 1,072, respectively (WHO, 2016b). The ward is semi-urban with 41 settlements, and among these settlements, only one is hard to reach. Raha has four health facilities, but only two offer RI services. All three wards have an active ward development committee and traditional birth attendants.

Generally, in Nigeria, due to poor quality of data, reported administrative coverage is often orders of magnitude higher than the corresponding survey coverage. In Kebbi, for example, administrative coverage of penta 3 for 2014 was reported as 87% while the SMART survey of 2013, which surveyed the same cohort of children, estimated it as 8%.

3.0 Intervention description, intervention logic, monitoring plan and the theory of change

3.1 The Innovation

The Vaccine Indicator and Reminder (VIR) band is an innovation designed to be worn on a child's ankle to serve as a constant reminder to parents/caregivers on the need to vaccinate their children in a timely manner.

The band consists of a sealed dye blister which forms the time indicator that is activated at each vaccine (BCG, Penta 1 and Penta 2) initiation by pressing the blister, releasing the dye to move along a membrane by capillary action to reach the end point. The ink progression gives a visual cue and serves as a reminder to caregivers to vaccinate children in a timely manner. The time strip indicator contains plant-based vegetable oil and dye that are safe for contact with humans. Each band is inscribed with a unique identifier (QR code/number) that can be used connect the child to his/her records in the study register.

Figure 3: The VIR Band

Designed by Dr. Noor Sabah Rakhshani of PDRA Pakistan

Before deployment, the band was subjected to rigorous design processes keeping in mind the safety and comfort of new-borns, as well as daily practices of bathing, oiling and clothing the child. The band was tested in 2015 among 346 infants in two study sites in Karachi Pakistan.

Preliminary results from the study indicated parental support and compliance with the VIR band.

The focus of the evaluation in Nigeria, was the acceptability of the band among Nigerian parents especially those in rural and remote areas, the best modality to deliver these bands to babies born in the community, and presence of any socio-cultural factors that might impede the uptake of the intervention.

Each child received three colors of bands (yellow, purple and green), representing different vaccination intervals. The first (yellow band) was given at birth with BCG administration, the second (purple band) at six weeks with the first dose of pentavalent vaccine and the third (Green band) at 10 weeks with the second dose of pentavalent vaccine.

3.2 Key intervention programme components and activities

Health workers from the study HFs, TBAs from the study sites and community gatekeepers (religious and traditional leaders, ward development committee (WDC) members, men and women groups, town announcers) were involved in the delivery of the intervention (see Appendix A for detailed description of roles and responsibilities). Specifically, all health workers and TBAs involved in the intervention implementation reported to the study team. See organogram of the

reporting structure in *Online Appendix B*. The logical framework containing a detailed list of key activities for each component of the intervention can be found in *Online Appendix C*.

Key personnel engaged for VIR band study

The study engaged various governmental and non-governmental personnel in delivery of the VIR band intervention. These include:

1. **Health workers (HWs):** The intervention was primarily based in the six health facilities offering RI and their catchment areas in the study wards. HWs (RI providers and officers' in-charge) were the distributors of VIR bands. The bands could only be affixed on a child and activated by an RI provider. This was done after consenting the parent and enrolling an eligible child during fixed or outreach RI sessions. Children enrolled in the study were followed up for 18 weeks. A 4-weeks health worker strike that started in May 2018 elongated the follow up period to 22 months for some of the enrolees who had not completed their penta series at the time of the strike, Health workers were provided a monthly stipend of $13 as an incentive to encourage adherence to the study protocol.

2. **Traditional Birth Attendants (TBAs):** TBAs from each settlement in our study wards were nominated by their community leaders (traditional or religious leader) for selection by the study team using specific criteria such as: age (<70 years of age), past experience with health/PHC related activities, and past involvement with distribution of health commodities (to be confirmed by HF in-charge or Officer in-charge). Involving the community leader in the nomination was to encourage ownership and improve acceptability of the project in the community. Sixty-four (64) TBAs were nominated from the three wards and screened by the VIR band team with support from Bunza LGA local immunization officer (LIO) and the LGA Health educator (LHE). The screening was to ensure TBAs that met the specific criteria were engaged for the study. Out of the 64 TBAs screened only 53 were selected to participate (18 from Bunza Marafa, 14 from Maidahini and 21 from Raha).

   These TBAs were engaged to refer mothers with eligible children in the community to the health facilities where they would be enrolled in the VIR band study. They were also provided stipends for logistics based on their performance (number of children refered) in assigned responsibilities. The stipends ranges from $3 (0 referral) to $16 (>3 referral) per month.

3. **TBA supervisors:** To oversee the TBAs, three supervisors were recruited (one for each of the study wards) to ensure TBAs followed the study protocol in their respective wards and communities. These TBA supervisors were paid about $33 per month and they met with TBAs on a weekly basis and reported to the study team on a monthly basis.

4. **Data Clerks:** Due to the large workload of health workers, data clerks were hired to enter all study data in both the hard copy and online study registers. Data clerks were paid $23 monthly.

5. **Community gatekeepers:** These are religious (Imam) and traditional (Sarki) leaders, ward development committee (WDC) members, and town announcers who mobilized community members for sensitization activities on VIR band and importance of vaccination.

3.3 Monitoring and evaluation plan

The team developed a monitoring and evaluation plan with input, output and outcome indicators (see table 2-4) that measured and tracked implementation of the intervention.

Table 2: Input indicators, source and mode of data collection, and data quality measures

Input Indicators	Source and mode of data collection	Data quality measures
No. of TBAs trained and engaged to sensitize and refer mothers to the HF for immunization and VIR band	Attendance sheets, reports, pictures	Monthly review of TBA supervisors register
No. of health workers trained to distribute and activate VIR band during fixed and outreach services	Attendance sheets, reports, pictures	Weekly visit to HFs to observe distribution of bands by trained HWs
No. of sensitization meetings with parents/caregivers on the importance of timely and complete vaccination and the use of VIR band	Attendance sheets, reports, pictures	Review of all reports for activities conducted
No. of sensitization meetings with political leaders from study wards, community leaders, WDC members	Attendance sheets, reports and pictures	Review of all reports for activities conducted
No. of community mobilization activities conducted on the importance of timely and complete vaccination and the use of the VIR band	Activity sheets	Review of all reports for activities conducted
Observation of health workers distributing and activating VIR band during fixed and outreach sessions	Participant observation checklist	Review of participant observation checklists

Table 3: Output indicators, source and mode of data collection, and data quality measures

Output Indicators	Source and mode of data collection	Data quality measures
No. of VIR bands distributed to new-borns in the community & HF (i.e. no. of enrolled children)	Study monitoring register	Weekly comparison of VIR band unique identification numbers in tracker sheet with number of children enrolled with bands
No. of trained TBAs referring mothers to the HF to receive the band	TBA Supervisor register	Weekly comparison of TBA supervisors register with number of children referred and enrolled in each health facility
No. of referrals by trained TBAs	TBA Supervisor register	Weekly comparison of TBA supervisors register with number of children referred and enrolled in each health facility
No. of referrals by trained TBAs that came to the HF for immunization and VIR band	Study monitoring register	Weekly comparison of TBA supervisors register with number of children referred and enrolled in each health facility

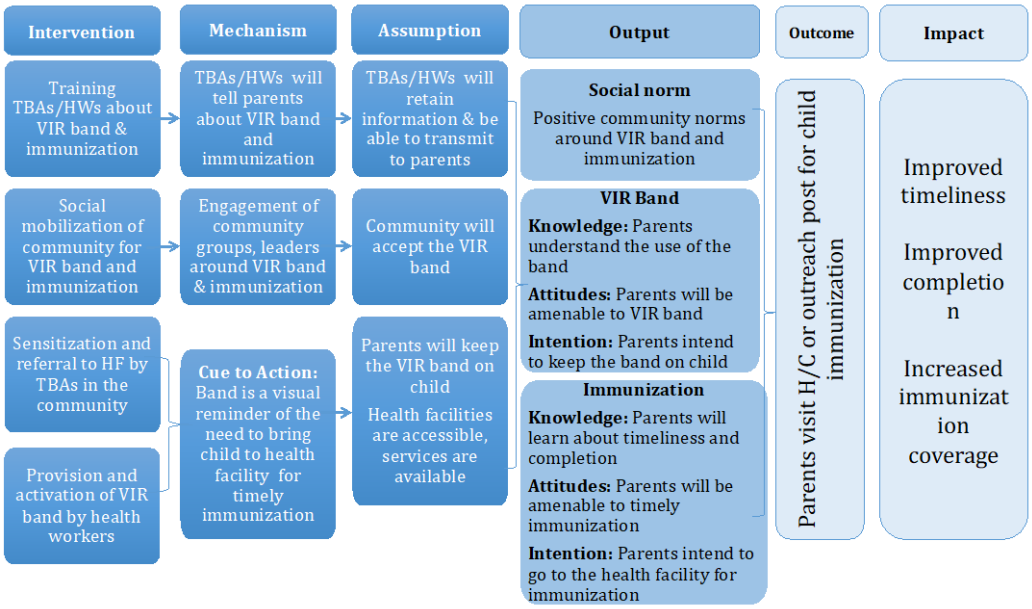
Table 4: Outcome indicators, source and mode of data collection, and data quality measures

Outcome Indicators	Source and mode of data collection	Data quality measures
Proportion of children who received BCG within two weeks of birth	Study monitoring register	Weekly verification of hard copy of study register and online study register
Proportion of children with the band who received Penta 3 by Week 18	Study monitoring register	Weekly verification of hard copy of study register and online study register
Proportion of parents allowing their children wear the band on the ankle	Study monitoring register	Weekly verification of hard copy of study register and online study register

3.4 The Theory of Change

Our theory of change suggests that the VIR band could potentially improve vaccine timeliness, completion and coverage (see Figure 4).

Figure 4: Theory of Change



The study conducted four major activities in the intervention phase;

1. ***Training of TBAs & health facility worker***

   Using trained community-based healthcare providers or community volunteers such as community health extension workers (CHEWs) and TBAs to promote behaviour change communication including vaccinations has proven to be effective in creating demand for services and improving maternal and child health in resource constrained communities (Bhutta et al., 2008; Darmstadt et al., 2005; Tripathy et al., 2011). In a study by Findley et al. (2013), trained community volunteers in each village organized and led community dialogues on maternal and new-born care topics, which in turn led to improved maternal and new-born care behaviours including vaccinations.

   By training TBAs and HF health workers, we assume they will effectively communicate to parents the appropriate use of the VIR band and the importance of immunization timeliness and completion. It was our hope that at the end of the study, parents; 1) will understand the use of VIR band as well as be willing to allow their children wear the band as a reminder for their next immunization session; and 2) will gain knowledge about vaccination timeliness and completeness, recognizes the importance of timely vaccinations, and willingness to visit a health facility for their child's immunization.

2. ***Community sensitization & mobilization:*** Stakeholder identification, consultation and mobilization at all levels is paramount to ensure the success of any intervention. This approach was successful in a community directed intervention process of delivering five health interventions, where many stakeholders had vested interests in or a strong sense of ownership of particular delivery approaches that they perceived as meeting their own programme targets (CDI Study Group 2010). In addition, engaging communities in health intervention delivery including immunization increases their awareness of public health issues, availability of health commodities and rights to access health services, which in turn would reinforce their commitment to the delivery of the intervention and other health measures (CDI Study Group, 2010).

   We assumed that by identifying, consulting and mobilizing key stakeholders; and conducting intensive community engagement exercise campaign, we will promote the acceptability of the VIR band as well as trigger positive discussions around immunization in the community.

3. ***Sensitization and referral to the health facility by TBAs***

   In rural and remote areas TBAs assist mothers during childbirth especially in communities where health facilities are far (Inem et al., 2008). Though efforts to formalize the role of TBAs in maternal and child health programs in Nigeria have recorded limited success (Oshonwoh et al., 2014), their continued role in attending to home deliveries suggests their potential in influencing maternal and neonatal outcomes (Falle et al., 2009). Meanwhile, an increased referral of mothers to health facilities have been demonstrated with TBAs interventions (Ahmed et al. 2007).

In our study settings, TBAs were identified as service delivery points because they reside in the community, are well respected, and are able to reach the target group -newborns. They also serve as a link between the community and the HF, and are engaged to mobilize women and children to the HFs for antenatal care and other PHC services. For this study, trained TBAs were engaged to sensitize and refer mothers to the health facility for children's immunization.

4. ***Provision and activation of VIR bands by health workers***

   Bhutta et al. (2008) and Yeboah-Antwi et al. (2014) in their studies demonstrated that training health providers on the intervention package was efficient in delivering health interventions. Another study found that training TBAs and linking them with the existing health system staff led to a reduction in perinatal mortality (Jokhio et al. 2005), as well as neonatal mortality (Baqui et al. 2008; Kumar et al. 2008).

   We assumed that with our TBAs informing health workers of every newborn and mothers referred by TBAs visiting the HF for child's vaccination, our trained health workers can enroll every eligible child and activate the VIR band. We hoped that parents will allow their children wear the band throughout the study period, and that the health facilities were accessible and immunization services available for them. And at the end of the study, parents would learn about vaccination timeliness and completeness as well the importance of timely vaccination to the child's health. We also expected parents will be willing to visit a health facility for immunization.

4.0 Formative study evaluation questions and primary outcomes

Given the VIR band is a new device for demand creation that had not been tested in Nigeria, our formative research was focused on assessing the **acceptability** and **feasibility** of children wearing the band as a memory aid for their parents to get them vaccinated.

The primary research questions on acceptability and feasibility were:

1. Will parents/caregivers and the community **accept the VIR band**?
2. Will parents/caregivers **retain** the bands on their infants' ankles for the duration of the study?
3. Is it **feasible** for health providers to incorporate the use of VIR band as part of routine immunization service?
4. Will healthcare workers **follow the protocol** for the appropriate use of the VIR band?

The secondary research questions were to related to parents' attitudinal and behavioral response to the band, viz:

5. Will parents' **perception** of the importance of timely vaccinations change as result of the exposure to the VIR band intervention?

6. Will parental **intention** to get their children vaccinated increase?
7. Will the **predominant norms** around vaccination change for the better?
8. Will the proportion of **children who receive BCG within two weeks of birth increase**?
9. Will the proportion of children who **receive Penta3 by 18 weeks increase[3]?**

4.1 Study objectives

1. To **assess the cultural and practical acceptability** among parents of infants wearing the VIR band as a reminder to parents of their vaccine schedules.
2. To **evaluate the feasibility** of incorporating the VIR bands as part of RI service.
3. To assess parents' **knowledge**, **attitude** and **practice** about childhood immunization.

