



Landscape Analysis of Routine Immunization in Nigeria: Identifying Barriers and Prioritizing Interventions

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This study was made possible by funding from the Bill & Melinda Gates Foundation
The Desk Review was supported by a grant from the GAVI Alliance

EXECUTIVE SUMMARY

Nigeria has the twelfth highest under-five mortality rate in the world, with 143 child deaths per 1,000 live births in 2010. Approximately one in four of those deaths are preventable through routine immunization (RI), but coverage of routine childhood vaccines remains lower than global benchmarks and, in many parts of Nigeria, is among the lowest in the world. Nonetheless, the Nigerian government and her partners have succeeded in achieving major improvements in coverage rates over the past three years. National DPT3 coverage rates have improved steadily, reaching approximately 69% in 2010 according to WHO best estimates. However, this overall progress occurs in the context of significant heterogeneity at the state level and an overall coverage rate below the regional average; the need for improved systems remains apparent.

In order to identify key strengths, weaknesses, opportunities, and threats facing the Nigerian RI system, the International Vaccine Access Center undertook a Landscape Analysis of Routine Immunization (LARI) in Nigeria, with funding from the Bill & Melinda Gates Foundation and the GAVI Alliance. The study was conducted between April and August 2011 in collaboration with the National Primary Health Care Development Agency and Solina Health. This white paper draws on responses from 126 key informant interviews and 11 focus groups in 7 Nigerian states and the Federal Capital Territory (FCT), hereafter referred to as 8 states. The analysis combines information from respondents with survey data and a review of the available literature; the final product is an analysis of supply-side constraints and demand-side determinants of RI coverage in Nigeria, along with an evaluation of potential interventions for the Nigerian context.

Key strengths in the RI system include strong support by high-level policy makers and technocrats at the federal level, specifically from the NPHCDA and the Ministry of Health. Other strengths include a federal budget line for immunizations and a record of success with polio eradication in most states of the federation. The RI program has also demonstrated the ability to disseminate pro-immunization messages and increase demand for vaccines.

Weaknesses in the RI system are both structural and logistical. Recurring themes include a lack of accountability stemming from poor governance, weak monitoring and evaluation systems, and the perception of low political benefit of RI support, especially at the sub-national level. Inadequate cold chain and transportation were mentioned as near-universal barriers; Nigeria's large area presents a logistical difficulty in and of itself. Disbursement of designated funds has also been problematic, and fiscal decentralization has resulted in inconsistent funding levels across states and LGAs.

The external context for RI is generally positive. Although the system is facing potential threats from a shrinking program landscape, an unstable global economy, and the prioritization of polio eradication efforts over routine immunization, there are important opportunities as well. These include strong global support for RI, a favorable political climate in-country, moderate to high vaccine demand, and the potential to piggy-back on polio eradication efforts.

Recommendations to address these barriers relate to the structural as well as logistical. Examples include technical support of newly formed State Primary Health Care Development Agencies, increased provision of cold chain equipment and vehicles, and demand-side interventions where appropriate. All potential interventions are categorized by likely impact and feasibility of implementation, with a suggestion that diversifying intervention investments provides a good balance between definite, but incremental improvements and riskier but potentially high-impact innovations.

1 INTRODUCTION

1.1 BACKGROUND

World Health Organization estimates for the year 2010 rank Nigeria as having the 12th highest under-five mortality rate in the world at 143 deaths per 1000 live births. Every year, more than 800,000 Nigerian children in this age group die. Due to the high under-five mortality rate and a large annual birth cohort of over 6 million children, Nigeria contributes disproportionately to the global burden of under-five deaths.

Vaccine preventable deaths constitute a significant proportion of mortality among children under the age of five years in Nigeria. For example, vaccine preventable diseases such as pertussis, tetanus and measles caused an estimated 42,000 annual deaths in these children in 2009. Recent estimates from the Child Health Epidemiology Reference Group found that pneumonia, diarrhea and meningitis, preventable in part with newer vaccines, led to nearly 300,000 annual child deaths in Nigeria in 2010—approximately a third of the country's under-five mortality.

Although there have been recent improvements in immunization coverage rates, in many parts of Nigeria coverage of routine vaccines remains among the lowest in the world. In 2010, nearly 1.5 million Nigerian children were unvaccinated, the highest number of unvaccinated children in any African country. Given the significant burden of vaccine preventable disease in Nigeria, improving access to and utilization of routine immunization services will contribute to reduced child mortality and accelerated progress towards the MDG 4 target.

1.2 OBJECTIVES

This Landscape Analysis was undertaken with two main objectives: 1) to identify barriers to universal RI coverage, and (2) to determine evidence-based solutions that would address these barriers and improve RI.

2 METHODOLOGY

The project was implemented as a multi-component qualitative assessment that included the following:

1. Facility-based participant observation and exit interviews to determine core issues facing RI utilization, uptake and demand.
2. Facility and community-based focus group discussions with key gatekeepers of vaccine demand. Discussants included representation from female groups such as market women and ANC attendees as well as representation from male groups such as commercial drivers and mechanics.
3. Key informant interviews with opinion leaders at the national, state, Local Government Area (LGA) and community levels.
4. Qualitative analysis to identify perceived barriers and cross-cutting themes.
5. Identification and assessment of potential solutions.

Facility observations were conducted in 14 facilities in 8 states. 11 focus group discussions were conducted in 5 states. 126 key informant interviews were conducted with key informants from 8 states. Responses were collected and analyzed by the LARI team to identify recurring themes by state and at the national levels.

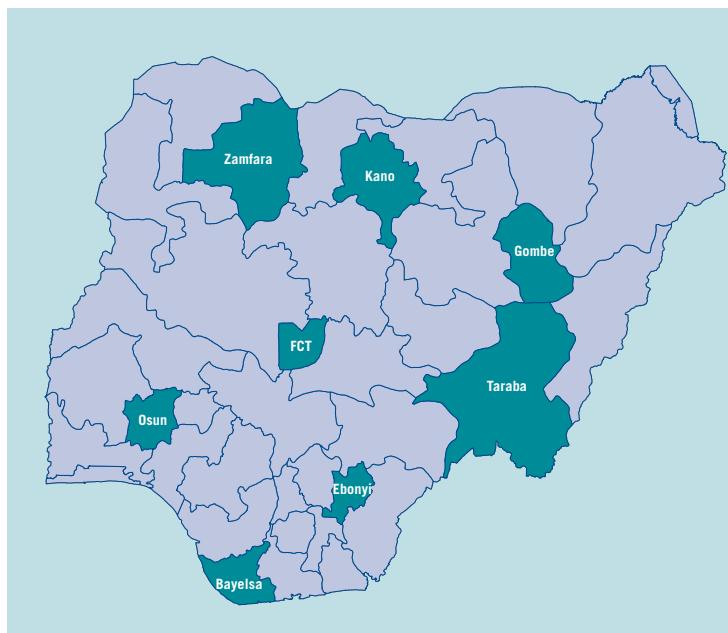
This study can be considered an exploratory analysis of RI gaps at the state level. Given the nature of qualitative research and the variations within a country as large as Nigeria, it would be overreaching to present these results as fully representative of the country. However, the selection of states from all six geopolitical zones and of respondents from all three levels of governments positioned this analysis to elicit a diversity of issues at different levels. The recurrence of key themes across geopolitical zones and governmental levels provides further verification of the relevance and usefulness of this approach.

2.1 FIELD SURVEY

2.1.1 STATE SELECTION

Based on DPT3 coverage rates reported in the 2008 NDHS and the 2010 NICS survey, the team categorized all states in Nigeria into one of four performance typologies. Typologies were based on the historic and current GAVI coverage filters for new vaccine support (50% and 70% DPT3 coverage).

1. States with **persistently low coverage** defined as those with DPT3 coverage of 50 percent or less in both surveys (2008 & 2010).
2. States with **persistently high coverage** defined as those with DPT3 coverage of 70 percent or more in both surveys (2008 & 2010). Of the remaining states,
3. States with **large increases in DPT3 coverage** (40 percentage points or more) between 2008 and 2010.
4. States with **small to moderate increases in DPT3 coverage** (less than 40 percentage points) between 2008 and 2010.



A total of eight states and the FCT were included in this study. Those states were Bayelsa, Ebonyi, Gombe, Kano, Osun, Taraba, Zamfara, along with the FCT. This group of states was selected to represent a range of performance typologies, geo-political zones, topography (upland vs. riverine) and level of current partner support for immunization strengthening.

2.1.2 PARTICIPANT SELECTION

Participant selection was conducted as follows:

Key informant selection. Key informants were selected for inclusion in LARI using the combination of purposeful selection and snow-ball sampling. Based on the LARI team's knowledge of stakeholders, a list of categories of key informants from government and partner agencies at the national, state, LGA, and community levels was developed. Categories of stakeholders included technocrats, politicians and policy-makers, immunization program managers and staff. As the interviews progressed, the initial set of respondents helped identify other national, state, and LGA level informants, who were then included in the study sample.

Facility-based participant observation. Primary Health Care facilities (PHCs) within selected states were purposively sampled for the field observations and exit interviews. In each state, two LGAs were visited, one urban and one rural. Actual LGA selection was informed by state Ministry of Health officials who were more familiar with the local landscape. One PHC was then selected within each LGA, this time based on the advice of the LGA officials (PHC Coordinators and Local Immunization Officers). While this method is a potential source for bias, it also facilitated willingness to participate and allowed researchers to include a large sample in a short time frame.

Community-based interviews. The community-based portions of the study included participants from communities served by the PHCs selected (according to the method detailed above). In each community, key informants were identified with input from the PHC workers and the Ward/Village Health Committee members.

Exclusion criteria. Potential community participants were excluded from this study if they did not have children or were less than 18 years old.

2.1.3 INTERVIEW METHODS

The LARI team used a set of standardized tools for each component of the study: an exit interview questionnaire and participant observation check list for facility-based participants, and a semi-structured interview guide for key informant interviews. All tools were jointly developed by IVAC and Solina Health staff and pre-tested prior to being used for data collection. Each interview was conducted by a minimum of two researchers and responses were captured electronically on audio recorders, as well as in interviewer notes.

2.2 DATA ANALYSIS

The research team analyzed the qualitative data according to a standard framework approach (Pope and Mays, 1995) using the domain classifications outlined below. As a first step, trained personnel completed transcription of interviews and FGDs from the audio recordings and interviewer notes. Following that, the researchers categorized and indexed all points made by each respondent into appropriate domains. Researchers then created a database of key issues, barriers, opportunities and recommendations for each state and the national level. The final step was a comparison and integration of insights from each state and national level interview into a composite set of findings and recommendations.

PERFORMANCE TYPOLOGY (DTP3)		STATES		
Persistently Low coverage: Less than 50% in 2008 and 2010		Kano, Kebbi, Katsina	Bauchi, Yobe	Borno, Taraba
Persistently High coverage: 70% or above in 2008 and 2010		Ekiti, Osun	Anambra, Imo	FCT, Lagos
Large coverage gains: Increase of 40 percentage points or more between 2008 and 2010		Sokoto, Zamfara, Jigawa	Adamawa, Enugu, Bayelsa	Nasarawa, Niger
Moderate to low or no coverage gains: Increase of less than 40 percentage points between 2008 and 2010		Kaduna, Gombe, Benue, Kogi, Kwara, Plateau	Edo, Rivers, Akwa Ibom, Delta, Cross Rivers	Abia, Ebonyi, Oyo, Ondo, Ogun

2.2.1 FRAMEWORK

Using the study objectives, a review of the literature, and conversations with diverse stakeholders, the LARI team identified six key thematic domains to frame the conceptual analysis. Four domains address specific components of the system, while two are cross-cutting contextual domains. The domains are as follows:

Contextual domains:

1. **Leadership and Governance.** The demonstrated and reported commitment of leaders at the national, state, and local level; the extent to which programs are actually implemented at each level.
2. **Financing and Resource Management.** Issues related to the designation, procurement, and usage of RI funding.

Component-focused domains:

3. **Logistics, Planning and Management.** The development and maintenance of necessary supply chain, storage, and delivery resources for RI.
4. **Human Resources for Health.** The quantity and capacity of RI staff.
5. **Health Management and Information Systems.** Data collection and feedback to improve service.
6. **Service Delivery and Demand Creation.** The demand-side domain; includes client-level barriers to RI.

Within each domain, we have analyzed key informant interviews to identify recurring themes. Barriers are presented by domain, with an additional section for state-level highlights. We then present potential intervention packages developed to address those identified barriers.

3 RESULTS: IDENTIFIED BARRIERS

3.1 OVERVIEW

Barriers are presented by domain; sections for state-specific highlights and the special case of polio eradication follow. This approach is appropriate given surprising homogeneity of the findings; most barriers identified were operating across states and local areas. Sub-national differences are noted where apparent.

Logistical barriers relate to supply and transportation of vaccines, cold storage, power supply, and other equipment-related issues. These barriers generally become more relevant as the point of service becomes more remote. The practical difficulties in addressing these barriers can be significant due to hard-to-reach target populations, difficulties with maintenance of provided equipment, and the necessity of ensuring that vehicles are used as intended. However, the impact of successfully addressing logistical barriers would be very high; these barriers were cited repeatedly by survey participants at all levels. Identified logistical barriers include transportation challenges at peripheral points, inadequate cold

chain capacity, poor cold chain equipment maintenance, vaccine stock-outs (inadequate supply), and inconsistent power supply.

Financial barriers are cross-cutting. They can affect the entire process of vaccine procurement and delivery, from the national to the health facility level. The practical feasibility of addressing financial barriers is often high, but issues such as sustainability and political feasibility may act as roadblocks to effective action. The impact of addressing financial barriers is variable; if the additional monies are not used efficiently, the impact will be lowered.

One important observation is that financial barriers are often the first to be cited by respondents. However, they are not always the most direct levers for change. In many cases, improving other aspects of the system can result in increased availability of funds. As with logistical issues, distance from point-of-service is important. While there may be sufficient funding within the greater system, if it's not available at the point-of-service the outcome will be the same as that of insufficient funds overall. In addition, the capacity to compensate for lack of funding decreases at each system level closer to point-of-service; at the PHC or individual level, few participants have the decision-making power or resources to make changes that would compensate for lack of funds.

Identified financial barriers include delays in release of designated funds (at all levels), inadequate funding, especially at the local level, inefficient use of funds, appropriation of RI-designated funds for non-RI projects, and non-sustainable financing of donor projects.

Human resource barriers can be in the form of inadequate supply, inadequate capacity, or both. These barriers are relevant at the managerial level as well as the health worker level. Addressing these barriers can be practically feasible, particularly in areas where inadequate supply is the main issue. However, the impact of addressing human resources barriers will be limited in the absence of other system improvements. Identified human resources barriers include capacity gaps; poor performance management; staff shortages; inefficient staff allocation or allocation of staff time; culture of monetization of tasks; and poor attitude, work ethic, and motivation.

Service delivery barriers decrease the standard of care; this domain is therefore the most closely linked to the demand side of RI, with potential feedback into the governance domain if perceived demand affects the political benefit of tackling immunization issues.

Addressing these barriers is practically feasible for interventions requiring improved conditions, but more difficult when behavior change is the goal. Addressing service delivery barriers has the greatest impact in areas where there are otherwise adequate resources to meet any increases in demand; it is not likely to be a stand-alone intervention in areas with other significant problems. Identified service

delivery barriers include poor integration of RI services with broader primary health services, inadequate quantity of health facilities, low or nonexistent community engagement, poor access to hard-to-reach communities, and poor conditions at health facilities.

Barriers for health information systems exist in terms of inaccurate data collection and lack of data use. Each problem exacerbates the other: with no consequences feeding back to the facility level, there is little reason to work for accurate reporting, while without accurate data, there is little reason to incorporate data-based decision-making into management protocols. The practical feasibility of improving data collection is relatively high, but there may be some political difficulty in implementing systems of data-based decision-making. The impact of improved data collection could be high, if it is accompanied by implementation of protocols for data-based decision-making. In those circumstances, improved data collection could increase accountability at multiple levels. It could also affect procurement by improving the accuracy of demand forecasts.

Identified barriers to functional and accurate HMIS include unreliable or invalid administrative data; unclear protocols and inadequate training of staff for appropriate data collection and utilization; data not used for decision making; some PHCs lacking basic data collection tools such as paper-and-pen registers; poor forecasting; and lack of feedback to the community, reducing accountability.

Governance barriers, like financial barriers, are cross-cutting. Because they affect system-wide issues such as accountability and funding availability, these barriers can have effects at every level. As last-mile provision is the most sensitive to disruption, the effects of poor governance are often compounded along the RI supply chain. Given the wide-ranging consequences of poor governance, the impact of addressing these barriers would be very high. The practical and political feasibility of a governance-focused intervention is low in the short term; the levers for change are not clear, nor is it obvious who might implement such an intervention. However, over the long term, sustained engagement with leaders in and out of government can address underlying issues in the system, creating lasting improvement.

Identified governance barriers include dependence on individual interests to prioritize RI at the state level, decentralization leading to low accountability, and elected officials' reluctance to invest in RI rather than more immediately visible projects.

3.2 LOGISTICS

Many states and LGAs do not commit adequate resources to vaccine logistics and transportation. This results in compromise of the cold chain and supply chains at different levels. Mechanisms for transporting vaccines from states to LGAs and from LGAs to PHCs are commonly underfunded and unreliable. Even when funds are

budgeted for vaccine logistics, they may not be released on time and to the appropriate personnel.

Specific issues cited by respondents include the following:

1. **Supply chain management.** All but one of the health facilities surveyed reported recent stock-outs of vaccine antigens and/or accompanying materials such as specialized syringes and diluents. PHC personnel most often cite inadequate supply at the state level as the reason for the shortage. Poor inventory management practices at state and LGA levels combine with delayed upward feedback of data when stocks approach a minimum threshold, resulting in slow responsiveness and restocking from the national levels. It is common to have excess stock at one LGA while another has a stock-out even within the same state. Also, because of a failure to 'bundle' vaccines, it is commonplace to find states and/or LGAs with vaccines that are not usable because of a shortage of required accompanying supplies.

According to NPHCDA officials, these supply shortfalls occur because the federal government distributes vaccines based on forecast estimates that are based on target populations in each LGA and states. Respondents noted that population estimates are sometimes not accurate or not adjusted for recent increases in coverage, resulting in shortfalls.

2. **Inadequate transport for vaccines and health workers.** Particularly in remotely located PHC facilities, transport of supplies and services is challenging. Facilities may be far from LGA cold stores, or located on access roads which are impassable throughout the year or during the rainy season. Consequently, they are unable to collect vaccines for RI days regularly. When collection does take place, the journey to and from the cold store may take most of the day, resulting in a delayed clinic start time that reduces the number of clients served. According to one national level interviewee, NPHCDA currently engages small scale independent contractors for transportation of vaccines, but some of these contractors have not used appropriate and reliable equipment.

Transportation for health workers themselves is also lacking. In low-coverage areas where vaccination is accomplished at least partly by outreach efforts rather than solely at PHCs, health workers must have adequate and reliable transportation in order to reach families in their homes.

These transportation problems were noted by local and facility level informants in multiple states. Perhaps surprisingly, even the relatively small and dense FCT reported transportation difficulties, suggesting that while the impact is magnified in rural areas, it is not solely a rural problem.

- 3. Inadequate cold chain capacity.** Across the country, lack of established mechanisms for repair and maintenance of cold chain equipment can lead to frequent breakdowns and disruption of the cold chain system, particularly at LGA and health facility levels. Only one state (Kano) had a system for maintaining cold chain equipment, put in place by a donor-funded project. Even in Kano, however, respondents noted the same issues, indicating that the cold chain problem has yet to be successfully addressed at scale.

3.3 HUMAN RESOURCES FOR HEALTH (HRH)

Many PHC departments, particularly at LGAs, are headed by staff with limited training and capacity. Training and qualification of the system leaders appears to correlate quite closely with overall PHC system performance. Because PHC department heads tend to be more qualified than others in the department, the qualification of the PHC head is reflective of the general capacity of PHC workers in the LGA. One interviewee stated that in many southern states PHC departments at LGAs are headed by Medical Officers of Health (physicians), while in the north equivalent offices are held by PHC Coordinators (Community Health Officers/Workers). These regional differences may be contributing to observed regional differences in RI coverage.

The staffing and supervisory structure within government health agencies is not straightforward. Most states, in addition to hiring their own cold chain and immunization officers, hire and deploy the more senior PHC staff (e.g., physicians) where those exist. The LGAs are responsible for hiring and paying most mid-level and junior PHC health workers, including nurses and community health workers. This structure can lead to confusion when workers are not supervised within the communities they serve.

Overall, the RI system contends with a number of human resources problems:

- 1. Inadequate numbers of health workers in many PHCs.** States and LGAs often invest in building or upgrading physical structures for PHC facilities but do not follow through with staffing upgrades, resulting in significant staffing gaps in many PHCs. One official stated that while the human resource gaps occur in part from inadequate hiring by LGAs, there is also an overall shortage of qualified staff that can be hired. In addition, two state level interviewees mentioned that the few staff available are inequitably distributed; many staff members are located in urban areas, leaving rural areas underserved.
- 2. Inadequately trained PHC staff.** Health workers manning PHC facilities often have limited basic training, with most being community health workers or extension workers. There are only a few nurses and virtually no doctors working at the PHC level in

the northern states. A similar situation exists even for managerial functions. For example, in the northern states, PHC departments at LGAs are run by PHC coordinators who are most commonly Community Health Workers, compared to the southern states where PHC departments are headed by Medical Officers of Health, who are generally public health physicians.

- 3. Poor staff motivation and work ethic.** Three national level respondents and thirteen state and PHC level respondents in Gombe, FCT, Kano and Taraba states cited a lack of motivation among PHC workers. In these cases, the problem may be exacerbated by a lack of supervision, particularly at the LGA and PHC levels. Some respondents suggest that the PEI campaign approach of paying healthcare workers for participation has resulted in a ‘monetization’ of staff commitment. There is a perception that the financial incentives motivate PHC workers to participate in polio eradication activities instead of carrying out routine responsibilities. Even when no active polio campaign is taking place, respondents suggest that the expectation of financial incentives has reduced commitment to RI activities.
- 4. Mis-aligned accountability structures.** Within the states, two different line ministries are involved in the execution and supervision of PHC services. The Local Government Service Commission (or, in some states, Ministry of Local Government Affairs) bears the responsibility for recruiting, training, deploying and paying salaries of senior LGA personnel, including PHC system leaders like the PHC Coordinators. The State Ministry of Health (SMoH), on the other hand, sets the PHC agenda, defines policy and program objectives and monitors performance against set goals and targets.

Although the SMoHs tend to be staffed with more technically savvy healthcare professionals, they do not directly supervise LGA personnel, and therefore cannot hold them accountable for performance. The body responsible for supervising LGA personnel is the LGSC, but the LGSC often lacks full understanding of and/or commitment to healthcare priorities at the LGA level. This disconnect was cited by respondents as a driver of poor commitment and performance by LGA staff, particularly those working in the PHC system.