5.0 Evaluation Methods

We used a mixed method (qualitative and quantitative) approach to conduct the formative study. A before and after community acceptability study (qualitative study) using focus group discussions (FGDs) and in-depth interviews (IDIs) was conducted to assess: 1) community perceptions, attitudes and norms towards vaccination; 2) community acceptability of the VIR band; 3) TBA's role in community service delivery, and capacity for distributing VIR bands to newborns; and 4) health care worker's willingness to distribute and activate the band, and perceptions of community knowledge about immunization and acceptability of the VIR band.

A baseline survey (quantitative study) was conducted to quantify community perceptions and attitudes towards vaccinations, acceptability of the VIR band, knowledge about the importance of timely childhood vaccinations, parental intention to get their children vaccinated, and timely vaccination of the BCG and Penta 3 vaccines. It is worth noting that baseline household survey conducted in June 2016 had to be repeated due to the 12-months manufacturers delay in producing the bands, so the intervention deployment had to be delayed. The repeat household survey was conducted in July 2017 to capture the contemporary picture of immunization before implementation. The July 2017 baseline household survey findings are reported here.

Immunization services were monitored monthly at the health facilities using a HF monitoring tool. At these HFs, we tracked vaccine supply and management (availability of vaccines, AD syringes and safety boxes; and number of BCG, Penta 1, Penta 3 doses given); planned immunization sessions (administrative data on the proportion of fixed and outreach sessions planned and conducted); and cold chain performance (total number of refrigerators in the HF and total number of functional refrigerator in the HF).

Trained health workers (study nurses) were observed between 8th and 10th January 2018 by the study team, to assess their adherence to the study protocol and experience with the band using

[3] These objectives were later modified to focus on acceptability and feasibility of the band because with only 500 bands being be distributed to the study area with a birth cohort of 4,250 infants.

a participant observation tool. The health workers were aware that they were being observed. Data clerks were present at every RI session held by our study health facilities to collect study data during implementation They also served as a second eye to ensure health workers' adherence to the study protocol as they were also trained on the enrolment and follow up procedures. These study nurses were assessed on:

- Effective communication on VIR band and immunization importance and schedule to mothers
- Ability to carry out designated tasks and responsibilities:
    - Affix band on the child's ankle
    - Activate the band upon vaccine administration
    - Fill out register and enrollment form
    - Record follow up information in the study register
    - Regular interaction with TBAs to obtain information on new-borns in the community
- Issues with distributing and activating bands
- Effective management of issues that arise with bands during the study

It is worth noting that a household survey was planned at end line, but following a mid-term review by the study advisory group the end line assessment was changed to exit interviews of the study parents that returned for penta 3. The interviews were done either in the facility or in their homes. The team felt that since the primary objective of the study was to assess acceptability of the band, a household (community) survey would not be an efficient way to assess perceptions of parents who were enrolled in the study. With only 503 participants, the probability a participant being in the household sample is small. Using a pretested exit interview questionnaire, we assessed parent's attitudes and perceptions around vaccination post-intervention; parent's perception and acceptability of the VIR band and understanding of its use; and parent's knowledge of vaccination and importance of timely childhood vaccination.

5.1 Sampling method

Qualitative data: Participants for the qualitative interviews were purposively selected. They included state level policy makers, program managers and development partners, LGA level program managers, HF healthcare workers, caregivers, older and younger women groups, men group, TBAs, WDC members, and community leaders from the three study wards. A total of 28 IDIs and 7 FGDs were conducted for the baseline, and 18 IDIs and 7 FGDs for the end line. *See Appendix C and D for details of the interviews held and the participants involved*.

Survey data: Participants for the baseline household survey were mothers with children under the age of one (0-11 months) from the three study communities, and were selected using the cluster sampling method. According to the then released MICS 2016-17, penta 3 coverage in Kebbi State was 13% (unweighted). Because we intended to compare baseline and end line data,

our sample size was estimated based on the two-sample comparison of proportions as recommended by the WHO 2015 guidelines for vaccination coverage cluster surveys. The parameters were as follows: Proportion 1 (p1) = 13%, Proportion 2 (p2) = 27%, Alpha = 5%, Delta = 8%, Power= 80%, Ratio= 1, m (number of respondents per cluster) = 7, Intracluster Correlation Coefficient = 0.33, DEFF= 2.98, and Non-response rate= 5%. This yielded a sample size of 1100; total number of households to visit as 3635, number of clusters needed as 157, and the total number of households to visit per cluster as 23. We also used the probability proportionate to size to determine the clusters to be sampled.

Household selection in the study wards was conducted using systematic random sampling procedure, which involved enumerating all the households in the cluster and recording them in the cluster control form to create a household listing or sample frame. Afterwards, the sampling interval (S.I) was calculated as follows:

$$S.I = \frac{\text{total number of HH enumerated}}{\text{Number of HH to be sampled}}$$

A random number was selected using the random table, and then the sampling continued using the S.I until the last HH. A total of 7017 households were enumerated in the 157 clusters visited. Among these households, 3437 households were sampled as against the targeted 3635, and only 669 mothers with under-one children were eligible for the survey. *See Online Appendix 5 for Sampling status of Household Survey conducted in Bunza Marafa, Raha and Maidahini, Bunza LGA.*

Enrollment: Infants were eligible for enrollment into the study if they were delivered at the health facility (HF) or encountered in the community; if they were <2 weeks old and had not received BCG vaccination; if their parents were resident in the study area and agreed to participate in the study. Between August 14th 2017 and February 15th 2018, 503 eligible children were enrolled (432 with the yellow bands and 71 without due to unavailability of bands at the time). The majority of children (86%) were followed up for 18 weeks as planned, while the others enrolled in the later third of the study were followed for at least 22 weeks in total. The additional four weeks was due service disruptions following a national health worker strike. Exit interviews began after most of the enrolled children had passed the 18-week mark. Of the 503 enrollees, 155 (31%) returned for penta 3 vaccination. All but two of them (who refused to be interviewed) were given an exit interview in the facility or in their homes. Exit interviews were conducted for every mother-infant pair enrolled in the study who received the penta3 series of vaccination.

Table 5. Summary of data collected for the evaluation

	Baseline	**End line**
Qualitative	**Method**: FGDs, IDIs **Respondents:** Parents, Community leaders, program officers, TBAs **Sampling:** purposive **Timing:** May 2016	**Method:** FGDs, IDIs **Respondents:** Parents, Community leaders, program officers, TBAs **Sampling:** purposive **Timing:** July 2018

Quantitative	**Method**: Household survey **Respondents:** Mothers of infants **Sampling:** Cluster sampling – representative of study area **Timing:** July 2017	**Method**: Exit interviews in health facilities or homes **Respondents:** Parents of study enrollees who returned for penta 3 **Sampling:** none **Timing:** From May to July 2019

5.2 Data collection method

The baseline household survey was conducted in July 2017; post-intervention exit interviews at facilities and homes were conducted from May to July 2018. During the intervention, from August 2017 to July 2018, we collected data on the availability of immunization services from the health facilities on a monthly basis.

The interview guides and questionnaires were developed in English, translated in Hausa and back translated to English to validate the translations. These instruments were pretested in Argungu and Kalgo LGAs in Kebbi State and Dei-Dei LGA in the Federal Capital Territory. Findings from the pretest were used to refine and finalize the guides and survey questionnaires.

Experienced research assistants and data collectors with proven track record in the respective fields were selected and trained for the study data collection. These trained research assistants and data collectors were responsible for the qualitative data collection, data entry (using the Interview Tracking Tool), cleaning and coding. The household survey was conducted by the same trained research assistants using the Open Data Kit (ODK) mobile data collection application. No compensation was provided to respondents during the qualitative data collection but respondents for the household survey were given pluses in form of bar soaps after the interviews.

To ensure data quality and veracity during data collection, the enumerators submitted the data collected on the ODK to the supervisors who in turn checked each response for errors and inconsistencies until they were fully satisfied with the data quality. Thereafter, the supervisors double checked before uploading to the central hub that was managed by the study team. During study implementation, data quality checks were continuously conducted by the study team to ensure data accuracy and completeness, especially data entered by the data clerks on the online study register. This included data clerks sending pictures of the hard copy study register to the study team at the end of each immunization session. The study team then compared it with the online study register for accuracy.

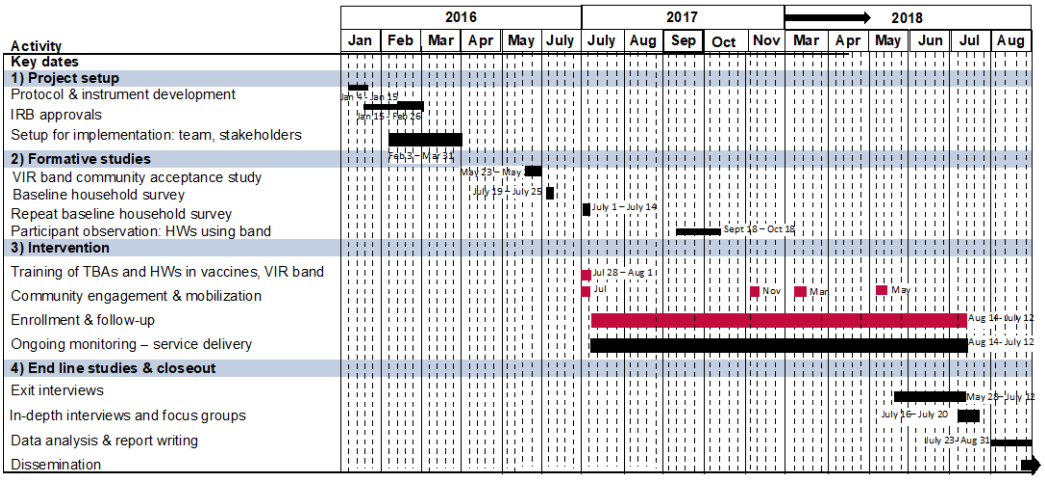
5.3 Ethical considerations

Ethical approval for the study was obtained from the National Health Research Ethics committee of Nigeria (NHREC), Approval Number: NHREC/01/01/2007-10/03/2006. This was used to further obtain consent from the Kebbi State Ministry of Health, Kebbi State PHC Development Agency, LGA PHC Department and LGA Chieftaincy Authority to conduct the study. Individual consent for the interviews and surveys were obtained using a standard oral consent script. Consent to enroll a child into the study was obtained from parents. Parents had a right to refuse to participate in the study. Refusal to participate in the study did not deprive the child from being vaccinated.

6.0 Study timeline

The project set up, and baseline data collection (qualitative interviews and household surveys) were conducted between January and July 2016. See Figure 5. However, the implementation phase was delayed by one year due to VIR band design issues (time strip accuracy) from the manufacturing company. A repeat baseline household survey was conducted in July 2017. Implementation phase commenced August 2017, enrollment was extended by one-month to February 2018 in order to achieve the target of enrolling 500 children. Timing of exit interviews were extended by 3 weeks due to national Joint Health Sector Unions strike that affected availability of immunization sessions at our study health facilities.

Figure 5: Formative study activity timeline



7.0 Analysis and findings from the formative evaluation

7.1 Data analysis approach

Responses from the qualitative interviews (FGDs and IDIs) were audio recorded and transcribed verbatim. Codes were derived from the research questions and related survey questions, and grounded in themes emerging from the data. These codes were recorded in a code book. Two study members hand coded each interview transcript independently using the code book, after which another member reviewed and entered the coded transcripts into Atlas.ti software. This software was used to query the data for meaningful content and interpret it terms of identified themes. The completed questionnaire was obtained from the ODK platform, de-identified, and analyzed using SPSS.20. Descriptive statistics (frequencies, cross-tabulation, means) were generated for each variable.

7.2 Findings

Both baseline survey and end line exit interview findings are presented in two sections. Section I starts by presenting the socio-demographic characteristics of our respondents followed by findings on the primary evaluation questions comprising of relevance of the intervention; acceptability of VIR band at different levels; parents retaining the band on their infants for the duration of the study; and feasibility of distributing and activating the VIR bands through health workers; and health workers' ability to follow study protocol.

Section II presents other findings related to the evaluation questions covering knowledge, attitude and practice about immunization; parental intention to vaccinate their children, predominant norms around vaccination, and timeliness of BCG and Penta 3 vaccinations by 2weeks and 18weeks, respectively.

7.2.1 Section I

7.2.1.1 Socio-demographic characteristics of direct beneficiaries (parents/caregivers)

A representative household sample of 669 eligible respondents (mothers with under-one children) were surveyed at the baseline. At end line, 153 study parents who returned for penta 3 were interviewed. The exit interview population is self-selected and likely represents the caregivers most motivated to vaccinate their children.

Ages of women in the baseline sample ranged from 16 to 71 years with the average age for women at 27 years, and 23 weeks old for the infants. The educational status was generally low. As much as 86% had no formal education, only 4.2% had attained senior secondary school or higher (table 6). Other demographic characteristics are reported in Appendix E.

Table 6 and 7 shows the socio-demographic characteristics of the baseline and end line respondents.

Most respondents had no formal education 86% and 99% in the baseline and end line samples, respectively. Among those who had attended formal education, the highest level of formal education attended was primary school 48% in the baseline and secondary school in the end line. Table 5 and 6 shows the socio-demographic characteristics of the two study respondents. Other demographic characteristics of the baseline sample is presented in Appendix E.

Mean age for the end line respondents were 30 years for the women and 36 weeks old for the children.