3.4 SERVICE DELIVERY

LGAs bear the primary responsibility for delivery of RI and other PHC services, though states provide some supervision and resources to enable service delivery. The Federal government, through NPHCDA, sets the overall direction and mobilizes resources at the federal level. A number of important gaps in overall RI service delivery were identified during this study.

1. Some PHCs are not providing a high standard of care. A common finding across all states is that demand for RI is diminished when availability and quality of services from PHC facilities is low. According to respondents, the quality and availability of services is generally better in the southern states than in the northern states. Nationwide, however, many PHCs are not functioning optimally to provide healthcare services in the community. Even within states, LGAs differ in their performance; urban PHCs tend to do better than those in remote locations.

A number of mothers who participated in the focus group discussions and exit interviews stated that frequent unavailability of vaccines at the clinics discourages patients from continued attendance; they do not return when they are unable to receive vaccines as scheduled. Participants in the focus group discussions also reported perceptions of poor work attitudes among health workers. The same issue has been noted in our discussion of the human resources domain, but warrants mention again here as it impacts demand for PHC-based services.

In addition, some remote communities face unique challenges with respect to the inability to reach them with services. One focus group participant raised the issue of nomadic communities that cannot be served effectively through fixed locations. Community interview respondents identified a lack of systematic engagement of communities in the planning of RI services in their communities as a cause of decreased ownership. Dilapidated clinic structures and obsolete equipment were also mentioned as deterrents to seeking PHC care.

2. Low demand in some areas. Many respondents believe that demand for RI is still not as high as the ideal, particularly in the northern part of the country. There is a high degree of variability in demand for RI services between states, and even among LGAs in the same state. In states with relatively high coverage, particularly states in southern Nigeria, awareness and demand for RI services is high among the population; some focus group respondents in these areas even expressed willingness to pay for services.

In those states with lower coverage rates, however, there is still ground to be covered in creating population awareness and generating demand. Respondents report pockets of vaccine rejection in a few states in the north due to persistence of traditional or religious anti-vaccine beliefs.

3. Focus on Immunization Plus Days (IPDs). Respondents report that participation of clinic staff in frequent polio-focused IPDs has had a negative impact on service delivery at PHCs. These campaigns pull health workers from their regular activities in order to

participate in polio outreach, sometimes leaving the clinics unmanned for the duration of the campaign.

4. Poor integration of immunization services into routine PHC services. Respondents suggested that other health services and treatments are not well-integrated with RI. This has resulted in immunization fatigue and even frustration in some communities, as residents perceive a lack of focus on other important issues such as malaria and malnutrition. This poor degree of integration may be due in part to the campaign-focused structure of supplemental immunization and polio eradication campaigns; those campaigns are not facility based and not integrated into routine PHC services.

Respondents also suggested that donor and federal government support tends to be program focused, with goals based on the specific interests of the funder at the time. Because immunization has enjoyed a relatively higher amount of focus and resources than many other program areas, the availability of vaccines at PHCs is not matched by that of other basic services, which discourages many mothers from seeking services from the facilities. One common finding in all eight focus group discussions of mothers conducted in three states and the FCT was that mothers attending antenatal care with their first pregnancies were often not aware of required childhood immunizations, which suggests both a service gap and an opportunity for immunization education as part of antenatal services.

3.5 HEALTH INFORMATION SYSTEMS

PHC facilities are tasked with collecting data on vaccine utilization, number of children immunized, wastage rates. These data are theoretically collected with a nationally standardized paper instrument. The data are reported to the LGAs, where they are aggregated and sent to the states for collation and transmission to the NPHCDA. This system, however, has not been highly functional, and several lapses in data management were identified:

1. Unclear and/or inconsistently implemented data collection protocols.

LGA staff and frontline PHC staff are not consistently trained in methods for accurate data collection and reporting, and appropriate materials are not always provided. This capacity gap can result in incomplete and inaccurate data collection. In addition, LGA officials mentioned that many PHCs routinely lack required registers and other data capture forms. LGAs often do not have funds available to print or provide the forms for PHCs, and the states do not always provide adequate quantities. In addition, without consistently implemented protocols and data checks, there are few opportunities to identify incidents of falsification; while it is difficult to determine the existence or extent of deliberate falsification, it was cited as an issue by a small number of respondents at the state and national level.

2. Administrative data are unreliable. The above-mentioned issues with data collection at the local and facility level carry through as data are aggregated at the state and national level. As a result, it is generally accepted that administrative data do not accurately represent RI coverage levels; they tend to be inflated relative to actual coverage. The lack of accurate coverage data makes it difficult to accurately target and evaluate programs within the RI system, as well as RI in Nigeria as a whole.

3. Lack of implemented protocols for decision-making based on collected data. Respondents at all levels identified a general disregard of data and its use. Collected data are not used for planning health activities or decision making, and there is therefore little incentive at any level to devote time and resources to ensuring data accuracy. In turn, the inaccuracy of collected data makes it difficult to justify decision-making based on those data; the problems of collection and use amplify each other.

Several LGA and PHC personnel expressed dissatisfaction that RI data is collected solely for reporting purposes at sub-national levels, and they do not receive any feedback on their data. This issue was also identified by two national-level interviewees who suggested that because of the lack of feedback, there is no ownership or use of the data for decision-making at PHC, LGA or even state levels. In addition, communities and PHCs are rarely provided feedback regarding their performance data, which creates a significant missed opportunity to stimulate performance improvement.

4. Lack of accountability. Because data are unreliable, not disseminated to the public, and not used for feedback, program design, or funding decisions, there is a widespread lack of accountability. When combined with the mismatched supervisory structure discussed in the human resources section, the result is a system in which it is very difficult to reward and scale-up high performing programs and to pinpoint and address issues in low-performing settings.

Along these lines, one direct observation by the study team was that the use of administrative data results in a false sense of high performance. All states and LGAs visited were well below the national target coverage rates for RI (based on 2010 NICS data). However, in the three states where SMOH officials knew their performance numbers at all, they referenced the administrative coverage rates, which tend to be higher than actual coverage levels. Low-coverage LGAs and states were therefore expressing satisfaction that they had met performance targets of 80% or higher coverage rates. This false sense of high performance contrasts sharply with the performance reflected in more rigorous survey data.

3.6 FINANCIAL

The majority of funding for RI comes from the federal government through direct budgets and from designated MDG funds. States and LGAs are required, through statutory provisions of the National Health Bill, to provide funds for vaccine logistics and transportation within the states and LGAs. However, there are questions about the consistency, sufficiency, and enforcement of these contributions. In all states visited, states contribute some funds for vaccine logistics. Also, because the states directly control funding to LGAs, they are able to influence contributions by the LGAs by withdrawing LGA funds 'at source' to fund a vaccine logistics pool, as in Zamfara state.

International donors provide significant resources for immunization services. A few, like GAVI, fund nation-wide activities, while many others support targeted interventions in specific states (e.g., SRIK supports capacity building and logistics in Kano state). Excluding GAVI, donors most often fund vaccine cold chain and transportation.

1. Budgeted funds are not released regularly and promptly, disrupting vaccine supply. The Government of Nigeria procures vaccines through UNICEF, but strictly on a cash basis. This vaccine procurement is relatively well funded in the federal budget. However, federal budget cycles and bureaucratic processes often mean that funds are not available for drawdown until late in the year. Since vaccine procurement is scheduled to be quarterly, supplies for the 1st and 2nd quarters are often not ordered on time, and vaccine provision is disrupted.

2. States and LGAs do not provide sufficient funding for logistical support. Despite statutory obligations, many respondents felt states and LGAs do not provide sufficient funding support for logistics and transportation; even in cases where funds are budgeted, they may not be disbursed or they may be used for non-RI purposes. These funding gaps create gaps in vaccine distribution that worsen at each level closer to point-of-service. While donor programs sometimes step in to bridge these gaps in implementation, most of these activities terminate once donor funding ceases.

3.7 GOVERNANCE

Stakeholders interviewed were consistent in their understanding of the delineation of responsibilities between the national, state, and LGA. Respondents cited the regular provision of funds for vaccine procurement in the national budget as evidence that RI is a high priority at the national level. Three out of seven national-level respondents stated that the Federal government, through NPHCDA, provides strong leadership for RI in Nigeria. However, according to these respondents, the impact of this strong leadership has been limited because commitment is lacking at the state and LGA levels.

According to stakeholders interviewed, the gap in leadership and governance is due to multiple factors:

- 1. State and local RI efforts are inconsistent and dependent on personal interests.** Respondents consistently indicated that states and LGAs were lacking in terms of leadership. At the sub-national levels, the degree of government commitment varies considerably, with many states and LGAs showing little evidence of local ownership of RI. The degree to which a state prioritizes and commits resources to RI depends very heavily on the personal interests of the state governor and his advisers. In Kano, for example, the state executives are supportive of RI and have used their influence on LGA funding allocations to increase the engagement of LGA chairmen. It is worth noting, however, that this apparent increased level of commitment has not translated to significantly improved RI performance in Kano.
- 2. Decentralization hampers accountability.** As noted earlier, Nigeria's PHC system is fiscally decentralized. The federal government sets the overall agenda, but each state and LGA funds components of service delivery at its discretion. There are therefore no accountability mechanisms allowing the federal government to ensure that states deliver on key health programs. There is also little incentive or opportunity for feedback to move back up the service chain to the federal level.
- 3. Leaders do not perceive an immediate political benefit from investments in immunization.** Without clear mechanisms for accountability to communities, the political value of investments in RI is low. Politicians may see more immediate benefits to investments in highly visible, tangible projects that can serve as their 'legacies'. According to interviewees in two states, physical infrastructure and construction projects are preferred investment initiatives for politicians, and it is common for states and LGAs to invest in building new PHCs rather than rehabilitating or improving existing facilities.

3.8 NOTE ON POLIO ERADICATION EFFORTS

The ongoing Polio Eradication Initiative (PEI) provides both an obstacle and an opportunity for the RI system. While respondents have cited some negative impacts, discussed below, there are also openings for RI to build on PEI investments and accomplishments. In many states, RI activities piggyback on PEI resources and activities and have benefited significantly from them. In all states surveyed, respondents reported that the increased awareness created by PEI has resulted in increased overall demand and utilization of immunization services. Also, particularly in the northern states, PEI is often the main driver of immunization activities and the only source of guaranteed, committed funds for immunization at the LGA and PHC facility levels.

However, the PEI has had a few significant negative effects on RI and, more broadly, PHC system functioning. The focus on polio in many low resource states and LGAs (again, often in the north) has meant that the limited human and material resources available are channeled almost exclusively towards polio eradication activities, to the detriment of other PHC services. A particular concern has been that healthcare workers and other stakeholders may have financial incentives for participation in PEI campaigns, resulting in a 'monetization' of staff commitment. Policymakers and PHC system leaders have so far demonstrated a preference to engage in PEI activities rather than RI activities that do not have any attached financial incentives. Some PHC workers surveyed also expressed a preference for PEI activities over their routine responsibilities, due to the financial incentive.

Overall, the impact of polio eradication on RI functioning depends on the baseline performance of the RI system. In the northern states where RI performance was low, polio eradication has had a net positive impact on RI. However, in states where performance was high to begin with, the PEI may have had a net negative impact on RI performance.

3.9 STATE-SPECIFIC STRENGTHS & WEAKNESSES

Due to the cross-cutting nature of most factors noted in this analysis, we found that national issues were among the most important factors influencing RI performance at the state level. However, the heterogeneity of RI coverage by state is evidence that state-level factors are also important. In this section, we present identified factors particular to each state included; these factors are operating in the broader context discussed earlier, but may provide some insight into state-by-state differences.

3.9.1 NORTHERN STATES

Gombe. Coverage in Gombe is in line with national trends. Lack of cold storage is particularly problematic in Gombe; most PHCs report no cold storage capacity. PHCs therefore collect on each

immunization day from the LGA store, returning unused vaccines at the end of the day. Gombe's population is reportedly no longer in line with the census estimates used to forecast demand, and respondents say that the supply of vaccines from the federal government is often well below the level required to meet their need.

One key access barrier in Gombe is the inadequate number and distribution of health facilities and the distance from the home to the health center. For example, two women in the Gombe focus group said they sometimes do not attend clinic because of the distances from their homes to the health centers.

Kano. Despite strong programmatic and state-level support, RI coverage in Kano is persistently low. A particular strength of Kano state is the strong RI support from the state Governor. That support has resulted in funding for RI service delivery at the LGA level, contributing to improvements in the state's transportation and cold chain system. Kano has also capitalized on the opportunity provided by the Support to Routine Immunization in Kano (SRIK), an initiative funded by the European Union delegation since 2007. SRIK provides N250, 000 to each LGA in Kano, contingent on satisfaction of the counterpart funding requirement of N50, 000. SRIK funds are meant to support vaccine logistics, data collection and submission, and outreach services.

However, SRIK is currently in its wrap-up phase. Respondents in Kano state are concerned that the transition arrangements are inadequate; LGAs currently have no clear strategy to replace the N250, 000 provided by SRIK. The lack of a clear transition plan presents an important threat to RI in Kano. Without SRIK support, internal program weaknesses will have an increased impact. Weaknesses highlighted by Kano respondents include inadequate cold chain maintenance capacity and the failure to "bundle" vaccines with other necessary equipment such as syringes.

Awareness and demand for vaccines is reportedly high among the population in Kano, due largely to increased awareness campaigns and IPDs targeted at polio eradication. However, RI-specific demand is variable, and there are pockets of indifference and immunization fatigue.

Taraba. Taraba is a large state with persistently low RI coverage and a low population density that exacerbates logistical difficulties. It is also one of the few states in Nigeria with no international program support.

A particular weakness in Taraba's system is the lack of PHC-level cold storage. Because almost all PHCs have no cold storage facilities, staff from PHCs collect daily vaccine stocks on RI clinic days and return any unused vaccines to the LGA cold stores after the immunization clinics/sessions.

Taraba officials also report a non-functional distribution system, with frequent incidence of inadequate or incomplete vaccine supply from the federal government. For example, one of the LGAs visited by the team had received no supply of yellow fever and DPT vaccines for about five months. This is likely the result of poor forecasting; Taraba's population may be particularly out of line with outdated census estimates. In addition, vaccine supplies have not been correctly bundled; the state has experienced a stock-out of BCG syringes for the past year.

In general, respondents in Taraba believe that the state government currently provides strong leadership for the RI program. However, front-line execution by LGAs is very poor. The executives and senior LGA officials who make most RI program decisions do not always prioritize RI. Some respondents were, by their own admission, unaware of the specifics of implementation and performance of RI programs in the LGAs where they work. During interviews, they repeatedly referred to their PHC staff to provide answers to interviewer questions.

Most of the funding for Taraba's RI delivery is provided by the state government through the State Technical Committee on Immunization (STCI). The STCI disburses N1.7 million monthly to all the local governments. These funds are deducted at source by the state from LGA joint accounts rather than disbursed at the discretion of individual LGA chairmen. In theory, these funds are supplemented by direct LGA funds as needed. In practice, however, those supplemental funds are often not provided, and STCI funds are not disbursed regularly. Taraba is therefore susceptible to funding shortfalls and resultant disruption of RI activities.

Zamfara. Zamfara has seen large gains in coverage between 2008 and 2010. A particular strength of the Zamfara system is the existence of a comprehensive strategic plan for primary health care. The plan was developed by the state with the help of international development partners. Before implementation, traditional leaders were involved, disseminating messages about vaccine safety to their communities. The state then set up a Task Force Committee on Immunization to develop a strategic plan for RI; the "basket fund" for RI was created in 2008 as a result of these meetings.

The continued cooperative effort for RI remains a strength for Zamfara. The state holds joint management and planning meetings between federal, state, local governments and development partners such as GAVI and PRIN. At the LGA level, stakeholder meetings are held monthly, and activity plans are reviewed. RI data are shared among the groups; respondents report that communication among the groups is effective, minimizing duplication of effort. The presence of actively involved partner agencies has been an important opportunity for the state.

All the stakeholders interviewed believed that routine immunization is of high importance, and that it is given high priority by the state. When questioned about who should be responsible for ensuring successful RI within Zamfara, respondents mentioned the Emirs, village heads, mallams (Islamic religious leaders), the local governments and parents. It appears that most respondents have some general understanding of what RI is even if they do not know the specifics.

Each of the 14 LGAs in the State has a generator and a cold room. In addition, the state provides N25,000 monthly to each LGA to maintain its generator. However, logistical problems remain relevant. Respondents report that vaccine stock-out is becoming more common than in the past; vaccines with recent stock-outs include BCG, DPT and OPV.

Respondents note that there are still demand issues in Zamfara; some mothers are not bringing their children for immunization. Suggested reasons include ignorance, religious beliefs, distance to a facility, poverty, and frustration due to vaccine stock-out.

3.9.2 CENTRAL & SOUTHERN STATES

FCT. The FCT has consistently high coverage. A particular strength for the FCT is its central location and small size; transportation from the national cold store in Abuja is logically simpler in the FCT than in any other state. In addition, respondents at all levels believe that demand for immunization is high in the FCT. However, the high population density in the FCT results in an overall increase in need, and some respondents reported that supply has been inadequate. The system also faces weakness in maintenance capacity; there is no provision for maintenance, and broken equipment is common.

Official support for RI services is highly variable across the FCT. For example, in one Area Council visited, the Council Chairman was a Supervisory Councilor of Health before his current position, and healthcare is foremost on his agenda. This translates to greater commitment to RI in that Area Council, as compared to previous administrations and other Area Councils.

Respondents report problems with absenteeism among staff, and regular supervision of the workers is currently hampered by financial constraints. For example, during a routine supervisory visit to health facilities in the state last year, less than half of the workers were at their duty posts.

Ebonyi. RI coverage in Ebonyi is in line with the national trends. One opportunity reported in Ebonyi is the presence of international program support. Ebonyi also has a relatively high population density, reducing the effect of transportation issues but increasing the overall number of clients with RI need.

While respondents at the state level express an understanding of the importance of RI, respondents at the LGA and facility level say that support is lacking. In Abakaliki, there is a perception that the previous LGA administration prioritized RI, while the current administration does not show the same level of support.

Five respondents noted the state's dependence on donor funding; there was concern that the donor dependence was reducing local sense of ownership and accountability.

Ebonyi is unusual in that health workers are paid an allowance, approved by the state governor, and staffing constraints were not reported as a high priority. One LIO noted that facility workers lacked motivation to work hard, but also reported that it was difficult for them to do their work without adequate resources such as transportation.

Respondents report that false rumors of negative outcomes from immunization have lowered demand, as have religious beliefs, lack of education, and the lack of monetary incentives. An LGA official reports that social mobilization efforts have been ineffective, with poor attendance at RI events.

Osun. Osun has been consistently high-coverage, in part due to the opportunity provided by the strong demand for RI in the southern region and the state's relatively high population density. A particular strength in Osun is the high capacity for cold storage at the state level; state officials report that they have enough space to occasionally store vaccines for neighboring states as well. Osun is also aided by current donor funding to LGAs; this funding is meant to aid LGAs in procuring vaccines from the state store.

One identified weakness is that Osun lacks sufficient transportation even at the state level; when the federal agency does not deliver vaccines from Abuja, the state must charter vehicles to bring the vaccines to the Osun cold store facility.

Assessments of government support varied with some indicating that they thought it was high and others assessing it as weak. Staffing at the state level is adequate, according to state officials. However, lack of appropriate staffing at the LGA and health facility level is unanimously cited as a concern.

4 SOLUTIONS ANALYSIS & RECOMMENDATIONS

In addition to identifying barriers, participants suggested a range of potential solutions. We have combined these suggestions with expert feedback and a review of available literature in order to create a suite of potential intervention packages which together address the most-cited barriers to immunization coverage in Nigeria. In addition, we analyzed the likely feasibility and impact of each intervention, providing a broad framework for prioritization that can inform on-the-ground decisions.

4.1 SUMMARY

Our analysis indicates that many key supply-side barriers are operating across a range of states and settings. The overarching issues of structure and governance have far-reaching effects at every level of the system, and addressing those issues will influence service provision throughout the country. Interventions at the structural level are often complex and limited by political feasibility considerations. However, the National Health Bill currently awaiting Presidential approval will provide an opening for structural improvements; the bill provides for formation of state Primary Health Care Development Agencies (SPHCDAs). Well-designed SPHCDAs could alleviate many of the structure and governance concerns highlighted by respondents. Technical support to SPHCDAs when the time comes could therefore be an effective intervention.

At a more granular level, however, there are several potential levers for action. Issues of transportation and cold chain storage were highlighted again and again across states and government levels. In-kind support for either service component would likely be helpful in most contexts, though it would be particularly relevant to underserved rural areas with low market connectivity. Maintenance of available equipment is also a recurring issue; interventions providing maintenance training or financial support for private-sector contracts could address these barriers in many regions. Maintenance training programs have the added benefit of a high potential for sustainability; they could also be targeted towards disadvantaged community members or local youth.

While demand was not the primary issue highlighted by respondents, there are areas in which there is still low preference for or low knowledge about vaccines. Liaising with traditional leaders to ask for RI support is one potential approach; this strategy appeared effective in Zamfara. Incentives to parents could also be considered. Many Nigerians remain uninsured, and low-income families have few options to smooth the financial risk of an adverse health event. Offering vouchers for future health care in exchange for RI participation could function as de facto health insurance, taking

advantage of the fact that most consumers value curative care more than preventative care. Other behavior-change programs include conditional cash transfers and SMS reminders.

4.2 INTERVENTION PACKAGES

Based on our analysis of identified barriers, we designed six intervention “packages” to address the highest-priority, highest-impact components of the RI system. The first three are directly targeting supply chain issues consistently identified as high priority: the transport and cold chain packages address logistical barriers, while the financing package addresses financial barriers. The next two are cross-cutting: the performance management package addresses HRH capacity as well as governance and accountability, while the advocacy and leadership package addresses governance, financing, and demand-side issues. The final package focuses on demand creation; while supply-side factors emerged as more consistently relevant, there are areas where lack of demand remains as an important barrier.

4.2.1 TRANSPORT PACKAGE

Transportation of vaccines, materials, and health workers remains a near-universal need. While transport from the national cold store to state cold stores is relatively consistent, key informants in Nigeria noted that there are multiple breakdowns along the supply chain from state cold stores to the facilities, and in some cases from the facility to the individual.

The impact of addressing transportation needs could be very high, and the relatively straightforward nature of the problem makes many of these interventions highly feasible with appropriate funding. A literature review by Molesworth (2006) determined that road conditions and access to transportation have a significant impact on access to health services and technologies in poor rural areas. The author concludes that transportation costs are typically underestimated and inadequate transportation for vaccine supplies and health workers is associated with reduced utilization of immunization services. Transportation issues become more critical for PHCs that serve large geographical regions. Data from 43 developing countries show that health worker density is a major determinate of vaccine coverage (Anand et al., 2007). Larger land areas are inversely related to vaccine coverage, stressing the importance of transportation interventions.