Table 6: Socio-demographic characteristics of household survey respondents at baseline

Characteristics	**Number (n=669)**	**Percentage (%)**
	Baseline	
Age group in years		
16-25	317	47.4
26-35	284	42.5
36-45	63	9.4
>46	5	0.7
Highest level of formal education completed		
None	573	85.7
Primary School	46	6.9
Junior Secondary School	22	3.3
Senior Secondary School	26	3.9
Tertiary Institute	2	0.3

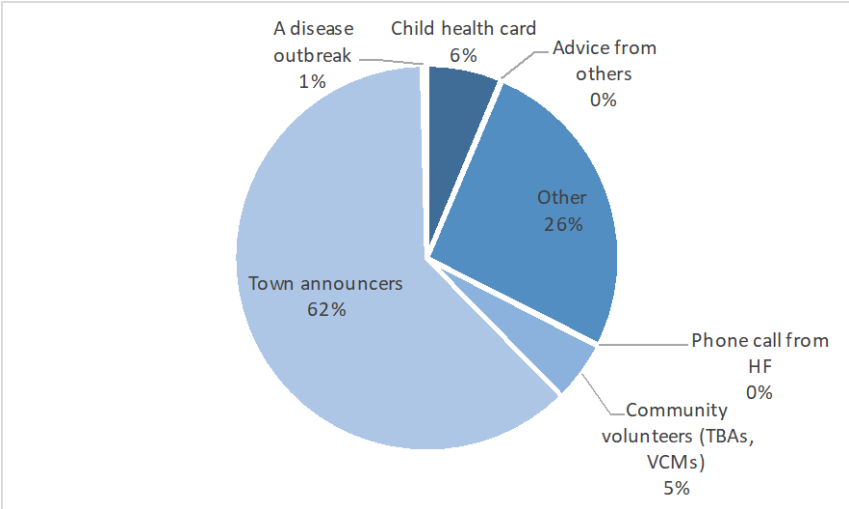
Table 7: Socio-demographic characteristics study parents at exit interviews

Characteristics	Number (n=153)	Percentage (%)
	End line	
Age group in years		
16-25	31	20.3
26-35	104	67.9
36-45	16	10.5
>46	2	1.4
Attended formal education		
No	152	99
Yes	1	0%
Highest level of formal education completed (n=1)		
Primary School	-	-
Junior Secondary School	-	-
Senior Secondary School	1	100
Tertiary Institute	-	-

7.2.1.2 Relevance of the intervention

There was a high demand for reminders. Several modalities for reminders were mentioned with town announcers, as the most frequently cited reminder for parents 62% (See Figure 6). Despite the variety of approaches mentioned, most of the respondents, 89% still thought other vaccination reminders are needed besides the existing reminders, and the majority, 92% were willing to accept a new reminder device.

Figure 6: Reported means of reminder for vaccination by baseline respondents

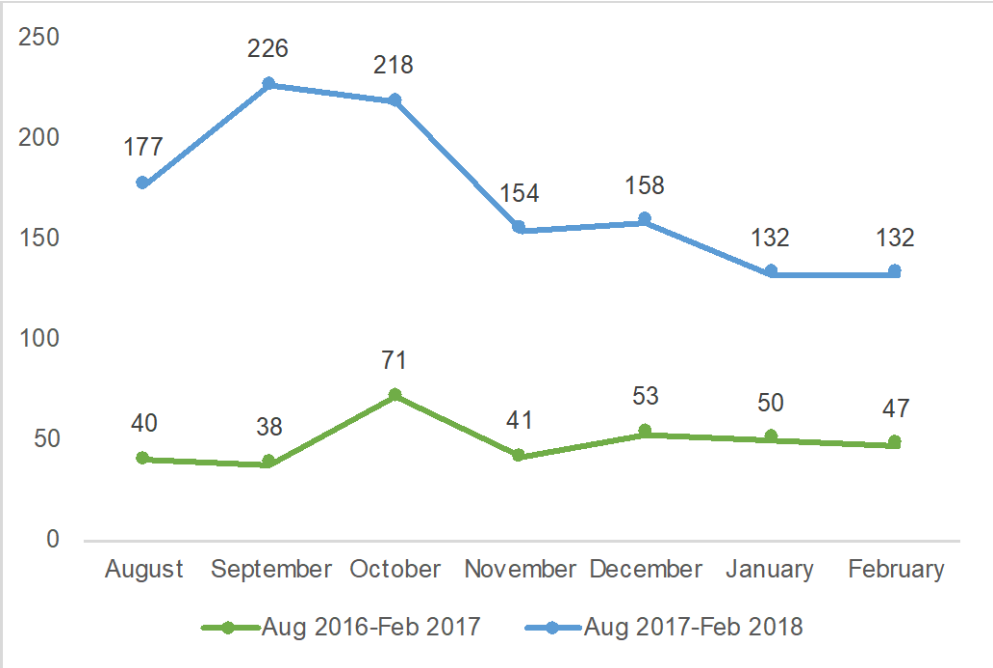


7.2.1.3 Acceptability of VIR band

We noticed a significant increase in BCG vaccination uptake during the intervention period compared to same period the previous year (see figure 7). VIR band intervention may have contributed to the observed increase in the number of children vaccinated, as there were no other interventions ongoing in the study sites. Between August 2017 and February 2018, the LGA level documented that 1,197 infants were vaccinated with BCG across our study health facilities (see table 8). However, only 874 infants actually received BCG vaccination in our study health facilities as reported by our study records. This discrepancy was due to poor data collection at the health facilities by health workers. It is worth noting that quality RI data remains an issue in Nigeria. There are inconsistencies in the data found at the health facility when compared to the LGA reporting platform (LGA Summary Sheet). Its improvement has become a priority in the country.

Among the 874 infants that actually received BCG vaccination in our study health facilities, 503 parents with infants <2weeks old accepted to use the VIR band and were enrolled, while 371 infants were excluded (see table 9). Most common reason for exclusion were unavailability of bands, 71% while parents not residing in the study areas, 1% were the least. Maidahini ward recorded the highest number of enrollment 196, followed by Raha with 182 and Bunza Marafa ward 125. Children enrolled were followed up for 18 weeks after the first dose of vaccine was administered by the study health worker. Among the 503 children enrolled, 386, 197 and 155 returned for penta 1, 2, and 3, respectively (see Table 10).

Figure 7: Number of children who received BCG vaccines between Aug 2016-Feb 2017 and Aug 2017-Feb 2018



Data source: Bunza LGA Summary sheet 2017-2018

Table 8: Number of children vaccinated with BCG across the study HFs from August 2017 to February 2018

Ward	Name of Health Facility	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Grand total
Bunza Marafa	MCH Bunza	16	25	49	41	38	36	28	233
	Balu Dispensary	13	27	35	9	21	13	18	136
Maidahini	PHC Maidahini	53	43	29	29	23	15	18	210
	Garadi Dispensary	62	39	34	20	20	21	16	212
Raha	Raha PHC	16	46	32	40	42	32	23	231
	Matseri Dispensary	17	46	39	15	14	15	29	175
	Grand Total	**177**	**226**	**218**	**154**	**158**	**132**	**132**	**1197**

Data source: Bunza LGA Summary sheet 2017 - 2018

Table 9: Enrolment and exclusion figures in study HFs from 14th August 2017 to 15th February 2018

Ward	Name of HF	Total no. of children enrolled (Data source: VIR Band Study register)	Total no. of children excluded (Data source: Child Immunization Register at the HF)	Reasons for exclusion:				
				Parents do not reside in the study wards (Data source: Child Immunization Register at the HF)	Child is >14 days (>2 weeks) (Data source: Child Immunization Register at the HF)	Parents refusal to participate	VIR Band shortage	Vaccine stock out
Bunza	MCH Bunza	116	95	0	11	0	67	17
Marafa	Balu Dispensary/Health Post	9	0	0	0	0	0	0
	PHC Maidahini	114	69	0	9	0	52	8
Maidahini	Garadi Dispensary/Health Post	82	56	0	3	0	44	9
	MPHC Raha	99	79	2	3	0	56	18
Raha	Matseri MDG	83	72	0	3	5	44	20
	Total	503	371	2	29	5	263	72

Data source: VIR band study register

Table 10: Immunization uptake in study health facilities

Name of Ward	Name of Health facility	Number of children enrolled and received BCG	Number of children that returned for penta1	Number of children that returned for penta2	Number of children that returned for penta3
Bunza Marafa	**MCH Bunza Marafa**	116	91	44	38
	PHC Balu	9	7	0	0
Maidahini	**PHC Maidahini**	114	97	54	42
	Garadi Dispensary	82	52	25	22
Raha	**Raha PHC**	99	67	31	27
	Matseri Dispensary	83	72	43	26
	Total	503	386	197	155

Data source: VIR band study register

Among the 153 parents/caregivers surveyed (i.e. parents of children who returned for penta 3 vaccination), majority 95% were informed about the VIR band before enrollment (This could be because another caregiver, not the mother, gave consent for the child to participate in the study). There was good knowledge of VIR band among those who were educated about the band before enrollment. Most, 92% knew VIR band as a device to help them remember when next to vaccinate their children. The VIR band was also seen as an effective vaccination reminder among 97% of the end line respondents. Most cited reason for its effectiveness were its ability to remind them all the time, 80% and majority, 95% said they would recommend VIR band to others (see table 11).

Table 11: Knowledge of and attitudes toward VIR band among end line respondents

Categories	Number (n)	Percentage (%)
Informed before enrollment (n=153)		
Yes	146	95.4
No	7	4.6
Knowledge about VIR band (n=146)		
It helps to remember when next to vaccinate the child	134	91.8
Ensure your child wears the VIR band at all times	79	54.1
It does not cause any harm to the child	60	41.1
There is no unexpected reaction due to VIR band	22	15.1
I don't remember	2	1.4
VIR band an effective way to remind about vaccination (n=153)		
Yes	148	96.7
I don't know	5	3.3
Cited reasons for its effectiveness (n=148)		
It reminds all the time	118	79.7
It is waterproof	38	25.7
It is easier to understand	86	58.1
It is easier to take care of	34	23.0
It is a timely reminder of child's vaccination	34	23.0
Recommend VIR band to others (n=153)		
Yes	145	94.8
No	3	2.0
I don't know	5	3.3

Majority of the respondents at baseline, 92% and at end line, 99% were willing to allow their children wear the VIR band. Post-intervention, most respondents, 97% allowed their children wear the band on their ankle. In the two study samples, the reasons for not wearing the VIR band on the babies' ankle were similar among those who opposed. Most cited reason for objection was that it was strange in the community, 96% at baseline and 94% at end line. Half of the baseline respondents, 46% said they would retain the band on child's ankle "only for the duration of the

study and as long as it is needed". Interestingly, most end line respondent, 98% actually did same (see Table 12 and 13). Respondents of age groups 26-35 years old and with no formal education were more likely to allow their children wear the VIR band in the two study samples (See table 14 - 17)

Table 12: Caregivers preferences on modalities of wearing the VIR band at baseline

Categories	Number (n)	Percentage (%)
Allow child to wear VIR band	**(n=669)**	
Yes	616	92.1
No	53	7.9
Preferred place to wear VIR band	**(n=616)**	
Ankle	424	68.8
Wrist	187	30.4
Other: Specify	5	0.8
Object to wearing the VIR band on babies' ankle	**(n=616)**	
Yes	198	32.1
No	418	67.9
Reasons for objection (multiple choice response)	**(n=198)**	
It is strange in our community	189	95.5
It is strange in our community and looks like a handcuff on the leg	5	2.5
It is strange in our community, looks like a handcuff on the leg, and against our tradition and religion	1	0.5
It only looks like a handcuff on the leg	2	1.0
Other	1	0.5
Band retention period among those who preferred VIR band on babies' ankle	**(n=424)**	
1 week	3	0.7
1 month	23	5.4
Only during the study duration and as long as it is needed	195	45.9
After vaccination period	203	47.9

Table 13: Study parent's preferences on modality of wearing the VIR band at end line

Categories	Number (n)	Percentage (%)
Allow child to wear VIR band	**(n=153)**	
Yes	152	99.3
No	1	0.7
Preferred place to wear VIR band	***(n*=152)**	
Ankle	147	96.7
Wrist	5	3.3
Object to wearing the VIR band on babies' ankle	**(n=152)**	
Yes	17	10.8

No	136	89.4
Reasons for objection	**(n=17)**	
It is strange in our community	16	94.1
It is strange in our community and looks like a handcuff on the leg	0	0
It is strange in our community, looks like a handcuff on the leg and against our tradition and religion	1	5.9
It only looks like a handcuff on the leg	0	0
Other	0	0
Band retention period among those who preferred VIR band on babies' ankle	**(n=147)**	
1 week	0	0
1 month	2	1.4
Only during the study duration and as long as it is needed	144	97.9
After vaccination period	7	4.8

Table 14: Age distribution of mothers at baseline who would allow their children wear the VIR band

Age group in years	***Allow child to wear VIR band (n=616)***	**Percentage (%)**
16-25	290	47.0
26-35	272	44.1
36-45	52	8.4
>46	2	0.3

Table 15: Age distribution of study parents at end-line, who would allow their children wear the VIR band

Age group in years	***Allow child to wear VIR band (n=153)***	**Percentage (%)**
16-25	31	20.3
26-35	104	67.9
36-45	16	10.4
>46	2	1.3

Table 16: Distribution of mothers at baseline who would allow their children wear the VIR band, by education

Attended formal education	***Allow child to wear VIR band (n=616)***	**Percentage (%)**
Yes	92	14.9
No	524	85.0

Table 17: Distribution by education, of caregivers at end line who would allow their children wear the VIR band

Attended formal education	*Allow child to wear VIR band (n=153)*	Percentage (%)
Yes	1	0.7
No	151	98.6

There was general acceptability of VIR band at different levels pre-and post-intervention. The band was perceived by policy makers as a solution to drive demand for vaccination, as mothers tend to forget.

> "*Like I said, some people cherish immunization but they are always forgetting. So this will help solve that problem of forgetfulness. Especially by wearing it on the child, the mother will always remember her child is due for vaccination, and is something she can see physically when she is bathing and breastfeeding the child…Not only reading the indicator but by looking at it you will remember that your child is undergoing something very special. So I think it is a welcome idea."* –Policy maker

Its ability to remind mothers of child vaccination due dates was seen as relevant to the need of the state to improve RI performance and coverage.

> *"Many strategies have been applied, but this is the first time we've had this bracelet and the people are very lucky to be part of the study. In a wider perspective all over the state, I think it is something that can be scaled up because there is so much importance attached to it. The most important thing is that the mother will be monitoring when her child is due for immunization and without anybody telling her, the band tells her that her child is due for immunization".* – Policy maker

For program managers, the VIR band complemented the existing reminder system for health workers called the Tickler Box (where a detached part of the child's immunization card is kept at the health facility to serve as an indication for number of defaulters) used to track defaulters in order to increase uptake and reduce dropout rate. The band did not only serve as a reminder, it also raised awareness about RI in the community and motivated parents/caregivers to vaccinate their children and, requested for reminders up to 9months.

> *"**Respondent 1:** The band is an important intervention for Routine Immunization. There has been a lot of achievements in BCG coverage. With the co-opting of TBAs, traditional and religious leaders, our people accepted the band. We have seen improvement in the LGA and better BCG coverag*e. ***Respondent 3:** It is a reminder that enables parents remember when to vaccinate. There was low coverage and few immunized children before, but with the band it makes parents come to the health facility. So it is very important and we appreciate it."* – LGA program managers

> *"It also helped in raising awareness of RI in the community. It served as a reminder in terms of access and utilization. It motivated people to come for immunization. People's*

perception that people didn't want to be immunized was changed. It made me realize that if we are to do something there should be proper sensitization." - State program managers

All health workers in our study health facilities were in agreement that VIR band eased the workload on them, as they don't have to go the extra mile to remind mothers; and also encouraged immunization turnout (for RI sessions) and uptake. The band also served as an "incentive" and "fashion piece" for vaccination when other incentives such as disposable diapers, baby mattress, mosquito nets distributed to mothers to encourage uptake were unavailable. These other incentives are usually funded by development partners and are not always specific to vaccination. They are also not always available (as was the case for the duration of the study) as they rely heavily on funding from projects and once the projects end, the incentives are not sustained. However, health workers sometimes provide such incentives to mothers out of their pockets.

"Whenever we put the band on their babies they see it as an adorable piece of jewelry, as a result they always want to come back for it. They see the band as some kind of fashion, and whoever is given feels really proud of having it, they think is not okay to just give card only after the injection." - Health worker, Garadi Dispensary

"Actually, since we started using the bands we've recorded a lot of progress, and there has been increased turnout of children. Whenever any of the parents came for the child immunization and was given the VIR band, when the others see it with her they tend to be stimulated to bring their babies too." -Health worker, Matseri MDG

"*With the band, they tend to bring more babies for vaccination and they seldom bring the babies when the band is not available. The VIR band has brought about more demand and we easily reach our monthly target even above the target, but before the arrival of VIR band we hardly achieve the target to even send monthly data*." - Health worker, Garadi Dispensary

There was general acceptability of the band among community members (TBAs, WDC members, traditional and religious leaders, men and women groups and parents of under-one children). The strong support from trusted stakeholders in the community such as the traditional and religious leaders, the TBAs and the health workers who were involved in sensitizing and educating community members on the importance of VIR band and vaccination increased acceptability of the band. Furthermore, the design, safety and durability of the band made it acceptable among community members. The band was colorful, never harmed or irritated any child and children were able to bath, cloth and do anything with it. Majority of community members understood the importance and how to use the band, and were able to communicate the benefit of the band. In addition to motivating mothers to vaccinate their children, VIR band also triggered discussions about vaccination in the community. Children who wore the band were perceived to be "active" and "healthier" than those who do not.

"*Immunization has benefit and the VIR band helps in reminding us parents when its full to take our children for vaccination even when we are not told of the date. Sometimes I don't*

have to check the immunization card, I will just notice that the band is full and that is all."- Parent of under-one child, Bunza Marafa

"The VIR band is also a means of encouragement. When a mother sees it tied on a baby's ankle, they take their children for vaccination to get same VIR band and to be honest VIR band really encourage people a lot"- Sarki, Maidahini

"*The VIR band also used to bring about discussion about vaccination. When a woman sees the band on our child she wants to know what it is, am talking about women outside Bunza. This happens mostly when we travel for events*." – Younger women

"*The band whenever it is worn on the child it tends to differentiate that child from those that are not wearing the band, in that those wearing the band appears to be more active. Therefore, we concluded that the band is of great importance*". – Men group

"***Respondent 1:*** *Through mobilization they explain to them about its importance.* ***Respondent 2:*** *The people listen to the Imams. Since they accepted it, everyone will accept but if they did not nobody will accept it.*" – WDC members

The VIR band was also likened to a "wristwatch" that will always remind mothers when next to vaccinate their children.

"It is also a watch used to remind parents of their child's next appointment." –Older women

Similar accessories such as laya (traditional amulet necklace), kandu and ijiya (traditional bracelets) are worn on newborns immediately after birth for cultural or religious reasons thus, was not an impediment. However, there were concerns pre- and post-intervention on wearing accessories on the ankle. Although majority of our end line respondents wore the band on their child's ankle, they still prefer it to be worn on the wrist.

"*Truly in our culture here, anything that will be tied on a child is worn on the band(wrist). If you advocate for it to be worn on the leg(ankle), it will be a strange thing. More like handcuffs on their leg."* – WDC members

"Culture and religion do not stop the wearing of the VIR band on the ankle of the children, but am advising that the band be worn on the wrist. Wearing it on the ankle makes it looks as if you are putting on a charm". Imam

In addition, concerns were raised about the red ink/dye in the band. It was rumored to be the "blood" of the infant. Although this was addressed by HWs and TBAs, and through re-sensitization of community members using their traditional leaders, all stakeholders advised that the color be changed.

"*There were no challenges at all. Except that some women said the band is sucking the blood of their children that is because of the red ink*". Parent of under-one child, Raha

"***Respondent 1:*** *Some parents think that the VIR band is using their children's blood that is why they don't allow their children put it on.* ***Respondent 2:*** *Yes, even in my community*

some women think it sucks their children blood. Though most women accepted it." Younger women

"*That red colour that moves in the band, people complain thinking that it is sucking the blood of their children that is spiritual way of sucking their blood through computer. If there is a way you can change that red colour. Although we usually explain to them that is not blood, but that it is oil*."- TBAs

"*They did, but at the inception stage before they understood how it works. We hear rumors that the band we are giving to them is sucking their babies' blood, because of the red color of indicator. So we had to educate them continuously that it's not true that red is just a color, it has been there when you collected it. We activated it we do show it to you, and that it's the indicator. When they finally understood, we activate and put it on the babies, they don't show any reaction. They be like "we thought its blood", and we will say no*." – Health worker, MCH Bunza

"The only advise I will give is that the color be changed from red. People complained that it is sucking the blood of their children". – Health worker, Matseri PHC Raha

"*People like the design not only me, and for the fact that a child can wear it for a long time and not hurting the child. The VIR band is ok this way, but people don't like the red liquid inside it, change the red color because red looks like blood parents are thinking that its blood that is on their children's ankle*." –Imam, Raha

Also discovered to be a challenge was the high malfunction rate of the bands. We classified a band as malfunctioned when the ink failed to reach the end mark at the designated time (For activated yellow, purple and green bands, the ink should have reached the end point of indicator strip at exactly six, four and four weeks, respectively). To determine the exact rate of malfunction, the study team catalogued all bands returned to the health facilities by mothers when children were brought for subsequent vaccinations. This was to identify bands that malfunctioned and how they malfunctioned for design improvement (see table 18). There were also few incidents of the ink spilling during activation, inability of health workers to confirm if the bands had been fully activated and the band lock/clasp mechanism falling off.

"*The VIR band stop some time that is the only challenge we have but parents understand how it works*". –Imam, Raha

"*It use to last, but the only problem is the indicator fluid that should reach the desired level in 6 weeks as expected might extend to 7 or 8 week before it's full, so sometime when the time for the return is due you will find out the indicator fluid is not full yet. So we will just use the time interval on record and then vaccinate the baby and give the next band*. *The second thing is the pins on the band should also be improved as it removes after the band is activated and they've left with the babies. Mostly they use thread to tie it so it doesn't fall off. Other times when they go out with the children on their backs the pins remove and the band falls without their knowledge, some are able to find it and while others don't*." – Health worker, Garadi Dispensary

Table 18: Proportion of malfunctioned VIR bands*

Band color	Number distributed	Number returned to HF	Number malfunctioned	Proportion of malfunctioned bands
Yellow	432	342	249	73%
Purple	259	132	85	64%
Green	116	74	38	51%

*Proportion of malfunctioned band is measured by dividing the number of malfunctioned bands by the number of bands returned
Data source: VIR band catalogue

While there was general acceptability of the band and it encouraging turnout for immunization, its unavailability may have reduced immunization uptake among caregivers who perceived it as an incentive.

> "*Some mothers even say they will not bring their children to the health facility except if the band is available*." –TBAs

> "*Yes, we do, whenever we have meetings we tell them. But most of the women have decided not to bring the babies because there is no band to give them, and there is no way of responding to the band deprivation*." – Health worker, Garadi dispensary

> "*And the challenge we mostly face is the in availability of the band, maybe after the collection of the first, when they return for the second and it's not available, or it won't be enough to go round, and u know those that didn't get will not be happy. So this should be avoided*."- Health worker, Matseri MDG

Pre-intervention, all participants stressed the need for robust awareness/sensitization in the community and engagement of community leaders to improve acceptability and avoid criticism and rejection. Also identified to improve acceptability is having the husband's permission to allow the band to be worn on the child.

> "*We should engage key stakeholders especially community leaders. The top hierarch up to the lower level…We need to sensitize them and let them understand what the innovation is all about and with that we can get a good level of acceptability."* - Partner

To this effect, we first mapped the key stakeholders to be sensitized (community gatekeepers: WDC members, respected traditional and religious leaders, women and men group) and held a meeting with them to ensure community buy-in. Following this, a schedule was developed and the group was informed on when the sensitization meetings will hold. Advocacy visits were held with the LGA political leader, and the traditional and religious leaders within the three wards to solicit support. Throughout the child enrolment and follow up periods, community gatekeepers were intensively sensitized on the importance of vaccination timeliness and completion, and of the functionality of the VIR band. WDC members including the men groups were also engaged in the implementation of the intervention in their study wards and mobilized to advocate for immunization. Posters on VIR band and importance of vaccination timeliness and completion

were pasted at strategic areas across the 3 study wards. This was to saturate study wards with key messages on RI and the VIR band. Community mobilization activities were conducted in market places, town halls, and village head palaces; and community sensitizations were held every quarter. A song about the importance of vaccination and VIR band in Kebbi local language was developed by the study team and used for these community mobilization and sensitization activities. We conducted a total of 32 community sensitization meetings and an estimated 798 individuals were reached (See table 19 below). We also held four community mobilization activities. All activities were conducted by the study team with support from the state RI focal person, Bunza LIO, Bunza LHE, and community town announcers; who had received trainings from the Principal Investigators on the message and content for the sensitization.

Table 19: Community sensitization meetings held and the number of individuals reached during the implementation phase

Type of stakeholder	No. of meetings	Estimated no. of participants
Meetings with LGA level stakeholders	1 planning meeting 1 meeting with Sole Administrator Bunza LGA 1 meeting with LIO Bunza LGA 1 meeting with Religious leaders and influential members of Bunza LGA	10 10 4 15
Meetings with District Heads	1 meeting with Bunza Marafa District Head 2 meetings with Raha District Head 2 meetings with Maidahini Village Head	25 50 10
Meetings with community stakeholders	12 meetings with WDC members (4 per study ward) 9 meetings with women (3 per study ward) 3 meeting with men (1 per study ward)	180 384 110
Grand Total	**32**	**798**

Data source: Sensitization attendance sheet

The decision to scale up or adopt an intervention like the VIR band in the state according to policy makers depends on: 1) its ability to address the issue at hand i.e. create community demand for vaccination, which should be backed with credible data; and 2) its cost effectiveness. Once perceived as important and cost effective by the State Primary Health Care Development Agency (SPHCDA), state technical and management team (comprising of the state immunization team, partners, NPHCDA Zonal representatives), LGA team, community leaders and political leaders; it will be included in the State PHC plan and reviewed by the task force for PHC implementation (Chaired by the Executive Governor of Kebbi State) before its inclusion in the budget for the next year. Interventions like VIR band are implemented by the RI and communication departments of the SPHCDA. The RI department will monitor its progress in improving RI coverage and uptake, while the communication department will track its acceptability in the community. While our study did not assess the cost effectiveness of the intervention, policy makers and program managers attested to VIR band potential in increasing demand for immunization. Thus, suggested the need to assess its cost effectiveness as well as effectiveness in improving coverage and uptake.

7.2.1.3 Implementation fidelity and programmatic feasibility

Eligibility criteria

Our intervention targeted two groups: children less than 2 weeks old (final beneficiaries) and mothers/caregivers with newborns (direct beneficiaries). These targeted population groups were relevant for the intervention's outcomes because the final beneficiaries are yet to receive their first vaccination, which usually occur after the naming ceremony (8 days after birth); thus perfect for enrollment. While mothers/caregivers with newborns as the most relevant target group for understanding awareness and acceptance of the VIR band, and norms around vaccination.

Enrollment duration

We originally planned to enroll 500 infants <2weeks for a period of 5 months (inclusive of one-month grace), between 14th August 2017 and 14th January 2018 based on data on the number of children vaccinated with BCG from the LGA Monthly Summary Sheet March to May 2017. However, we extended enrolment for an extra one month to ensure the target number of infants were met. Also, during this one-month enrolment extension, 71 infants whose parents agreed to participate in the study were enrolled without the yellow bands and were subsequently given the purple bands during their next visit.

Programmatic feasibility

Initially, we planned distributing the bands to newborns in the community through TBAs as most deliveries occurred at home 586(88%), and TBAs assisted 100(15%) of them (See Table 20). It is interesting to know that most relatives who assisted in deliveries were also TBAs.

Table 20: Delivery practices among baseline respondents

Place of delivery	**Delivery assisted by**						
	Skilled provider	Community health worker	Relative	TBA	No one	Other	**Grand Total**
General Hospital	27	6					**33**
PHC	10	27					**37**
Private clinic/Maternity		2					**2**
Home	4	25	330	95	130	2	**586**
TBA's home				5			**5**
Other			2		2	2	**6**
Grand Total	**41**	**60**	**332**	**100**	**132**	**4**	**669**

*Doctor, Nurse, midwife and auxiliary nurse/midwife

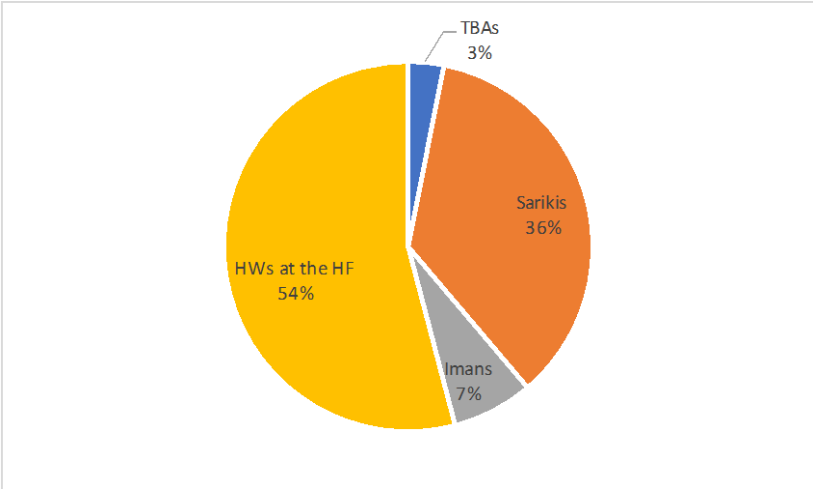
Policy makers during the baseline interviews believed TBAs have the potential to distribute the VIR bands to newborns in the community because they assist in delivery of a large proportion of babies and know every newborn in the community. Also, they are highly respected and accepted in the community; sometimes used to resolve non-compliance cases and mothers trust them enough to help take their children for vaccination. Program managers were hopeful that once trained, TBAs could effectively deliver the bands in the community as they have been previously

engaged in similar health interventions such as distribution of Mama-kits to pregnant women. In agreement, health workers stated that TBAs supports them by providing information on all new births in the community and refer mothers for antenatal care and child's vaccination.