Transportation contracts. Among ninety interviewed health workers and managers at thirty primary health care clinics in Nigeria’s Plateau State, the lack of transportation and poor maintenance of those vehicles was cited as the major constraint to the effective running of the health facilities (Lawan, et al., 2009). Informant interviews for this project indicated that there are some transportation contracts

in place, but say that contractors have not provided reliable and consistent service. With improved implementation, however, a system of transportation contracts could function at scale while providing context-appropriate service. Potential improvements to contracting include specific provisions for vehicle maintenance, coordination with state and local cold stores to determine appropriate routes and schedules, and preferential contracting with woman-owned businesses.

Riders for Health is the most noteworthy example of a vehicle maintenance system designed to keep health services accessible in remote and rural areas of Africa. Founders of the Riders for Health program recognized that the primary challenge to reliable healthcare delivery was a pervasive neglect of vehicle management -- and not just lack of vehicles in general (Coleman et al., 2011). Riders for Health designed a vehicle management system that incorporates training of vehicle users on driving, training technicians in skilled transport maintenance, and scheduled maintenance of the vehicles themselves. This system of “preventative maintenance” serves to increase the lifespan of each vehicle and reduce off-road time due to damage (Rammohan et al., 2010). The program boasts the additional achievement of contracting with local mechanics and training local youth for a skilled trade.

Vehicle distribution. Vehicle procurement, distribution and maintenance can alleviate transport difficulties. This is not the preferred option in most contexts, as it is very difficult to avoid some misappropriation of vehicles, and maintenance needs can be logistically difficult to fulfill. However, particularly in communities that rely on outreach efforts rather than in-facility services, the availability of a PHC vehicle could dramatically improve access to services.

There are no peer-reviewed papers showing the effectiveness or measuring the cost incurred by implementing a vehicle procurement and distribution program. The effectiveness of such a strategy is based on empirical evidence from immunization programs across

Africa. Again, Riders for Health serves as a model evidence-based program for this proposed intervention (Coleman et al., 2011). As opposed to requesting one time vehicle donations and scraping together funds for emergency maintenance, Riders for Health works with governments to lease vehicles (spreading the cost over several years) and paying for routine maintenance as a predictable recurrent cost (Rammohan et al., 2010).

Vehicle provision can also be considered as part of a results-based incentive scheme. This approach would provide opportunities for continued advocacy (through branding of the vehicle) while reducing issues of misappropriation through a less strict mandate for appropriate use. However, an incentive program may have a less immediate effect in the high-need, low-coverage rural areas if geographically large catchment areas make it more difficult to share ownership of a vehicle.

4.2.2 COLD CHAIN PACKAGE

The consistent citation of cold chain and storage problems indicates a need for specific and proactive cold chain strategies. Where donor-funded projects bear the responsibility for maintenance, a sustainability plan should be put in place to ensure continued funding following conclusion of the project. Protocols for preventive maintenance and repairs of cold chain equipment will help ensure that existing equipment is fully utilized, and provision of additional storage will alleviate transportation difficulties in remote areas by allowing for advance planning and storage of multiple days' worth of vaccine. This will be especially important in the coming years as additional vaccines such as PCV are added to the RI schedule.

As with the transportation package, the impact and feasibility of cold chain interventions are both relatively high: the widespread need for cold storage indicates that providing these services would have a high impact, and the straightforward nature of the problem indicates high feasibility. In addition, examples of effectively implemented cold chain programs can provide guidelines for success.

INTERVENTION	PRIMARY BARRIERS TARGETED
<p>Transportation contracts. Government sets up contracts with the private sector to transport vaccines to the last-mile point of care; this may be set up as an income generating activity of women in the community.</p>	<ul style="list-style-type: none">• Transportation challenges at peripheral points• Vaccine stock-outs• Low access to hard-to-reach communities
<p>Vehicle distribution & maintenance. Government or donors distribute vehicles, motorcycles, boats and bicycles to health facilities for use in vaccine transport; could also include mobile vaccination units.</p>	<ul style="list-style-type: none">• Transportation challenges at peripheral points• Vaccine stock-outs• Low access to hard-to-reach communities

Provision of solar fridges. Providing solar fridges to PHCs is an intervention that can be implemented almost immediately, by donors or by government. It is one of the simplest ways to address some of the logistical difficulties reported, and there is little danger of misappropriation. A 2007 situational analysis was performed in Zimbabwe to assess barriers to immunization (Chadambuka et al., 2012). Researchers determined that lack of power for gas-powered cold-storage equipment caused a discontinuation of routine immunization services for 3-11 months. 20% of immunizations were delayed because cold storage equipment is down due to gas shortage. Solar powered equipment can mitigate these cold-storage limitations. Many PHCs in Nigeria have solar fridges, but often they are non-functional due to improper use or maintenance. Any provision program should therefore include careful training along with clear protocols for whom to call and what to do in the case of a non-functional refrigerator.

Solar powered refrigeration for vaccine storage has been used with success in Africa as an alternative to kerosene powered refrigerators (Burton, 2007). Evidence for this proposed intervention comes from empirical observations. The field of solar powered refrigeration has made strides in improving the efficiency and reliability of this technology. As an example of technological improvements, the SolarChill Project, stores thermal energy in ice, not an electrical battery, and is able to maintain the vaccine cooler within a temperature range of 2-8 degrees Celsius, even during periods of low-sun (Burton, 2007). This project was field-tested in Cuba, Indonesia, Columbia and Kenya and received WHO qualification for use in low- and middle-income countries in 2010 (Mate & McCarney, 2010).

Maintenance contracts. Provision of cold chain equipment such as solar fridges may have a greater impact if accompanied by a system of maintenance contracts between the government and the private sector. Most solar powered refrigerators contain batteries that need regular maintenance, must be replaced about every three years, and must be disposed of as hazardous waste (Burton 2007). As with transportation contracts, maintenance contracts offer good potential for context-appropriate services that can be implemented and managed at scale. A combination of maintenance training for local youth with subsequent provisional contracts could provide economic benefit to communities while improving routine immunization service (Coleman et al., 2011). In 1993, fifty-three solar electric networks, with an average of six local solar refrigerators each, were established to operate the cold chains needed for vaccine storage following a large polio outbreak in Sudan (ElZein et al., 1998). These refrigerators were still in operation during an assessment three years later, attributed in part to the training of cold chain technicians. The SolarChill Project, described above, also has a contracting component for maintenance to improve immunization program sustainability (Burton, 2007).

Satellite cold chain storage. In some large and/or rural states, logistical difficulties are exacerbated by the long distances between state cold stores (where vaccines from the federal supply are kept) and the LGAs and facilities where the vaccines are used. In interviews with 402 parents and guardians at a PHC in Calabar, Nigeria, a primary reason for dissatisfaction with the immunization services was long wait times (Udonwa et al., 2010). Families were observed leaving the clinic without being immunized because of the unreasonable wait times. The authors determined that these long wait times were due to vaccines not being readily available because storage site was too far away.

INTERVENTION	PRIMARY BARRIERS TARGETED
Provision of solar fridges. Government or donors provide solar fridges to PHCs.	<ul style="list-style-type: none"> • Inadequate cold chain • Inadequate power supply
Maintenance contracts. Government or donors train and contract with local workers to maintain cold chain equipment, including generators.	<ul style="list-style-type: none"> • Inadequate cold chain
Satellite cold chain storage. Set up additional cold storage centers in LGAs that are either very large or far from state cold store.	<ul style="list-style-type: none"> • Inadequate cold chain

In these situations, setting up satellite cold stores could alleviate some difficulties. This approach was implemented in Sudan, in which solar refrigerators replaced kerosene or propane refrigerators and enabled establishment of satellite storage facilities where it was previously not feasible due to a lack of fuel (ElZein et al., 1998). This study determined that operating a satellite solar refrigerator network in Sudan costs approximately 55–75% less than operating a vehicle to transport vaccines to more remote areas. This satellite cold storage component would be a good candidate for a government intervention, as it would ease the process of including the new facilities in the national vaccine distribution strategy.

4.2.3 FINANCING PACKAGE

The study team identified a number of suggestions from the interviews that can improve the financing and mobilization of resources for routine vaccines in Nigeria, reducing finance-related service disruptions. The impact of these interventions could be particularly high if they succeed in eliminating supply disruptions due to inadequate funds. The feasibility is lowered, however, by the complex and dynamic landscape of health services funding in Nigeria. An effective financing intervention must build in flexibility and responsiveness to a changing political climate, along with a high degree of transparency to ensure accountability at each level. Alternatively, donor-funded interventions can work outside of the government funding system, enabling a higher degree of feasibility in the short term (though perhaps reduced sustainability in the long term).

Financial guarantees. Nigeria has a line item for vaccines in the national budget, but procures all vaccines from UNICEF on a cash basis; if funds are not released on time, vaccines are not procured and service and supply are interrupted. Due to Nigeria's funding calendar, there have been incidents of fund release occurring after the deadline for procurement orders, with resulting delays and stockouts. Donor agencies or other governments can provide short-term guarantees or loans in order to fill the gap between ordering deadlines and funding release. A long-term strategy would address the underlying issues that lead to funding delays, but donor guarantees could be an appropriate and feasible short-term remedy.

Re-designating vaccine budget line from capital to recurrent. The slow release of funds at the district level has impacted many immunization programs in developing countries, Nigeria included (Kamara et al., 2008). Delayed release of funds disrupts vaccine provision by delaying or preventing national vaccine purchases.

One possible intervention to address this issue would be advocating for the federal government to treat routine immunizations as a recurrent rather than a capital expense. Funding for recurrent activities is not interrupted even when release of funds for a fiscal year is delayed. With more predictable national funding, financing gaps are easier to identify and necessary steps to fill those gaps can be planned and initiated sooner (Kamara et al., 2008). On the other hand, recurrent expenditures may be more vulnerable to spending cuts; there has been discussion of reducing the proportion of the budget that is recurrent rather than capital. The first step in any financial intervention will be a

INTERVENTION	PRIMARY BARRIERS TARGETED
Financial guarantees. Donors can provide financial guarantees to help the NPHCDA tide over budgetary delays.	<ul style="list-style-type: none"> • Delay in release of budgeted funds • Inadequate funding, esp. at LGA level • Vaccine stock-outs
Re-designating vaccine budget line from capital to recurrent. Parliamentarians re-designate vaccine procurement as a recurrent expenditure, bypassing the delay-inducing process for annual review and approval of capital expenses.	<ul style="list-style-type: none"> • Delay in release of budgeted funds • Inadequate funding, esp. at LGA level • Vaccine stock-outs
Creation of a basket fund. Pooled funds from state and local governments will be established and made available for vaccine logistics.	<ul style="list-style-type: none"> • Delay in release of budgeted funds; inadequate funding, esp. at LGA level
Flexible funding for vaccine logistics. Donors provide cash support that can be targeted at the most peripheral level and/or towards hard-to-reach or high-risk communities, bypassing bureaucratic bottlenecks.	<ul style="list-style-type: none"> • All financing barriers • Poor access to hard-to-reach communities

careful consideration of the current funding structure. This process will require the engagement of NPHCDA , the ministries of health, finance and national planning, and the legislature.

Creation of state-level basket funds. The recent improvements in Zamfara state are likely due in part to the development of a basket fund in that state. An RI basket fund would be implemented by states, and would pool financing from the state with funds from each LGA. Funds are then redistributed for RI service provision. This would be particularly useful in ensuring that LGAs and PHCs have access to funds for equipment maintenance and other relatively small but important expenses. Careful oversight would be crucial to ensure timely disbursement and avoid issues of misappropriation.

Flexible funding for vaccine logistics. Vaccine provision goes beyond procurement, but it can be difficult to find and distribute funding for ancillary costs such as logistics and training, particularly at lower levels of government. While a system-wide approach to those difficulties is an appropriate long-term approach (and other intervention packages in this document address those issues), improving the flexibility and availability of non-procurement funding may allow states and LGAs to address immediate issues and quickly improve the effectiveness of their RI programs.