However, given the technicality of activating the band, keeping records of children enrolled (most TBAs are illiterate), and avoiding accidental activation of the band by mothers at home before vaccine initiation, TBAs were only asked to refer every newborn using the referral card. For those unable to write, they asked those that can to help. Moreover, pre-intervention, 333(54%) of the respondents who were willing to allow their children wear the VIR band preferred to receive the band from health workers than TBAs 19(3.1%). (See Figure 8). This preference did not change as parents/caregivers still cited their preference for health workers because they vaccinate their children.

> "*Since the bands are given by HWs, I think that is a good motivation as the band itself motivate some women to go for immunization. So I advise that HWs should continue to distribute this as they are trusted in the community. Some women go for immunization just to get the band*." – Younger women

Figure 8: Mother's preferences on who administers the band (at baseline)



At baseline, health workers and TBAs expressed willingness to deliver the VIR band intervention and mentioned the need to be trained on the use of the band to communicate effectively with mothers. To prepare both health workers and TBAs for the task, we conducted a 2-day training each. TBAs were trained by the study team on the importance of immunization timeliness and completeness, and use of VIR band. These TBAs informed health workers of every newborn; sensitized mothers during home visits and community group meetings, and referred them to the HF for their child's vaccination using a referral card designed by the study team (see *Online Appendix D*). These cards were also used to track TBAs performance on delivering the intervention. Referred mothers from TBAs presented their referral cards when they visit the HF

for child's vaccination. All 53 TBAs trained and engaged, referred mothers to the HF to receive the band. During the enrollment period, we recorded 813 referrals by our TBAs, and 729(89%) of these referrals came to the HF for immunization and VIR band (see table 21). MCH in Bunza Marafa recorded the highest referrals 180 that came to the HF and Balu dispensary the least 8.

Table 21: Referrals by TBAs across the three study wards

Ward	Name of HF	Total no. of referrals by TBA (Data source: TBA Supervisor register)	Total no. of referrals that came to the HF (Data source: Referrals forms at the HF and VIR band Study register)
	MCH Bunza	198	180
Bunza Marafa	Balu Dispensary/Health Post	0	8
	PHC Maidahini	244	148
Maidahini	Garadi Dispensary/Health Post	23	113
	MPHC Raha	293	156
Raha	Matseri MDG	55	124
Total		813	729

The use of TBAs in implementing health interventions cannot be over emphasized as the most critical service delivery point. Involving them in implementing the intervention was strategic as they are usually the first contact for mothers and in some areas where women are not allowed to go out or to be visited, TBAs were allowed access. Our TBAs not only identified newborns and referred mothers, they also visited mothers to check if the band have reached the end point and mostly took their children to the HF for vaccinations. Mothers entrusted TBAs with their newborns to take them for vaccinations at the health facilities, especially for those that practice the 40 days post-partum rest. This cultural practice prevents nursing mothers from leaving their houses until after 40 days. Most of our end line respondents 134(88%) said TBAs took their children for the first vaccination and for subsequent vaccinations 90(67%).

> "*I will say 80% of the babies are brought by the TBAs, because even after the announcement and other things parents still don't bring the baby, until the TBAs go to their houses*." – Health worker, Garadi Dispensary

> "*Yes, they did their work well, it's even because of them that we do get people to come to the hospital, as they are the ones inside town so whenever they heard a woman gave birth, they will go and give them the card telling them to take the babies to the hospital. Indeed, they are trying*." - Health worker Matseri MDG Raha

> "*TBA they are people from our community we know their character, we know their husbands, we interact with them. If a woman just puts to bed, she would not want to be going out because she just put to bed. But since they trust the TBAs, they give them the children to take to the health facility for immunization*." – WDC members

A total of 14 health workers who conduct vaccinations (RI focal persons) from the six study HFs were trained on the importance and use of VIR band, protocol for enrolling eligible infants to the study and for activating the VIR band, and on how to respond to deviations from standard protocol. However, only 5 from 5 study health facilities implemented the intervention.

Incorporating the VIR band messages and its activation as part of RI services provided at the HF was not an added workload for our study HWs, as they usually give health talks which include education about AEFIs during immunization session. They effectively communicated the importance and use of VIR band, distributed and activated VIR bands at first contact (i.e. first vaccine initiation) with an eligible child at the HF (fixed session) and in the community (outreach session). They were also pleased to implement the intervention and to work with the TBAs who they say contribute to the success of RI uptake in the community. Study data clerks were also present at every immunization session to support data collection and documentation.

> "*Why I will like to work with this band is because it has improved people's reception about my job on vaccination. With the band, they tend to bring more babies for vaccination and they seldom bring the babies when the band is not available*." – Health worker, Garadi Dispensary
>
> "*TBAs are the back bone of RI here. Any day we come for session and they are not there, we end up doing nothing for the whole day*. *Yesterday was my session I was just able to get 2 children to immunize for the whole period as none of the TBAs came*." – Health worker, Garadi Dispensary
>
> "*Because they are the ones to bring in the children, so without them our work will be poor this population will not be reached. In most instances their diligence is used to have more than the expected population*." – Health worker PHC Maidahini

An observation of HWs implementing the intervention during RI fixed session revealed that four out of the five trained HWs from our study HFs adhered to the study protocol in all 23 areas observed. Balu Dispensary conducted only four sessions throughout the study duration and was not observed during this period. Maidahini PHC did not adhere to educating caregivers about the benefits and importance of RI, and importance and use of the VIR band (see Appendix 10). This was addressed during supportive supervision conducted throughout the study duration.

7.2.2 Section II

7.2.2.1 Knowledge, perception and attitude about immunization

Most respondents at baseline, 76% and end line 89% knew vaccination as an injection that prevents diseases in children. Source of knowledge on vaccination differed in the two study samples. While town announcers, 46% was the main source of knowledge at baseline; TBAs, 43% and HWs, 31% were cited at end line. This is not surprising as TBAs and HWs were engaged to educate and sensitize community members on importance of timely and complete vaccination. While most of the end line respondents, 78% knew the correct number of times a child should visit the health facility for vaccination to be fully immunized, they do not know the vaccine a child

should receive at each age. TBAs assisting mothers in taking their children to vaccination center may have contributed to this because most mothers did not have the chance to know the vaccines their children were taking (see Table 22 and 23).

Table 22: Mothers' knowledge about vaccination at baseline

Categories	Number (n=669)	Percentage (%)
Understanding of vaccination		
An injection that prevents diseases in children	510	76
An injection that helps children grow well	37	6
An injection that makes children strong	19	3
An injection that makes children sick	3	0
Others: Specify	3	0
I don't know	97	14
Sources of information		
Family/Peers	110	16.4
HWs	123	18.4
TBAs	2	0.3
Radio	66	9.7
WDC	3	0.4
Traditional/Religious leaders	8	1.2
Town announcers	272	40.7
VIR band posters	-	-
During home visits	6	0.9
Other	1	0.1
None	78	11.7
Number of times a child should receive vaccination*		
One	13	1.9
Five	47	7.0
Nine	8	1.2
Others	2	0.3
I don't know	599	85.7

*This means the number of visit for vaccination

Table 23: Study parents' knowledge about vaccination at end line

Categories	Number (n=153)	Percentage (%)
Understanding of vaccination		
An injection that prevents diseases in children	136	88.9
An injection that helps children grow well	9	5.9
An injection that makes children strong	4	2.6
An injection that makes children sick	-	-
Others: Specify	-	-
I don't know	4	2.6

Sources of information		
Family/Peers	11	7.1
HWs	47	30.7
TBAs	66	43.1
Radio	-	-
WDC	1	0.7
Traditional/Religious leaders	5	3.3
Town announcers	10	6.5
VIR band posters	10	6.5
During home visits	-	-
Other	3	1.9
None	-	-
Number of times a child should receive vaccination*		
One	8	5.2
Five	119	77.7
Nine	1	0.7
Others	-	-
I don't know	25	16.3

*This means the number of visit for vaccination

Community members' perception on the importance of childhood vaccination in reducing the risk of VPDs, preventing consequences of VPDs, and being beneficial and safe to child's health improved at end line (see table 24 and 25). Most community members trust vaccination and perceived immunization to be beneficial having witnessed the benefits of vaccination. For instance, children who were vaccinated were seen as been healthier than those who do not. Interestingly, the men believe the VIR band has exposed community members to the benefits of vaccination and reduced occurrences of diseases. This may be due to the education and sensitization activities on the importance of timely and complete vaccination, and use of VIR band. And caregivers increased uptake of vaccination just to receive the band.

> "*Surely, it is important. The children remain healthy, and whenever there is a disease outbreak in the community, the vaccinated babies are not affected. That's why we do bring our children for this vaccination*". Parent of under one child, Maidahini

> "*Because my child looks healthier than before and everything has been normal, now I understand that immunization makes a child healthy and normal*." Parents under one Raha

> "*Ever since this program was introduced, unlike before when we have several diseases in our children, but now with introduction of the VIR band, the vaccinations and other medications that are given, now such incidence has greatly reduced*." – Men group

> "*Children that are vaccinated when they fall ill it will not be serious, but children without vaccines their illness will be very serious*". – Younger women

> "*I personally realized that the child who had vaccine is better than the child who had not taken vaccine. Vaccinated children shows physical fitness and no complain of small illness, which disturbs the parents*". – Imam Maidahini

"*It is extremely effective because of the lack of vaccination may lead to crippling the child. Example, there was a man whenever is time for vaccination he will take his children to the farm just to avoid immunization which lead to his children been cripple for life. The children are living here in Bunza, and are living example, just like the saying: Seeing is believing*." – Imam, Bunza

"*The importance of these vaccinations is many; the most vital of all is that it reduces diseases in children. It is hard before you will see a mother not allowing a child to be vaccinated. People know the importance of these vaccines because their children are not falling ill like before. Almost 9% out of 10% people know the importance of vaccination; people come out in large numbers for vaccination*." –Imam Raha

"*It is very important such that our children hardly fall sick. I advise you continue with immunization else our children will fall sick again. Acceptance was an issue when immunization was first introduced but now everyone in the community has understood its benefits*". Sarki Bunza

Table 24: Perception about vaccination among baseline respondents

Categories	**Number (n=669)**	**Percentage (%)**
Thinks child is at risk of VPDs		
Strongly disagree	14	2.1
Disagree	40	5.9
Neither agree nor disagree	103	15.4
Agree	341	50.9
Strongly agree	171	25.6
Thinks vaccination will prevent consequences of VPDs		
Strongly disagree	15	2.2
Disagree	31	4.6
Neither agree nor disagree	104	15.5
Agree	364	54.4
Strongly agree	155	23.2
Thinks vaccination is beneficial to child's health		
Strongly disagree	13	1.9
Disagree	20	2.9
Neither agree nor disagree	98	14.6
Agree	357	53.4
Strongly agree	181	27.1
Thinks vaccines are safe for the child		
Strongly disagree	11	1.6
Disagree	40	5.9
Neither agree nor disagree	103	15.4
Agree	344	51.4
Strongly agree	171	25.6
Believe VPDs will lead to:		

Sickness	67	10
Disability	282	42.1
Death	320	47.8

Table 25: Perception about vaccination among end line respondents

Categories	Number (n=153)	Percentage (%)
Thinks child is at risk of VPDs		
Strongly disagree	2	1.3
Disagree	0	0
Neither agree nor disagree	2	1.3
Agree	118	77.1
Strongly agree	31	20.3
Thinks vaccination will prevent consequences of VPDs		
Strongly disagree	0	0
Disagree	0	0
Neither agree nor disagree	1	0.7
Agree	122	79.7
Strongly agree	30	19.6
Thinks vaccination is beneficial to child's health		
Strongly disagree	0	0
Disagree	0	0
Neither agree nor disagree	1	0.7
Agree	122	79.7
Strongly agree	30	19.6
Thinks vaccines are safe for the child		
Strongly disagree	0	0
Disagree	0	0
Neither agree nor disagree	2	1.3
Agree	122	79.7
Strongly agree	29	18.9
Believe VPDs will lead to:		
Sickness	70	45.8
Disability	44	27.8
Death	39	25.5

7.2.2.2 Norms around immunization

We found that community leaders (Imams and Sarki's) played a key role in shaping vaccination norms in the community. All community members, HWs, program managers and policy makers described community leaders as an important influence on parents/caregivers vaccination decisions. In fact, besides HWs and TBAs, community leaders are the most trusted and respected with information relating to vaccination. Throughout the study period, there was a strong support and reception towards vaccination from community leaders. From mobilizing community members to educate and sensitize them about the importance of immunization and use of VIR band to using

their respective town announcers to spread information on when vaccination sessions will be held, and sanctioning households who do not comply for vaccination.

> "*The village heads use to gather us and tell us about the importance of vaccination. If it is not the village head that tells people about vaccination, some will not take their children for vaccination*."– Younger women

> "*What the Imams do to support immunization, just as we mentioned at first is through gathering in the mosque. So, the imam informs the village head about vaccination. Since the village head and the imam are in support, then the people will definitely accept it*." – WDC members

> "*The head of community often sends people to announce around, educating us the more on immunization and it's important to our children. They mobilize town announces to share information regarding immunization and when immunization will take place at the heath facility*." –Parent of under one child, Bunza

> "*Anytime we notice low turn-out we inform the village head, he urges his people to try and come out for the vaccination. The village head is well informed of immunization program as we do have meetings with him to tell him more about the importance of the VIR band. They've also seen the importance of the band and could attest to the fact that the number of children who were fully and completely vaccinated was very low but with the introduction of the VIR band the figure has increased. It is currently becoming a competition*." - Health worker, PHC Maidahini

> "*Leaders of this local government had explained and taught us and we later teach other members of our community. We told them we have seen the effect of this diseases on our children, but now they have started coming to help us. We thank God and we have seen the positive outcome of the vaccines. Our community members trust us, since they know we are not going to cheat them and I have a lot of followers in this community*." – Imam, Maidahini

> "*We had a meeting at Magaji's house with some Immunizers, said at times you may find out that seven to ten houses refuse to be immunized, she asked us how to tackle this kind of problem? So I said why not find out whether they are Government employee and punished them through deducting their salary or withhold till the cooperate with the immunization. There is also a time when someone refuse to bring out his children, I have to go there myself and make sure all the children were vaccinated after that I turn to him and said go give alms*." – Imam, Bunza

However, a subset of parents who know the benefits of vaccination made their decision independent of their community leaders. Some participants described disease outbreaks as triggering discussions about vaccination in the community.