4.2.4 PERFORMANCE MANAGEMENT PACKAGE

Issues of performance management and accountability were widespread, cited by many respondents. The performance management package combines positive incentives for high performance with a tightened, data-based accountability system. Mid-level management training complements the package, encouraging supportive supervision as staff and officials work to make changes.

Addressing performance management is not an easy, short-term fix, but the impact could be both high and sustainable. Existing interventions in low- and middle-income countries have demonstrated impact; the challenge will be in implementing at scale.

Results-based financing and incentives (RBF). Effective RBF programs aim to provide positive accountability, reward high performers with increased funding and/or non-monetary incentives such as official recognition, increase efficiency by focusing on high-priority and cost-effective services, increase technical efficiency by maximizing use of existing resources, and improve equity of outcomes by encouraging expansion of services to underserved populations (Witter et al, 2012). Notably, GAVI funded programs receive results-based funds after a two years of an initial investment, though evaluation of this RBF by GAVI is limited because the relevant studies are not designed to evaluate the effect of only the performance-based component. RBF will need to be appropriately targeted; if individuals do not have the resources or decision-making power to improve practices,

incentives will not have an impact. Appropriate levels for RBF in Nigeria may include PHC heads and LGA chairs. There may also be opportunities to target incentives at the health worker level. Programs at this level could address the poor distribution of staff, improving retention of workers in rural areas and making LGA roles more attractive to qualified health workers (McCoy et al. 2008).

A systematic review of financial incentive programs for health workers show that these programs have placed substantial numbers of health workers in underserved areas of developed countries (Bärnighausen & Bloom, 2009). While there is concern about perpetuating a culture of monetization among health workers, non-financial incentives such as training opportunities and communication infrastructure could increase the standard of care without monetizing routine tasks. For example, in a survey of 234 health workers in Zambia, 40% of respondents had not been promoted or received increased remuneration as a result of improved skills or performance in the past 5 years. Respondents from that survey indicated that career advancement opportunities mattered more to them than financial incentives (Gow et al., 2011). Incentive programs could be implemented from within the government, by outside donors, or in some combination or phased transition between the two.

Data checks and data collection support. In order to be effective, RBF or other performance management programs must be built on a foundation of accurate and complete data collection to inform policy and financing decisions (Nelson et al., 2009). Data checks and improved data management are therefore crucial to improving performance management and evaluation, and form the foundation of evidence-based advocacy to politicians and donors. Data collection interventions aim to improve accuracy, but also to create a work environment that empowers staff to collect accurate data and communicates the importance of that data in terms of their work and the larger community.

Checking to be sure that reported vaccination rates at a facility do not exceed recorded supply would be one simple step to improve data quality; this is done at some levels in Nigeria, but the frequency is inconsistent and there are no negative consequences to facilities or LGAs that over-report coverage. In a published study from Mozambique (Mavimbe et al., 2005), a review of the 2002 immunization data collection materials at seven health facilities demonstrated that facility reports often show higher values than those from the facilities' tally sheets. For example, facility report counts were 95% higher for DTP+HepB and 72% higher for measles immunizations when compared to the tally sheets. These authors suggest managerial support for accurate data collection among health workers needs to be implemented in tandem with health worker training about the details of data collection.

In an assessment of data collection procedures in Uganda, Hotchkiss et al. (2010) conclude that the promotion of a culture of information

was associated with health workers' motivation, data collection competence, job satisfaction and use of information. Similar results were generated in Kyrgyzstan after a program was implemented to improve record-keeping and immunization service delivery (Weeks et al., 2000). Aside from the obvious benefits of improved data management, immunization workers were proud of their work and new data collection responsibilities. Accurate data systems can be used for supervising health workers and generating workplans, as demonstrated for immunization health workers in India (Krishnan et al., 2010).

SMS reminders to staff. The widespread use of text messaging can strengthen communication and improve health service delivery in developing countries (Zurovac et al., 2012). Additionally, this type of messaging the least-expensive mobile phone function and is available on most basic handsets without the need for additional applications.

A recent cluster-randomized controlled trial in Kenya found that twice-daily text-message reminders sent to health workers' mobile phones can improve the management of malaria treatment in children (Zurovac et al., 2011). The messages in this study included clinical instruction and an inspirational quote. The authors speculate that this approach works because it addresses worker's forgetfulness with certain tasks, reminds health workers that someone is paying attention to their work, and provides motivation from popular quotes. This text-messaging strategy could improve routine immunization coverage in areas where health worker performance or motivation is lacking.

A similar intervention was applied in South Africa among midwives (Woods et al., 2012). The trial demonstrates that information sent via text to health care workers is generally well received; the information is often widely shared with colleagues, and is believed to improve learning and patient care. An alternative use of text messaging among African health workers is documented by Barrington et al. (2010). In this pilot study, health workers at 129 rural health facilities in Tanzania used weekly text messaging to communicate stock levels of malaria medicines to the district management team. The proportion of health facilities with stock-outs fell from 78% to 26% in just six months. These results suggest that large scale text-message applications using health workers' personal mobile phones are feasible in remote districts and can be used to maintain supply levels and communicate with management.

Mid-level management training. The issue of effective supervision of staff, particularly at PHC facilities and LGAs, was frequently raised during key informant interviews and focus groups. These informants anticipate that holding workers accountable will improve performance. Similarly, respondents indicated that performance management mechanisms that enable consequences for erring health workers need to be strengthened to ensure staff accountability

and enhance performance. Supervision of health workers typically consists of 'surprise' assessment visits, which carry a punitive connotation and are not constructive (Ehiri et al., 2005). In contrast, a review of the literature found that training managers in priority setting, resource allocation and supervision improved the quality of health-worker performance and delivery of health care in low and middle income countries (Rowe et al., 2005).

An assessment of management performance in Nigeria's Plateau State found that 4 out of 10 local government areas had poor performance and the other 6 LGAs had management rating of 'fair' (Lawan et al., 2009). The researchers determined that the management staff lacked necessary resources to run immunization programs efficiently and effectively. In Kenya, only one-quarter of health managers responsible for overseeing vaccine programs had received supervisory training in the last ten years, and poor managerial oversight was associated with substandard immunization delivery and low vaccine coverage rates (Ayaya et al., 2007). Ehiri et al. (2005) documented the fact that none of the ten health clinics in Calabar, Nigeria had a supervision schedule to guide managerial processes and none of the 28 health workers designated as supervisors were involved in actual supervisory activities. This study demonstrates the need for managerial training, with a focus on program planning and communication.

In other settings, researchers have evaluated management training and shown positive impacts on health worker activities and population health outcomes. One evaluation of the Mid-Level Management (MLM) training program in Ethiopia, Ghana, Lesotho, Senegal and Zambia from 2000 to 2004 showed an increased level of performance in the trained staff. Researchers associated this improved managerial performance with the increase of DTP3 coverage in the African Region over the same time period (DTP3 was 49% in 1991; 53% in 2001 and 69% in 2004) (Mutabaruka et al., 2010). Similar mid-level management training in Sudan from 1993 to 1996 was associated with increased DTP3 coverage (79% from 51%) (ElZein et al., 1998). These researchers concluded that training managers on how to train their staff can be a useful approach to improving immunization services. From 1994 to 1997, immunization service managers in Kyrgyzstan were trained on analytical supervision and how to promote accurate data collection by their health workers (Weeks et al., 2000). The study established that following the training, the supervisors' attention on collecting and using information and on providing quality services energized the health workers and led to better service outcomes.

Managerial supervision of immunization workers could be integrated with supervision of other PHC activities for efficient management of available resources. The current practice of separate officers supervising separate aspects of PHC (e.g., a Maternal and Child

INTERVENTION	PRIMARY BARRIERS TARGETED
<p>Results-based financing (RBF). Government or donors provide cash to PHCs or LGAs, conditional on achieving set coverage targets in their population or catchment area.</p>	<ul style="list-style-type: none"> Poor accountability
<p>Data checks. States compare LGA coverage data with data on number of vaccines provided by the state; if reported coverage rates exceed provided vaccines, return to LGA for follow-up; repeated “offenses” carry consequences for personnel.</p>	<ul style="list-style-type: none"> Poor accountability Administrative data are not reliable Data are not used for decision-making
<p>SMS reminders to staff. PHC heads send SMS reminders and supportive messages to motivate staff and improve their performance.</p>	<ul style="list-style-type: none"> Poor performance management Low morale
<p>Mid-level management training. Government and donors provide management training to PHC managers and LIOs; focus includes identifying opportunities for task shifting and supportive supervision.</p>	<ul style="list-style-type: none"> Poor performance management Low morale Staff shortages Inefficient distribution of staff

Health officer monitors PHC performance in MCH while an LIO monitors performance of routine immunization) can be improved such that a pool of PHC supervisors can engage in integrated supervision of PHC services during visits to the health facilities.

4.2.5 ADVOCACY & LEADERSHIP PACKAGE

Advocacy and leadership issues were cross-cutting, cited by respondents at all levels of government. In Nigeria, state and LGA leaders have significant influence, and improving their understanding and ability to support immunization could have far-reaching impacts across all other domains. While the complex, competing needs of leaders at each level makes these interventions less immediately feasible than some others, their impact can be significant and sustainable.

PHC-under-one-roof/SPHCDAs. In recognition of some of the structural defects in health systems governance, the Nigerian government is encouraging states to establish functional State Primary Health Care Development Agencies (SPHCDAs) to administer PHC services within the states. When the National Health Bill is signed into law, it will require every state to have a SPHCDAs, though the structure of support and funding for those SPHCDAs is unclear.

Local control of immunization activities has been shown to improve service delivery by making governments more accountable to and

responsive to needs of local populations (Gauri & Khaleghian, 2002). In developing countries with decentralized government immunization programs, immunization rates for measles and DTP3 are 8.5% higher than low-income countries with a nationally-controlled program (Khaleghian 2004). As of 2008, this type of strategy had been proposed by seven African countries to promote quicker disbursement of funds to local authorities or to transfer financing responsibilities for some immunization items to local levels (Kamara et al., 2008).

With the establishment of SPHCDAs, all state level stewardship and supervisory functions will be domiciled in the same agency. The SPHCDAs will set directions and policies, hire and pay senior PHC staff in LGAs, and monitor performance of such staff. In addition, the SPHCDAs will serve as the single state government interface with NPHCDA and LGA PHC departments, which would enable more effective coordination of efforts. Some states have either established or are in the process of setting up their SPHCDAs.

A few states expressed the need for technical assistance for the establishment and functioning of their SPHCDAs. In a review of fifteen National Immunization Technical Advisory Committees, the most commonly identified area for technical assistance is in the realm of economic data. In addition to establishing the SPHCDAs, technical assistance might focus on the development and implementation

of policies regarding how to weigh economic data and incorporate economic expertise in the decision-making process (Gessne et al., 2010). These authors also identified a need for technical assistance and expertise in reaching evidence-based decisions. However, the current lack of accurate data collection and use (examples include disease estimates and vaccination rates) at the state-level limits the ability to make evidence-based decisions (Hotchkiss et al., 2006).

Advocacy to political leaders & traditional leaders. At sub-national levels, commitment to routine immunization is highly dependent on the individual preferences of decision-making politicians and officials. There is an opportunity to directly target and influence these politicians through effective advocacy. Effective advocacy will increase the political value of investing in vaccines, and will include those messages alongside the economic and human rights justifications for routine immunization investments. Strategies such as rewarding high-performers with public recognition from the government or international agencies can engage politicians while increasing routine immunization awareness.

As shown with polio eradication, engagement of respected Nigerians as champions of routine immunization can boost the commitment of politicians and the acceptance of immunizations by the public. The initial response to the polio vaccine boycott in 2003 failed because it focused on scientific evidence and ignored the cultural and religious concerns that fueled the boycott (Tomori, 2011). The involvement and outreach of traditional and religious leaders in immunization programs resulted in a more effective public education campaign about vaccine efficacy and safety (Jegede, 2007), (Kaufmann

& Feldbaum, 2009). As an example, Emir Alhaji Ado Bayero of Kano, one of Nigeria's most influential Muslim leaders, provided a significant endorsement for the polio vaccine by publicly immunizing 20 children in his palace (Majiyagbe 2004).

Evidence supporting current advocacy interventions to traditional leaders includes a 2009 assessment of the social factors impacting childhood BCG vaccinations (Babalola & Lawan, 2009). The top social influence on BCG immunization status was paternal support for the vaccine: children whose father approves of immunization are three times more likely to be immunized as those with a father who disapproves. This study supports the importance of advocacy from traditional leaders focused on paternal support of vaccines. During an influenza vaccine campaign, Kwong et al. (2010) demonstrated that older adults, a high risk group for flu and likely social leaders, are important partners in immunization programs. Researchers highlight that indigenous health practices embedded in different cultures should be used to complement, rather than compete with, vaccine uptake.

Structured transition of donor-supported projects. To ensure that activities funded by donors are sustained beyond the duration of the donor funding, implementers need to build in sustainability plans from program inception. Funding responsibilities for donor-funded activities should be gradually transitioned to the appropriate governments during the course of the project, rather than abruptly at its end. Donor projects may transition to providing technical assistance in establishing or strengthening vaccine procurement systems as an alternative to direct vaccine purchasing and administration program (Woodle, 2000).

INTERVENTION	PRIMARY BARRIERS TARGETED
PHC-under-one-roof – SPHCDAs. Government creates State Primary Health Care Development Agencies (SPHCDAs) with budgetary and decision-making power at the State level.	<ul style="list-style-type: none"> Poor accountability Disconnect of responsibility, authority, and capacity Poor performance management
Advocacy to political leaders e.g. APPG on RI. Vaccine advocates work with political leaders to prioritize routine immunization by ensuring adequate funding, using coverage rates as one of their performance benchmarks.	<ul style="list-style-type: none"> Inadequate funding at all level
Advocacy by traditional leaders. Vaccine advocates train and support traditional leaders to show public support for RI and encourage their subjects to vaccinate their children.	<ul style="list-style-type: none"> Lack of community engagement Demand-side barriers
Structured transition of donor-supported projects. Donors and government build in a transition period to phase out donor funding and phase in government funding to sustain programs.	<ul style="list-style-type: none"> Non-sustainable financing of donor projects

Many developing-country governments previously considered vaccines as donor-supplied commodities and did not include them in annual health budgets (Woolde, 2000). Ensuring that governments provide counterpart funding from the start of all programs ensures ownership. This provides a mechanism for the government to monitor the flow of money into the country, state, or LGA and assess the ongoing impact of the donor project, which is more difficult to do if they are not financially contributing to the project. This approach means that the budgeting process will be less distorted, because it includes the some of the cost of services that the government will eventually be expected to provide for its citizens (McQuestion et al., 2011).

4.2.6 DEMAND CREATION PACKAGE

The previous five interventions described in this paper all address supply side constraints to improve childhood vaccine coverage. Interventions to create and maintain demand for vaccines can complement and strengthen these efforts (Shea et al, 2009). The historical context is particularly relevant; Nigeria experienced a wide distrust of the polio vaccine in 2003-2004 during an international polio eradication effort (Tomori 2011). Despite ample and available supplies, the resulting sharp drop in demand led to devastating polio outbreaks across the country, until demand-creating interventions curbed the problem. This example serves as a reminder of the importance of creating and maintaining demand among a high-risk population with limited resources.

Studies have shown that many factors influence parental decision-making about childhood immunizations in Nigeria (Babalola, 2009a). Primary social factors include maternal knowledge about vaccine preventable diseases and immunizations, maternal education, and religion. Other more tangible factors include place of birth (home vs. health care facility) and the ownership of a child immunization card. Today, coverage rates drop sharply between DPT1 and DPT3, indicating that parents are not always following through to ensure that their child receives a full course of vaccines. Possible reasons for non-completion of the full course of DPT include forgetting the timing of necessary vaccines, lack of knowledge concerning vaccines, mistrust of western medicine, and insufficient motivation or lack of resources needed to complete the full vaccine series (Babalola, 2011 & Odusanya, 2008).

Increasing demand has traditionally focused on improving knowledge about immunizations. However, a recent review (Oyo-Ita et al., 2011) determined that information campaigns and parent/patient education have only a moderate impact on vaccine uptake in developing countries and that these finding have low levels of evidence. The interventions proposed in this package attempt to improve demand for childhood vaccines by focusing on other social issues.

SMS reminders to parents. SMS (short messaging system, also referred to as text messaging) reminders to parents at appropriate times could increase retention; this approach will be most helpful in regions where vaccine supply is adequate. Text messaging costs less than phone call reminders and the increasing availability of this technology in developing countries makes this a feasible intervention (Zurovac et al., 2012).

SMS has been used in developing countries to remind patients about primary care appointments that were scheduled a few months previously (a similar timeframe to the DTP and oral polio vaccines series). In Malaysia, patients receiving a text message reminder had a 60% better attendance rate for their follow-up primary care appointment than those patients with no reminder (Leong et al, 2006). Additionally, the text messaging reminder system cost half the amount of the phone call system in this study. Chen et al. (2008) demonstrated similar results in China. The authors note that SMS reminder systems require regular updating because people frequently change cell phone numbers.

Vaccine series (such as the DPT series) are more challenging to complete than one-time vaccination and timely reminders can increase the proportion of children who complete the full series (Kharbanda et al, 2011). Researchers in Spain found that text messaging increased the percentage of patients who completed a 3-shot hepatitis A series, from 27% in the control group to 47% in the SMS reminder group (Vilella et al., 2004). These authors note that SMS reminders make an impact in populations where the rate of vaccination is low. When people are already likely to be vaccinated, SMS reminder has a minimal effect. In a similar study, parents in New York who received a text message reminder were significantly more likely to have their adolescent daughters vaccinated with the second and third doses of the human papilloma virus (HPV) vaccine (51% completed the series on-time) than parents who did not receive this message (35% of controls) (Kharbanda et al., 2011).

Incentives: Health care vouchers and conditional cash transfers. The use of incentives to promote uptake of preventative health services has been implemented and studied in many countries to promote various health-related practices. By enhancing demand for health services, incentives have demonstrated improvement in the utilization of prenatal services, nutrition supplementation, child health checks, and vaccination in various low- and middle-income countries (Lagarde et al., 2009).

Many Nigerians remain uninsured, and low-income families have few options to smooth the financial risk of an adverse health event. Offering vouchers for future health care in exchange for routine immunization participation could function as de facto health

insurance, taking advantage of the fact that most consumers value curative care more than preventative care. This type of voucher system is modeled after other effective programs, but uses health care as the voucher versus food or commodities. In rural India, providing lentils and plates to families who vaccinated their children more than doubled the proportion of children who were fully vaccinated for DTP, polio, measles, and TB in one year (Banerjee et al., 2010). Authors of this study highlight the fact that even small incentives provide motivation to return to the clinic for subsequent doses, thus decreasing the drop-out rate. In Pakistan, families received a coupon for food or medicine as an incentive to vaccinate their young children with the 3-shot DTP series. Children with families offered the coupon were twice as likely to complete the DTP series (Chandir et al., 2010).

CCT programs have been implemented for various types of health care promotion in regions around the world. CCT has been used extensively in Latin America (PaesSousa et al. 2011) and the United States (Special Supplemental Nutrition Program for Women, Infants, and Children) to improve nutritional status and growth trajectories among children from high-risk families. A few programs have initiated CCT programs in developing countries and a subset of these have focused on immunization demand. Lagarde et al. (2007) and Ranganathan et al. (2011) reviewed several controlled studies in Latin America. Overall, these reviews concluded that CCT interventions have produced mixed results for immunization rates, but indicate a positive effect for parents of younger children and for certain populations. In Honduras, 7% more children received the first dose of DPT with a CCT incentive (Morris et al., 2004). In Colombia, CCT increased the probability that parents had complied with the DTP vaccination schedule for children less than 2 years, but there was no significant effect among older children (Attanasio et al., 2005). Mexico, CCT positively impacted BCG vaccination rates for

children under 12 months and for measles among children 12–23 months old (Barham, 2005).

Perhaps the most useful results come from Nicaragua. Barham and Maluccio (2009) demonstrated that CCTs can improve polio vaccination rates in hard-to-reach populations, specifically families living in remote locations and families with little formal education. These results can assist LARI (not sure what the official name is?) in targeting CCT incentive programs and increase the cost-effectiveness of such interventions. In areas where supply is sufficient, incentive programs could increase routine immunization uptake. However, this is not a stand-alone intervention; there is no evidence that coverage gains from incentive programs are sustained after the life of the program. Other improvements in service and coverage would need to be implemented in tandem with incentives in order to create lasting improvement.

4.3 EVALUATING POTENTIAL INTERVENTIONS

Within and across intervention packages, it will be necessary to prioritize which pieces to implement first; even with unlimited resources, it would not be possible to do everything at once. The appropriate priorities must be set by on-the-ground decision-makers, and there may well be differing goals and decisions between settings. While there is no single correct decision, a consistent and transparent approach may facilitate strategic decision-making at each level.

To that end, we analyzed interventions using a series of lenses: feasibility vs. impact, impact on underserved populations, time to implementation and impact, implementing stakeholder, and zero-cost interventions. Our analysis was based on feedback from survey respondents, a review of the literature, and consultation with experts in the field.

INTERVENTION	PRIMARY BARRIERS TARGETED
SMS reminders to parents. Providers send SMS reminders to parents to improve retention.	Demand-side barriers
Treatment vouchers for vaccines. PHCs offer vouchers to pay for future health services as incentive for uptake of vaccines.	Demand-side barriers
Conditional cash transfers for vaccines. Donors provide cash to HFs to give to parents, conditional on their child's receipt of vaccines.	Demand-side barriers