> "*What makes people discuss immunization is when there is an outbreak like diarrhea, vomiting, meningitis, measles in the community. Then people will start talking about*

vaccination and say that there is difference between those that are immunized and those that are not." – WDC members

"*They discuss. when a child is sick, it brings about discussion. They discuss that the child was not vaccinated that is why he is sick. This discussion reminds parents to vaccinate their children*." – Sarki, Bunza

Cultural practices such as Kulle (a cultural practice where a married woman is always indoors and not allowed to go out without an escort) or Arba'in (a cultural practice where a woman who put to birth does not go out for 40-days) commonly observed among mothers reportedly does not prevent them from vaccinating their children. Mothers usually vaccinate their children after the naming ceremony (8 days after delivery) or let the TBA, relative or older sibling take the child to the health facility for vaccination.

Among our respondents, community leaders proved to be a strong and lasting influence on social norms surrounding vaccination, while TBAs contributed to the success of routine immunization uptake in the community, especially for the new moms.

7.2.2.3 Immunization practice among respondents

Possession of child health card differed among the two study samples, 99% at end line and 16% at baseline. While the reason for not having a child health card among the only end line respondent was because it was torn/destroyed, baseline respondents mostly cited they have never gone to the hospital with their children 397(70%). Based on card verification or recall, proportion of vaccine initiation (BCG vaccination) within two weeks of birth, were 38% at baseline and 56% at end line. Whereas proportion of vaccine utilization (Penta 3 vaccination) by 18 weeks was 9% at end line (see table 26 and 27).

Table 26: Immunization practice among mothers at baseline

Categories	**Number (n=669)**	**Percentage (%)**
Possession of child health card		
Yes	105	15.7
No	564	84.3
Reasons for no child health card	**(n=564)**	
I have never gone to the hospital with my child	397	70.4
There was no card when I went	13	2.3
I couldn't pay for the card	5	0.9
My child has not received vaccination except polio	134	23.8
It was torn/destroyed/misplaced	-	-
Others (specify)	15	2.7
BCG vaccination		
Number of children that received BCG within 2 weeks	28	4.2
Total number of children that received BCG	74	11.1
Proportion of children that received BCG at 0 to 2 weeks		**37.8**
Penta 3 vaccination		
Number of children that received Penta 3 by 18 weeks	13	1.9

Total number of children that received Penta 3	50	7.5
Proportion of children that received Penta 3 by 18 weeks		**26**

Table 27: Immunization practice among end line respondents

Categories	**Number (n=153)**	**Percentage (%)**
Possession of child health card		
Yes	152	99.3
No	1	0.7
Reasons for no child health card	**(n=1)**	
I have never gone to the hospital with my child	-	-
There was no card when I went	-	-
I couldn't pay for the card	-	-
My child has not received vaccination except polio	-	-
It was torn/destroyed/misplaced	1	100
Others (specify)	-	-
BCG vaccination among the study parents*		
Number of children that received BCG within 2 weeks	503	
Total number of children that received BCG	874	
Proportion of children that received BCG at 0 to 2 weeks		**57.5**
Penta 3 vaccination among the study parents		
Number of children that received Penta 3 by 18 weeks	14*	
Total number of children that received Penta 3	155*	
Proportion of children that received Penta 3 by 18 weeks	**9%**	

*VIR band study summary enrollment complied
**VIR band study register

Reasons for non- and under-vaccination were grouped into three categories: ***Complacency*** (exists where perceived risks of vaccine-preventable diseases are low and vaccination is not deemed a necessary preventive action); ***Convenience*** (measured by the extent to which physical availability, affordability and willingness-to-pay for, geographical accessibility, ability to understand (language and health literacy) and appeal of immunization services affects uptake); and ***Confidence*** (defined as trust in 1) the effectiveness and safety of vaccines; 2) the system that delivers them, including the reliability and competence of the health services and health professionals and 3) the motivations of the policy-makers who decide on the needed vaccines). In the two study samples, complacency reasons were the most cited for non and under vaccination (see Table 28 and 29). Most baseline respondents, 69% cited complacency reasons for no BCG vaccination, and 57%, 76% and 86% cited complacency reasons for delay in penta 1, penta 2 and penta 3 vaccinations, respectively at end line. While "I don't think it was needed" was the most cited complacency reason at baseline; "I did not remember" was most cited among end line respondents. The VIR band intervention may have contributed to the change of perception at baseline that vaccination was not needed, but study participants (end line respondents) still forget to vaccinate despite available reminder.

Table 28: Reasons for not vaccinating with BCG among baseline respondents

Categories	Number (n=592)	Percentage (%)
Complacency reasons: 69% (409/592)		
I don't think it was needed	182	27.2
I don't know about childhood vaccination	81	12.1
I don't want to vaccinate them	26	3.9
I don't know where to vaccinate them	27	4.0
I do not know when to vaccinate them	58	8.7
I did not remember	16	2.4
I do not believe in vaccinations	18	2.7
My child/children does or do not need vaccines for diseases that are not common anymore	1	0.1
Confidence reason: 15.9% (94/592)		
I use traditional medicines/herbs	71	10.6
I do not think vaccines are effective	7	1.0
Someone told me their child had a bad reaction	3	0.4
There was no vaccine at the HF	13	1.9
Convenience reasons: 11.8% (70/592)		
I didn't go because I didn't think they had vaccine	1	0.1
The HF was not open when I had the time to go	4	0.6
The HF is too far	39	5.8
I don't have the means to get to the vaccination center	5	0.7
My child was sick	2	0.3
I was too busy	3	0.4
My husband refused	12	1.8
Could not leave the house (arba'in or kulle), work or farm	4	0.6
Other: 3.2%(19/592)		
Other: Specify	19	2.8

Table 29: Reasons for delay in receipt of penta 1, 2 and 3 vaccinations among end line respondents

Categories	Penta 1 vaccination (n=49)	Percentage (%)	Penta 2 vaccination (n=55)	Percentage (%)	Penta 3 vaccination (n=84)	Percentage (%)
Complacency reasons:						
I don't know about childhood vaccination	1	2.0	1	1.8	1	1.2
I did not remember	27	55.1	41	74.5	72	85.7
Confidence reasons:						
I am concerned about the side effects of vaccines					1	1.2
Someone told me their child had a bad reaction	2	4.1				
There was no vaccine at the HF	1	2.0	3	5.5	2	2.4
Convenience reasons:						
I didn't go because I didn't think the health facility was working	1	2.0				
I didn't go because I heard the band was not available	1	2.0	1	1.8	1	1.2
The HF was not open when I had the time to go	1	2.0	1	1.8	1	1.2
Vaccination wastes a lot of time	1	2.0				
Vaccination is not affordable					2	2.4
My child was sick	5	10.2	6	10.9	1	1.2
I was too busy	5	10.2	2	3.6	3	3.6

Could not leave the house (arba'in or kulle, work or farm)	3	6.1				
Others						
Others	1	2.0				

Although the perception of most community members on benefits of vaccination improved as a result of sensitization on the importance of timely and complete vaccination, and use of VIR band, there are still pockets of low uptake among some people. There was a general consensus that some people do not vaccinate their children on time and completely mainly due to ignorance on the benefit of vaccination and husband's disapproval. For others it is simply due to mothers forgetting and unavailability of incentives.

> ***"Respondent 1:*** *Some parents just will not take their children. It has become a habit for them because they don't know the value of immunization.* ***Respondent 2****: Some mothers will start and then their husbands will complain about the children rise in body temperature and they will stop taking the children for the vaccination*. ***Respondent 3****: Some mothers use to forget*"- Younger women

> "*This should be classified as lack of knowing how important the vaccine is to child health. Some after all the explanation and emphasis on this vaccine, they still took it for granted*." – Imam Maidahini

> "*Most people don't understand the benefits of vaccination... If they understand the benefits of vaccination, without the band, they will still bring their children. The biggest problem is that this community is rural, if a man doesn't understand the benefit of the vaccination, the woman will not be permitted to take the child for vaccination*." – Matseri PHC Raha

> "***Respondent 1:*** *Some will complain they will not bring their children because they do not get gift like net. Or some will say since they gave gifts yesterday, why did they not give me today that I allowed you to take my child?* ***Respondent 2:*** *But some will complain that after giving their children vaccine for the first, second, or third time, that they did not give them gift. Especially if they see others who got net or children bed sheet as gift, they will be complaining that they did not give them anything*." - TBAs

While there was better understanding of vaccination adverse events and how to manage them, community members still complained about pain after penta vaccination and it preventing some parents from returning for subsequent vaccination. This was strongly affirmed by all health workers.

> "***Respondent 1:*** *The vaccination causes body hotness in children; some husbands don't want vaccination for their children.* ***Respondent 2:*** *There is one of the vaccine that causes body pain which makes the child cry. That discourages mothers from going back for the next dose, though has been understood that it is normal*." – Younger women

"*We don't know really about the vaccines before, but now we know how important it is especially when polio and injections are given to the children. This injection is very strong once given to a child, the child will be crying for the whole day. That's the only challenge and it stops mothers from taking their children to the clinic. Later on, doctors said the child should be given few drops of paracetamol after the injection. Therefore, we have countered this problem. But if you have any advice or new idea about this problem you can tell me*." – Imam, Maidahini

"*No, there is no sign of rejection. People are now civilized about vaccination and they accepted it fully. You know there was a time they injected a child and his temperature went high, his mother was worried about his condition, she was advised to give him paracetamol and the temperature drops immediately. The only problem with the vaccination is the rise in temperature which can easily go down when taken paracetamol*". - Sarki, Maidahini

"*Some of them after receiving PENTA 1, which of course you know it's painful as a result they don't bring back the children. Also the fever makes the children cry so much and there is also swelling of the injection site. Some might even receive up to PENTA 2, after which they won't come back for the third shot*." – Health worker, Garadi Dispensary

"*Yes, mostly because of the pain the children get when PENTA is administered. We have currently devised a plan to get them to come for complete immunization so we could say the child is fully immunized. We promise to give out mosquito nets whenever they complete the three times immunization visits, so most of them never stop until they get their mosquito nets. Some might even come days earlier before their return date and we have to send them back informing that it's not yet time. The net we give out encourages and it has truly helped in preventing dropouts and delays in bringing the babies for vaccination*." Health worker, PHC Maidahini

When asked what will motivate mothers/caregivers to take their children for vaccination, all respondents recommended providing incentives (e.g. mosquito nets or paracetamol) and continuous awareness on the benefits of vaccination using the community leaders.

We also found that distance was not a barrier in accessing immunization services in the community. Location of HFs did not change during the study period. Most respondents, 78% lived less than 5km from the nearest HF in the community, and 43% and 41% usually get there via motorcycle and walking, respectively (See Table 30). Also, the average distance to the nearest HF that offers RI in the community is 15.5minutes; and majority, 86% said it was <29minutes away from their homes.

Table 30: Access to vaccination among baseline respondents

Categories	**Baseline**	
Distance to the nearest HF (km)	**Number (n=669)**	**Percentage (%)**
<5km	521	77.9
5-10km	135	20.2
>10km	13	1.9

Travel means to the nearest HF		
Walk	274	40.9
Bicycle	9	1.3
Motorcycle	286	42.8
Car	30	4.5
Other	70	10.5
Distance to the nearest HF (minutes)		
<29	577	86.2
30-59	70	10.5
>60	22	3.3

Though access to vaccination centers was not a problem, one HF Balu dispensary in Bunza Ward was not functional throughout the study duration. Only four sessions were held which may explain the low enrollment in that HF. Thus, were excluded in the analysis. The BCG stock out during the study duration may have affected enrolment of 72 eligible children on the VIR band study (See *Online Appendix G*). All health facilities conducted fewer outreach sessions than planned and none received funding for outreach sessions. This was attributed to poor logistics support at the HF level.

Below are findings from monthly monitoring of the availability of immunization services along these key areas:

1. **Vaccine supply chain and management**:
   i. An average vaccine stock out of 46% was reported across the five study HFs over a period of 5 months.
   ii. Stock out ranges from 30% in Garadi dispensary to 60% in MCH Bunza.
   iii. BCG had the highest stock out rate at 71% across all the study HFs.
   iv. Highest BCG stock out was recorded in August 2017.
   v. Health facilities receive vaccines via the PULL method (i.e. a mechanism where health workers have to collect vaccines from the LGA storage facility/cold store).
   vi. No stock out of AD syringes and safety boxes were reported.

2. **Planned immunization sessions**
   i. Among the 196 outreach sessions planned across the six study HFs, more than half 114(58%) were conducted, while 82(42%) was not held.
   ii. Only Matseri Dispensary conducted less fixed sessions than planned.

3. **Cold chain performance**
   i. None of the health facilities assessed have a functional refrigerator. While 3 HFs (Bunza MCH, Garadi Dispensary and Raha Matseri PHC) have refrigerators, they were not functional; and 2 HFs (Maidahini PHC and Matseri Dispensary) have no refrigerators.

The logistics surrounding the execution of RI activities for example, collection of vaccines from the cold store since there are no functional cold chain equipment and conducting outreach sessions are dependent on funds. The inability to fund the logistics activities associated with immunization results in unavailability of services to end users, which in turn leads to poor RI performance.

> "*Now, for the fixed sessions, there's no difficulty for anybody, nobody has any reason whatsoever to say that he won't conduct the sessions as it is conducted at the health facility, provided the vaccines are available. But for the outreach, that's where we're facing lots of problems because the routine immunization as we have now, the outreach is not supported at any level, neither the state nor the LGA, they're on their own*." – Policy maker, state level

All the end line respondents, 100% intend to take their children to the HF for subsequent vaccination (see Table 31 and 32). This is not surprising as these respondents acknowledge the benefit of vaccination and had vaccinated their children with penta 3 vaccination. In the study samples, we found that mothers allowed their relatives, older sibling and/or TBAs take the child to the health facility for vaccination in a situation where they could not go.