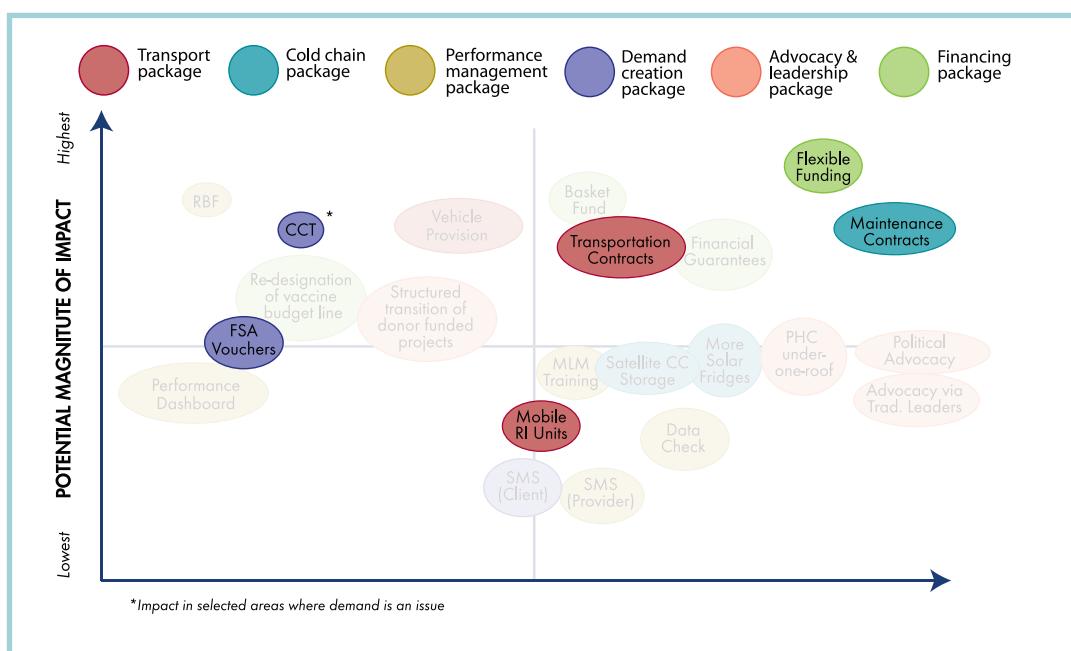
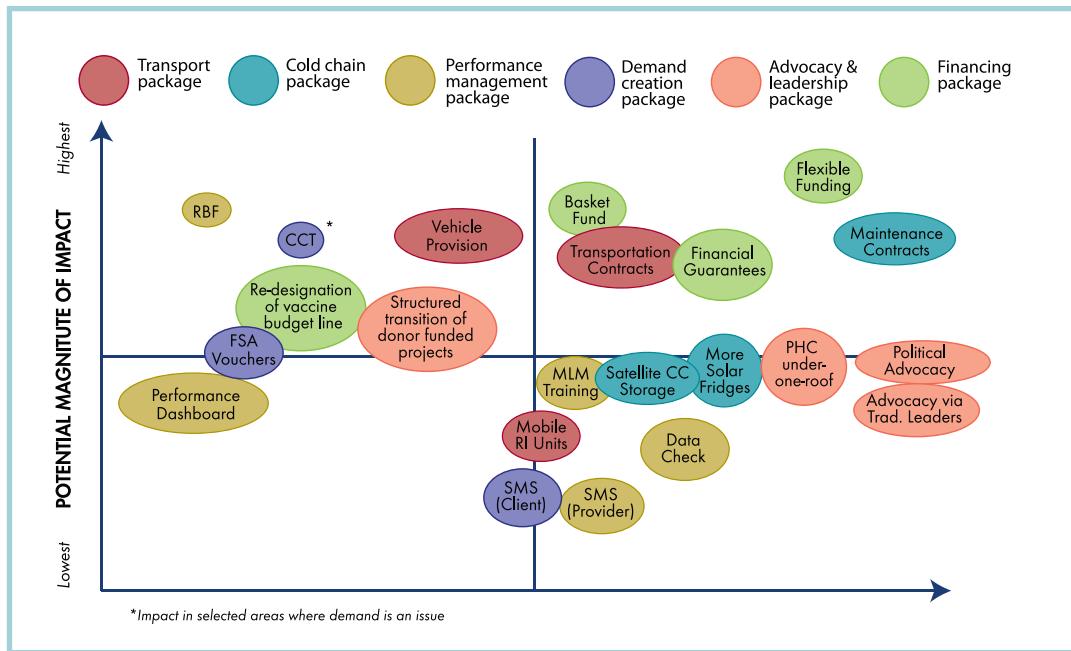
Ease of implementation vs. impact. With any intervention, a potential implemented needs to know whether it is feasible, and what kind of impact it can conceivably create. At the extremes, high-impact, high-feasibility interventions will be the highest priority, while interventions that are challenging to implement and return low coverage impacts will be lowest priority.

In the middle ground, however, a successful approach to system improvement will create a portfolio, making some investments in immediately feasible interventions with potentially lower impact, along with other investments that present greater challenge but have the

potential for greater return. An overall balance of risk and reward will allow for steady improvement alongside the leaps and bounds of high-impact innovations.

Our analysis, informed by survey respondents, expert feedback, and a review of the literature, finds that financing and logistics present promising opportunities for feasible, high-impact interventions at the national level. At the state and local levels, the analysis could look very different; this approach is simply a tool for on-the-ground decision-makers facing a range of choices.

EASE OF IMPLEMENTATION VS. IMPACT



Impact on underserved populations. While the high-impact, high-feasibility projects are the obvious targets, some projects with slightly lower impact may have the majority of that impact on underserved populations. For a decision-maker prioritizing improvements in overall equity, these projects might be higher-priority than they would initially appear.

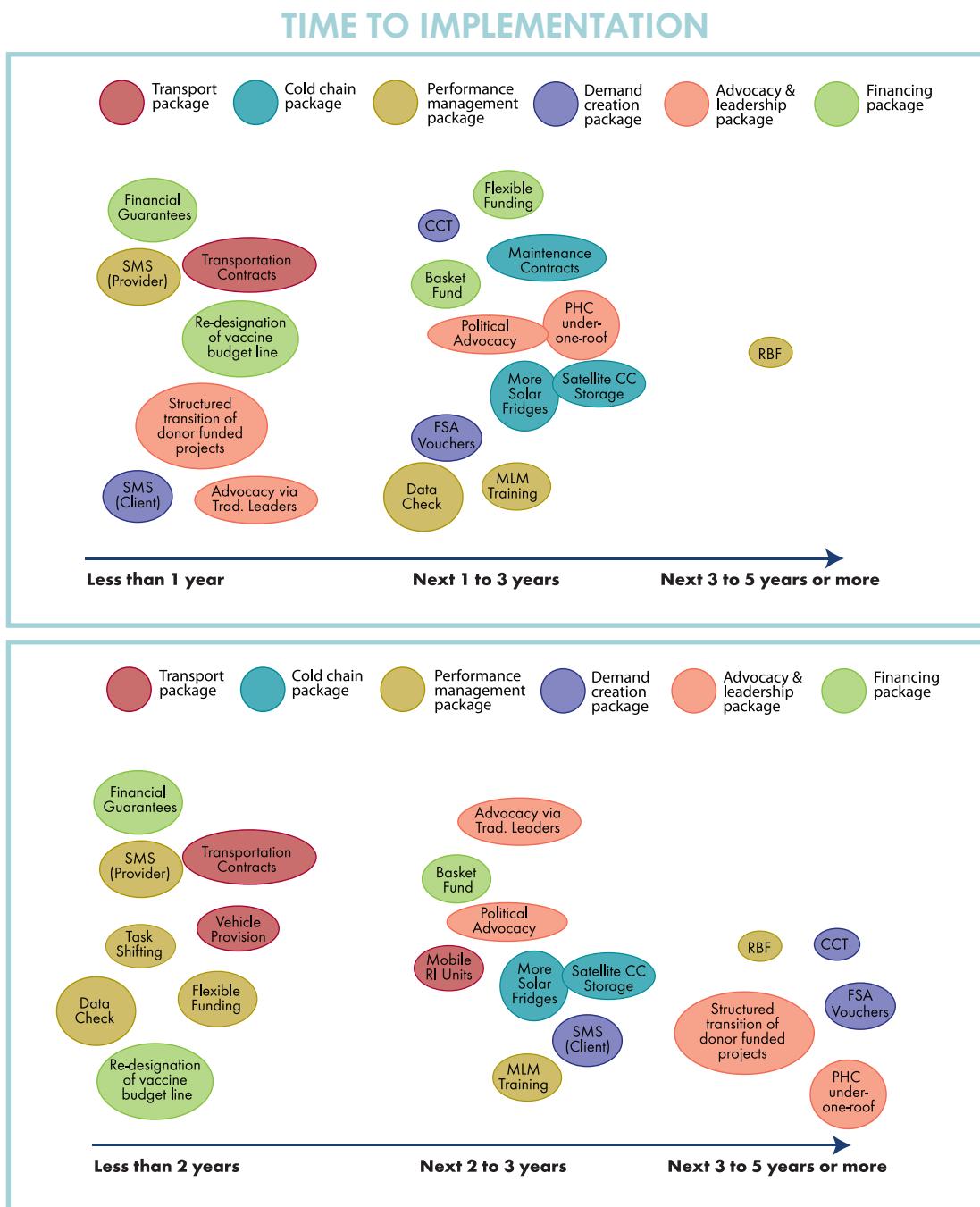
In our suite of interventions, the projects with most apparent benefits to underserved populations include maintenance and transportation contracts (including mobile RI units), flexible funding, and demand-side programs such as CCT and health care vouchers.

Time scale to implementation and to impact. Some interventions can be put in place relatively quickly, while others require long-term planning—but may also deliver long-term results. Again, the portfolio

approach is often appropriate, ensuring that progress is not stalled while long-term interventions are getting off the ground, but short-term fixes don't substitute for long-term improvement.

Time to implementation. In our analysis, the projects with first steps that could be begun immediately are divided across packages, with particularly short timelines for advocacy work and donor-implemented projects that are subject to fewer administrative hurdles.

It is important to note that the ability to begin work on a project immediately does not mean that the impact will be seen immediately. For instance, as demonstrated in the figure below, advocacy efforts are likely to bear fruit in the long term, even though they are some of the quickest interventions to implement.



Zero-cost interventions. A few interventions have essentially zero up-front costs; this is particularly relevant as cost barriers are often cited as roadblocks to service improvement. These solutions are adjustment of existing systems. For example, moving the national budget line from a capital to a recurring expense costs nothing, though the impact will be lessened if other systems are not strengthened.

Creating basket funds at the State level also costs nearly nothing, though there may be some increase in administrative costs. As with the national approach, impact will be lessened without other system improvements, and it requires high-level political commitment to be actualized.

Implementing stakeholder. Different stakeholders will have different resources and motivations, and some interventions require input and buy-in from a range of stakeholders. It is useful to consider the likely implementers of an intervention, articulating where the burden of implementation and evaluation will fall, as well as noting opportunities for cross-sectoral involvement.

Most components of our intervention packages could be implemented by more than one stakeholder. Donors and NGOs are often the immediate choice, but many interventions could also be housed in government agencies, or could be transitioned to government agencies after an initial period of donor/NGO ownership.

5 CONCLUSIONS

Our analysis drew from seven states and the FCT in order to represent a range of geopolitical contexts. In each state, we found the same issues highlighted repeatedly: governance, transportation, and cold chain. Through respondent suggestions, expert feedback, and a review of the literature, we were able to identify a range of possible interventions to address these recurring issues across settings and contexts. Due to the homogeneity of barriers reported across states, this analysis took a national perspective. However, we hope and

anticipate that this analysis can also be used as a tool to support decision makers on the ground in states and LGAs, aiding them in an effort to strategically apply their depth of local knowledge to address immunization in their communities.

While the national perspective was appropriate to the data we collected, the marked heterogeneity in immunization coverage across Nigeria indicates that there are still state- and LGA-level differences at work. This analysis identified some state-level considerations, but the similarities between responses across states were more apparent than the differences. The small sample size and the qualitative nature of this study made it difficult to characterize priorities of a particular state as respondents often had differing views based on their function.

The similarities across states may be due in part to the fact that respondents themselves have difficulty in pinpointing the most relevant barriers at any particular level. It is likely also due to the need for a richer contextual analysis. Current data at the state and LGA level are generally lacking, and mediating factors such as market access, poverty level, competing health concerns, and community and household dynamics may have a greater effect on RI coverage than has been captured here. Continued research may provide insight into these factors.

At the structural level, there is a lack of information about the knowledge, attitudes, and practices of government officials and parliamentarians. It is difficult to say whether lack of support or outright resistance to RI, when it occurs, is a function of poor information, personal beliefs, or competing political concerns. IVAC is in the preliminary stages of a KAP analysis focused on the Nigerian Parliament and other key high-level decision makers. This analysis, when complete, will improve our understanding of high-level levers for action; the ultimate goal is to understand the factors that will lead to sustained and stable political support for RI across parties and regions.



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