> "*In situations when the mother cannot take the child, the TBAs will take them. They use to go around the community when a woman had giving birth, they take the baby for vaccination and sometimes their elder ones with the TBAs will take the child*." – Imam, Raha

Table 31: Intention to vaccinate among baseline respondents

Category	Number (n=669)	Percentage (%)
Will visit HF for vaccination		
Yes	542	81.0
No	127	18.9

Table 32: Intention to vaccinate among end line respondents

Category	Number (n=153)	Percentage (%)
Will visit HF for vaccination		
Yes	153	100
No	0	0

8.0 Implications of formative study findings

8.1 Implications for the intervention

Our study findings revealed the importance of engaging and leveraging on existing community structures (community leaders and TBAs) to promote acceptability of any health intervention- immunization and VIR band. The strong support from community leaders, the TBAs and the health workers who were involved in sensitizing and educating community

members on the importance of VIR band and vaccination increased acceptability of the intervention.

Although knowledge about vaccination and intention to vaccinate was relatively high and there were no stated socio-cultural impediments to vaccine uptake, motivation among parents/caregivers to vaccinate was low despite available health services and external reminders (TBAs and town announcers). While the cue to action, VIR band was generally accepted in the community and may have motivated parents/caregivers to vaccinate their children during the intervention period, the sustainability of this motivation is not granted in the absence of the band or any other incentive. There may be a need for more personalized reminders and follow-up or non-financial incentives to encourage uptake and help overcome vaccination complacency. This should be combined with continuous sensitization on the benefits of immunization using existing trusted community structures, especially community leaders and TBAs to address knowledge gaps and encourage uptake.

In addition, while the concept of utilizing VIR bands as a reminder for vaccination is sound, the real world application of these bands may not be as efficient as necessary. The high band malfunction rate was a constant source of concern as the bands could have been damaged while being activated by health workers, or during daily handling of the child (both of which would lead to malfunction). Also, the delay in manufacturing the bands may suggest a difficult manufacturing process.

Lastly, the use of data clerks was crucial to getting good quality data during the study. However, the data clerks had to be trained repeatedly by other members of the study team. It may be useful to have less demanding but equally effective methods of training for data clerks in the future.

Thus, the following recommendations are suggested for future intervention:

1. Continue sensitization of community members on benefits of vaccination using community leaders.
2. Continue engaging community leaders to promote and encourage the men (grandfathers, husbands, fathers, brothers) to permit and support their wives to vaccinate their children.
3. Involve husbands, fathers, and male groups in community-based interventions to ensure active participation and approval for health interventions.
4. Continue engaging TBAs to increase knowledge and awareness about benefits of immunization among mothers through the introduction of community-based education initiatives e.g. home visits, compound meetings etc.
5. Continue using existing community reminder structures (town announcers) to remind mothers of immunization sessions in the community, and ensure adequate follow-up at community level.
6. Support community leaders to continue mandating vaccination/sanctions for non-vaccination.
7. Factor-in local activities and seasons e.g. farming seasons when planning community sensitization activities to promote participation.

8. Future cue to actions (e.g. VIR band) should to designed to fit country setting and cultural context. For instance:
   i. Accommodate other vaccination schedule e.g. measles and yellow fever administered at 9months.
   ii. Suit country-specific locales e.g. preferred place to wear (wrist) and colour of the ink.
9. Ensure availability of cue to actions at study sites.

8.1 Implications for further research

The VIR band was generally acceptable at all levels especially among the health providers and community members. Health workers in our study health facilities were able to efficiently distribute and activate the VIR band as well as incorporate it as part of the RI service rendered. While this finding is encouraging, we need to conduct a larger randomized control study to assess the effectiveness and impact of the band in increasing immunization uptake and coverage. We found that VIR band was perceived as an incentive that motivated immunization uptake. Likewise, we need to assess its role as an incentive in improving immunization uptake, timeliness and completion in this study setting. In addition, there is the need to investigate gaps between intention and action to vaccinate to enable better design and evaluation of demand interventions. To this effect, the following evaluation intervention is proposed: “The effectiveness of using Vaccine Indicator and Reminder Band to improve timeliness and completeness of childhood immunizations in Northern Nigeria: A Randomized Control Trial”

Evaluation objective: To assess the effectiveness of VIR band in improving immunization timeliness, completion and coverage.

Primary outcome of interest:

1. Increased proportion of timeliness and age-appropriate rate of routine vaccination among children 0-11 months of age.
2. Increased proportion of fully vaccinated- proportion of children aged 12 to 23 months who received all recommended RI vaccines (BCG, Polio3, Penta3, and Measles).

9.0 Major challenges and lessons learnt

Our study recorded a couple of challenges and lessons learnt that have been categorised by activities, and they include:

Study design (Baseline survey)

Among the mothers surveyed, information on child’s immunization status was based on recall or child immunization card. Given that child immunization card retention and documentation was poor at baseline, it is likely that recall bias and social desirability bias might have occurred. Though we inquired about the recommended sites, routes of administration and known time periods vaccine was received, it is not clear if this is the right criteria for accepting immunization of a particular antigen received; thus the need to improve home-based records for proper documentation of antigen received.

The first baseline household survey conducted in July 2016 had issues with inaccurate dates of birth for children surveyed. Most parents could not recall their children's date of birth and this was important to effectively calculate the vaccination timeliness of children in our study wards. Also, since one year had already elapsed (due to manufacturer's delay in band production) before the implementation of intervention activities, there was a need to conduct another survey to capture any change in immunization practice before implementation. The latter survey conducted in July 2017 was more robust (had a larger sample size) and only mothers with children under the age of one (0-11 months) in the community were surveyed as against pregnant and lactating mothers in the former survey.

This provided the team an opportunity to conduct another household survey to accurately estimate and obtain child's date of birth. Based on guidelines developed by the Food and Agriculture Organization of the United Nations for estimating the age of children under five years old, we developed a local event calendar for age estimation for children under-one. Dates for local events specific to each ward were obtained by interviewing LGA personnel, community leaders and religious leaders from each ward. The information was then collated and entered into the local events calendar. Mothers were asked child's date of birth in reference to events in the local calendar developed.

Trainings

Having state representation during the advocacy and training workshops signalled support of the state for the project. A single day was insufficient to train health workers on the importance of timely and complete immunization, the overview of the VIR band study and the use and activation of the VIR band thus, the training was extended to two days. In addition, on-the-job training and mentoring for data clerks was important to ensure accurate data collection. In future, supportive supervision at the health facilities provides another opportunity to improve the capacity of these data clerks.

Community sensitization activities

These activities were successful in obtaining buy-in and support for the VIR band project in the community. Kebbi state has a strong traditional leaders' system thus, gaining the support of community leaders contributed in increasing acceptance of the bands among community members. However, local activities and seasons e.g. farming seasons should be considered when planning community sensitization activities to promote participation.

TBAs referral system

- The use of TBAs as referees to ensure children were brought to the health facilities on time for their vaccinations was successful. A key strength of this process was that village heads from our study settlements nominated the TBAs and were tasked to refer mothers from their settlements. This created a sense of trust in the project because mothers were already familiar with these TBAs and were not afraid that the bands would be harmful to their children.

- While there were no cases of rejection of the VIR bands, there were cases of rejection of immunization in Raha and Maidahini. In cases where TBAs encountered resistance to vaccinations in the communities, the village heads were informed and would accompany the TBAs and study staff to the household to sensitize the parents on the importance of timely and complete vaccinations. All such cases were resolved and the parents took their children to the health facility for vaccination.

- TBAs met with their supervisors in each of the study wards monthly, this process was important to address any challenges they may have encountered during their work and to get feedback on what mothers in communities thought about the VIR bands. The TBA supervisors were a crucial part of the TBA referral system as they ensured our study TBAs adhered to the project protocol and carried out their duties effectively and efficiently.

- The inability of the TBAs to fill out the referral forms properly or at all due to illiteracy was identified. This sometimes made it difficult to specify which mother-infant pairs were referred by a specific TBA. TBAs were told to get assistance from their supervisors or community members where possible.

Enrolment and follow up

- Recruiting data clerks was largely successful although they had to be trained monthly to ensure data were accurately entered. Particularly problematic was the aspect of entering the data electronically, as the data clerks while technologically capable were not comfortable with the use of google sheets to enter data. Thus, the core study team had to conduct weekly data checks to ensure the accuracy of data entered throughout the study period.

- Another challenge encountered during enrolment was the delay in arrival of bands. Only 70 bands could be shipped once a month due to Pakistian and Nigerian custom regulations on objects containing liquids. This caused the health facilities to have stock-outs of bands monthly, which led to the study team having to extend enrolment period by one-month to ensure the number of children enrolled would make for a statistically relevant analysis. In the future, we suggest that the best course for delivery of bands in the country would be to obtain custom clearance for shipping products containing liquids in bulk, and start shipping the bands months before they are required for the study. In this way, the team will ensure an adequate number of bands are in stock within the country.

- There was BCG stock-outs in all the study health facilities, especially in August 2017. Thus, children were enrolled at first vaccine administration i.e. oral polio vaccine (OPV0) and Hepatitis B vaccine. Balu dispensary did not follow their official RI schedule for fixed and outreach sessions. This may have affected the study by reducing the number of children to be enrolled at that HF during the allotted time. There was no concrete reason for the cancellation of RI sessions by the health facilities in

question. The state and LGA leadership was informed about these lapses in the scheduled sessions.

- Health workers at the six health facilities were engaged in the activity of Polio immunization in October 2017. This schedule fell on week days and caused cancellation of RI sessions in all the study health facilities resulting in a number of eligible children excluded from the study in that month. In addition, the one-month national Joint Health Sector Unions strike affected availability of immunization services and caused the extension of exit interviews by 3 weeks.

VIR band malfunction

The high malfunction rate of VIR bands was a recurring concern during the study. The inks failure to reach the marked points at the designated times or sometimes at all may have caused a delay in vaccinating enrolled children. Possible reasons for malfunction include:

- Manufacturing defects
- Incomplete activation/damage during activation: While the process of activating the bands was easily understood by health workers, the actual activation of the bands was often difficult. The changes in protocol for activating the bands (e.g. pressing till one hears a “pop” sound) may have caused health workers to apply an excessive amount of pressure while pressing the ink sac, which may have damaged the bands.
- Misuse: The bands were designed to stay against the infant’s skin to ensure the steady flow of the ink based on the child’s body temperature. However, this meant that if the parent took the band off their child at any point, the accuracy of ink progression would become questionable.

Finally, the collective suggestion by all stakeholders that the ink’s color be changed is worrisome as the color change may not be possible due to copyright laws. However, as noted above, this misconception was dispelled by consistent messaging and education by TBAs and health workers.

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Appendixes

Appendix A: Roles and responsibilities of personnel involved in the intervention

Acronym	Full description	Employer	Position created by intervention	Specific additional task in intervention	Part time / Full Time	Remuneration
HW (OIC)	Health Worker (Officer In Charge)	Government	No	• Organize and oversee RI sessions • Participate in WDC meetings to get feedback from the community • Lead in the implementation of the overall study at the health facility. • Ensure both the RI provider and the TBA adhere to the study protocol. • Lead all mobilization and sensitization activities in the health facility (such as health talks) and the communities.	Full time	Government paid remuneration and stipend from study
HW (RI provider)	Health Worker (Routine Immunization Provider)	Government	No	• Administer vaccines to children • Educate caregivers of importance of timely and complete vaccination and the benefits of VIR band • Obtain consent for participation in the study from mother/caregiver. • Enrol eligible babies born at the health facility or community in the study. • Fill out study register during fixed and outreach sessions in the absence of study data clerk. • Administer VIR band to children as stated by study protocol • Activate the VIR band after each vaccine administration.	Full time	Government paid remuneration and stipend from study

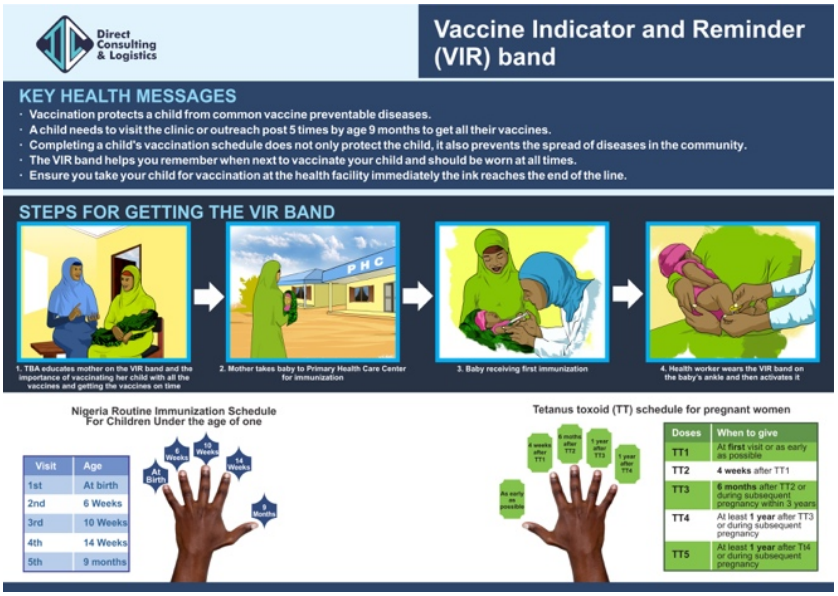
				• Liaise with TBAs and TBA supervisors to obtain information on new-borns in the community.		

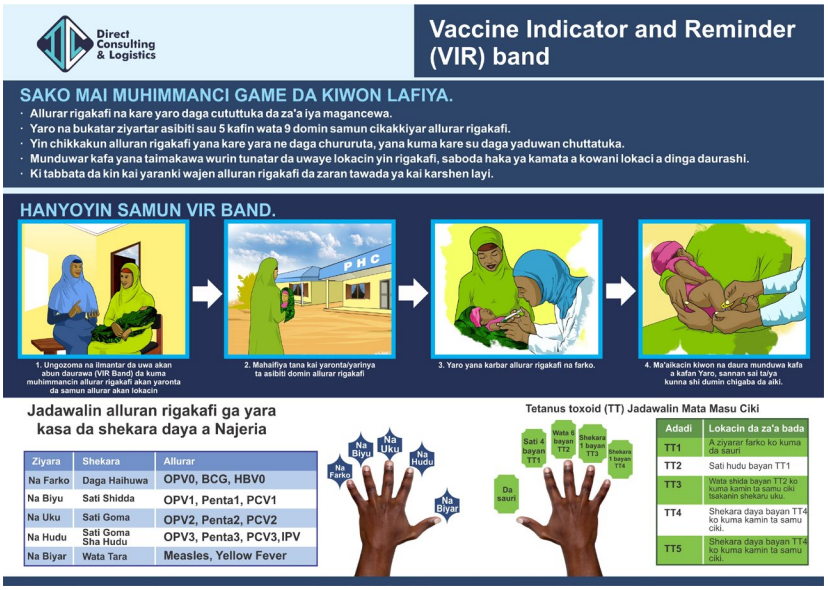
TBA	Traditional Birth Attendants	Community	No	• Map all households in the settlement/community for lactating mothers and pregnant women (conducted once at the beginning of implementation).
				• Conduct routine visits to houses where a child is about to be born or is born and;
				  ○ Encourage mothers to take their children to vaccination center soon after birth or within the first week of life, and refer mothers with children to the health facility for vaccination
				  ○ Explain to parents/caregivers that all vaccines are free and available at the nearest PHC
				• Show VIR band sample (in picture) to the parents/caregivers and educate parents/caregivers on the importance of VIR band for mother and child including purpose and use
				• Refer mothers to the health facilities for enrolment into the VIR band study and immunization.
				• Fill one section of the referral card and give to the mother to present at the health facility and present the second section of the referral card to their supervisor for documentation and enumeration purposes.
				• Inform health workers and supervisors about each new birth in their communities
				• Follow up on parent/caregiver who did not visit the health facility after the counselling session and previous immunization sessions.
				• Attend monthly meetings with supervisors.
					Part-time	Volunteer and transportation stipend from study

				• Know the immunization schedule of the health facility closest to their settlement in order to inform caregivers when to take their children for vaccination during fixed or outreach sessions.		
TBA Sup	TBA Supervisor	Community	Yes	• Supervise and assist TBAs in carrying out all their assigned duties as regards the VIR band study. • Follow-up TBAs assigned to them to obtain records of mothers with eligible children referred to the nearest health facility in the settlement for child's immunization. • Keep a record of all information obtained from study TBAs including; number of children referred by each TBA and any challenges or issues TBAs may have encountered in the communities. • Hold cluster meetings with TBAs on a weekly and monthly basis. • Should ensure that WDC discussions relating to TBAs activities (as it relates to the study) during the ward meetings are focused-on and guided to deal with sensitizing mothers on the importance of immunization timeliness and completeness, and use of VIR band; and referring mothers to the health facility for child's immunization and VIR band uptake.	Part-time	Study paid remuneration

DC	Data Clerks	Community	Yes	• Attend every RI session (fixed and outreach) conducted in their assigned health facilities. • After obtaining consent from the parent/caregiver to participant in the study, record child's information on the study register. • Fill out study register during fixed and outreach sessions and upload all data on the study registers to the online study registers on a weekly basis. • Liaise with TBA supervisors to obtain information on new-borns in the community on a weekly basis. • Cross-check to ensure harmonization of referral information in TBA supervisor registers with that of the study register at the health facility on a weekly basis. • Enter data from TBA supervisor register electronically (Google sheet) on a weekly basis. • Identify defaulters and inform HF Officer-in-charge and TBA supervisors.	Part-time (24 hours a week)	Study paid remuneration

Appendix B: Community sensitization posters





Appendix C: Qualitative interview respondent list (Baseline)

Level	Category of respondents	Designation of participants	Type of interview	Number of respondents
State	Policy makers	Permanent Secretary, Executive Secretary KSPHCDA State Director Primary Healthcare (DPHC)	IDIs	3
	Program managers	State immunization Officer, State Cold Chair Officer, State Monitoring and Evaluation Officer, Social Mobilization Officer, State Disease and Surveillance Notification Officer, State Health Educator, State Maternal and Child Health Officer, Zonal Technical Officer	FGD	8
	Partners	State Leads WHO, Unicef and CDC N-STOP	IDIs	3
LGA	Program managers	PHC Coordinator/ Head of Department of Health, Local immunization Officer, Local Cold Chair Officer, Local Monitoring and Evaluation Officer, Local Disease and Surveillance Notification Officer, Local Health Educator	FGD	6
Health facility	Health workers at PHC facility	Officer in charge/Ward focal person, RI In-charge in all 3 wards	IDI	4
Community	Parents/caregivers	Group of older mothers Group of younger mothers Parents in all study wards Group of men in all study wards	FGD FGD IDIs FGD	12 12 6 12
	TBAs	TBAs in all study wards TBAs in all study ward (2 each)	FGD IDIs	12 6
	WDC	WDC leaders and members in all study wards	FGD	8
	Community/ traditional leaders	Religious leaders in study wards Traditional leaders in study wards	IDIs IDIs	3 3
Total IDIs			28	**28**
Total FGDs			7	**70**

Appendix D: Qualitative interview respondent list (End line)

Level	Category of respondents	Designation of participants	Type of interview	Number of respondents
State	Policy makers	Director of Immunization	IDI	1
	Program managers	State immunization Officer, State Cold Chair Officer, State Monitoring and Evaluation Officer, Social Mobilization Officer, State Disease and Surveillance Notification Officer, State Health Educator, State Maternal and Child Health Officer, Zonal Technical Officer	FGD	8
LGA	Program managers	PHC Coordinator/ Head of Department of Health, Local immunization Officer, Local Cold Chair Officer, Local Monitoring and Evaluation Officer, Local Disease and Surveillance Notification Officer, Local Health Educator	FGD	8
Health facility	Health workers at PHC facility	Officer in charge/Ward focal person, RI In-charge in all 3 wards	IDI	5
Community	Parents/caregivers	Group of older mothers Group of younger mothers Parents in all study wards (2 per ward) Group of men in all study wards	FGD FGD IDIs FGD	9 8 6 10
	TBAs	TBAs in all study wards	FGD	9
	WDC	WDC members in all study wards	FGD	8
	Community/ traditional leaders	Religious leaders in study wards Traditional leaders in study wards	IDIs IDIs	3 3
Total IDIs			18	**18**
Total FGDs			7	**60**

Appendix E: Socio-demographic characteristics of respondents

Majority of the respondents were married 649(97%), and most were petty traders 322(48%) or unemployed 246(37%). Typical of the study setting, all respondents are Muslims.

The important determinants of the socioeconomic and health status of household members are the household environment. We found that only 107(16%) have access to an improved source of drinking water, and an overwhelming majority 634(95%) do not treat their drinking water. Two hundred and fifty-nine (39%) of households use improved toilet facilities while four hundred and ten (61%) use non-improved facilities. The most common type of non-improved toilet facility is an open pit latrine or pit latrine without slabs, used by 223(33%) of households.

We also found that 627(94%) households mainly use wood for cooking, 426(64%) have access to electricity, and 386(58%) use cement as their main flooring material. The number of rooms used for sleeping in relation to the number of household members is an indication of the extent of crowding, which in turn increases the risk of contracting communicable diseases. The average number of people living in a household is 6.8 (± 4.9) and ranges from 2 to 50. And 308(46%) of households use one room for sleeping.

On household possessions, most households have an agricultural land 475(71%), farm animals 458(69%), radio 424(63%), mobile phones 419 (63%), and less than half had motorcycle or motor scooter 280(42%).

Characteristics	**Number (n=669)**	**Percentage (%)**	**Number (n=153)**	**Percentage (%)**
	Baseline		**End line**	
Age group in years				
16-25	317	47.4	31	20.3
26-35	284	42.5	104	67.9
36-45	63	9.4	16	10.5
>46	5	0.7	2	1.4
Marital status				
Single	12	1.8	-	-
Married	649	97	-	-
Separated/Divorced	3	0.4	-	-
Widowed	5	0.7	-	-
Attended formal education				
No	573	85.7	152	99
Yes	96	14.3	1	0%
Highest level of formal education completed (n=96)			***(n=1)***	
Primary School	46	47.9	-	-
Junior Secondary School	22	22.9	-	-
Senior Secondary School	26	27.0	1	100
Tertiary Institute	2	2.1	-	-

Occupation				
Unemployed	246	36.8	-	-
Farmer	57	8.5	-	-
Fisherman	1	0.1	-	-
Civil servant/Employed	22	3.3	-	-
Petty Trader	322	48.1	-	-
Business woman/Self Employed	21	3.1	-	-
Source of drinking water				
Improved source of drinking water				
Piped into dwelling	14	2.1	-	-
Piped to yard/plot	23	3.4	-	-
Public tap/standpipe	14	2.1	-	-
Tube well or Borehole	38	5.7	-	-
Protected well	16	2.4	-	-
Bottled water	2	0.3	-	-
Non-improved source of drinking water				
Unprotected well	540	80.7	-	-
Unprotected spring	11	1.6	-	-
Cart with small tank	1	0.1	-	-
Surface water	9	1.35	-	-
Sachet water	1	0.1	-	-
Household Sanitation facilities				
Improved facility				
Flush/pour flush to piped sewer system (Govt built)	2	0.3	-	-
Flush/pour flush to septic tank (Private built)	6	0.9	-	-
Flush/pour flush pit latrine	14	2.1	-	-
Ventilated improved pit (VIP) latrine	2	0.3	-	-
Pit latrine with slab	100	14.9	-	-
Compositing toilet	135	20.2	-	-
Non-improved facility				
Flush/pour flush not to sewer/septic tank/pit latrine	9	1.3	-	-
Pit latrine without slab/open pit	223	33.3	-	-
Bucket	2	0.3	-	-
Hanging toilet/hanging latrine	1	0.1	-	-
No facility/ bush/field	175	26.2	-	-
Household characteristics				
Electricity				
No	243	36.3	-	-
Yes	426	63.7	-	-
Flooring material				
Earth/Sand	297	44.4	-	-

Dung	2	0.3	-	-
Vinyl or asphalt strips	12	1.8	-	-
Ceramic tiles	10	1.5	-	-
Cement	386	57.7	-	-
Carpet/Rug	6	0.9	-	-
Rooms used for sleeping				
0	1	0.1	-	-
1	308	46.0	-	-
2	256	38.3	-	-
>3	104	15.5	-	-
Cooking fuel				
Electricity	11	1.6	-	-
LPG/Cooking gas	1	0.1	-	-
Kerosene	1	0.1	-	-
Coal/Lignite	1	0.1	-	-
Charcoal	12	1.8	-	-
Wood	627	93.7	-	-
Straw/Shrubs/Grass	22	3.3	-	-
Agricultural crop	25	3.7	-	-
No food cooked in household	1	0.1	-	-
Others: Specify	1	0.1	-	-
Household possession				
Means of transportation				
A motorcycle or motor scooter?	280	41.9	-	-
An animal drawn cart?	27	4.0	-	-
A car or truck?	24	3.6	-	-
A boat with a motor?	1	0.1	-	-
A canoe?	10	1.5	-	-
Agricultural land?	475	71.0	-	-
*Farm animals?	458	68.5	-	-
**A bank account?	63	9.4	-	-
None of the above	46	6.9	-	-
Household effects				
A radio?	424	63.4%	-	-
A television?	147	21.9%	-	-
A refrigerator?	61	9.1%	-	-
A cable TV?	14	2.1%	-	-
A generating set?	8	1.2%	-	-
Air conditioner?	10	1.5%	-	-
A computer/laptop?	5	0.7%	-	-
Electric iron?	78	11.7%	-	-
A fan?	214	31.9%	-	-
A mobile phone	419	62.6%	-	-

* Cattle, cows, bulls, horses, donkeys, goat, sheep, chickens

** At least one household member has an account

Appendix F: Implementation pictures

Courtesy visit with District Head Raha

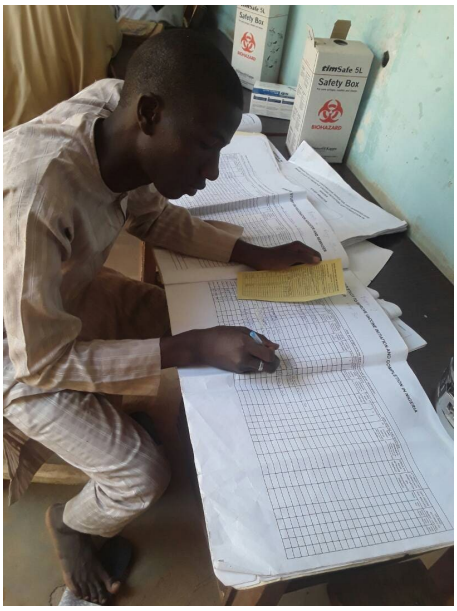
Educating LGA program managers on VIR band

Cross section of WDC members

Sensitization of women, Bunza Marafa

Sensitization at the market square

An enrolled infant in the community and study health facilities



Data clerk at the study HFs

Cross section of mothers waiting to be enrolled

VIR band Nigeria study team with Dr. Noor (VIR band Innovator)

Online Appendixes

Online Appendix A: Ward Characteristics using the ward selection criteria

https://www.3ieimpact.org/sites/default/files/2019-05/tw10.113-vaccination-Nigeria-Online-Appendix-A.pdf

Online Appendix B: Organogram of study staff reporting structure

https://www.3ieimpact.org/sites/default/files/2019-05/tw10.113-vaccination-Nigeria-Online-Appendix-B.pdf

Online Appendix C: Logical framework

https://www.3ieimpact.org/sites/default/files/2019-05/tw10.113-vaccination-Nigeria-Online-Appendix-C.pdf

Online Appendix D: TBA Child Referral booklet

https://www.3ieimpact.org/sites/default/files/2019-05/tw10.113-vaccination-Nigeria-Online-Appendix-D.pdf

Online Appendix E: Baseline Sampling status of Household Survey conducted in Bunza Marafa, Raha and Maidahini, Bunza LGA

https://www.3ieimpact.org/sites/default/files/2019-05/tw10.113-vaccination-Nigeria-Online-Appendix-E.pdf

Online Appendix F: Participant observation from five study health facilities

https://www.3ieimpact.org/sites/default/files/2019-05/tw10.113-vaccination-Nigeria-Online-Appendix-F.pdf

Online Appendix G: Availability of immunisation services

https://www.3ieimpact.org/sites/default/files/2019-05/tw10.113-vaccination-Nigeria-Online-Appendix-G.pdf