



Improving Vaccination Distribution Systems to Reach the Last Mile in Mozambique

(also referred to as the National Expansion of the PAV Support System)

Prepared by VillageReach in collaboration with the
Mozambique Ministry of Health (MISAU)

March 13, 2009

List of Acronyms

BCG	Bacillus Calmette-Guérin
DHS	Demographic and Health Survey
DPS	Dirreção Distrital de Saúde (Provincial Directorate of Health)
DPT	Diphtheria Pertussis Tetanus
FDC	Foundation for Community Development
LPG	Liquefied Petroleum Gas
MIS	Management Information System
MISAU	Ministério da Saúde (Ministry of Health)
PAV	Programa Alargado de Vacinação (Expanded Program on Immunization)
RED	Reach Every District

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Executive Summary

Globally, most remaining deaths from vaccine preventable and other preventable diseases occur in poor rural areas in developing countries. A major barrier to effective access to immunization and adequate care is the inability of the logistics and supply systems to reach the remote communities. The result is that critical vaccines, medicines and supplies are only sporadically available or unavailable.

In 2001 VillageReach, an international nongovernmental organization that specializes in implementing systems to deliver medical supplies and goods to remote, underserved communities, partnered with the Foundation for Community Development (FDC) to conduct an assessment and determined that logistics, availability of information, and supervision issues were major impediments to the effective delivery of immunization services in Mozambique. From 2002-2007 VillageReach, the Mozambique Ministry of Health (MISAU), and FDC undertook a successful pilot project to improve vaccination coverage in rural health centers in Cabo Delgado. In 2006, the partners expanded the project to Nampula province. The project developed and implemented an innovative approach to medical logistics and supply, improved information management and supportive supervision (PAV Support System). During the Cabo Delgado pilot project, diphtheria, pertussis and tetanus (DPT3) coverage rates increased from 68.9% to 95.4% and vaccine stock outs fell from 80% to 1%. In October 2008, the Minister of Health in Mozambique decided to expand the successful pilot into a national strategy, fully integrated with MISAU's overall health strategy and goals.

The PAV Support System will increase access to vaccines for last mile health units by strengthening the rural level of the health system through the provision of high quality logistics, information management, and supportive supervision. MISAU has determined that all provinces in Mozambique would benefit from a national expansion of the PAV Support System. After institutionalizing the system in Cabo Delgado and Nampula, the remaining provinces of Niassa, Tete, Zambézia, Manica, Sofala, Inhambane, Gaza, and Maputo will be included in a national expansion strategy. MISAU has agreed that the national expansion will be implemented with technical support from FDC and VillageReach on a province-by-province basis.

The national expansion of the PAV Support System has been designed to maximize its sustainability after VillageReach concludes its technical support. To achieve sustainability, VillageReach proposes MISAU reallocate resources (human, equipment, and financial) already devoted to logistics, supervision, and information management rather than require new inputs of people, equipment and funds. VillageReach believes this reallocation will be cost-effective or cost-saving (formal cost studies are in progress) and will result in much improved outcomes measured, for example, by vaccine stock outs and immunization coverage rates.

This proposal outlines Phase I of the national expansion of the PAV Support System in Niassa and Tete, with technical support from VillageReach in these provinces. VillageReach also proposes in Cabo Delgado to evaluate an alternative approach to the logistics and distribution solution proven in the Cabo Delgado pilot project. The alternative approach is district-based storage with teams operating out of the districts to distribute vaccines to the health units.

Implementation of these innovative strategies for logistics and supply will improve access and quality of care for rural families in Mozambique and support the achievement of Millennium Development Goals #4 to reduce child mortality and #5 to improve maternal health. The implementation will also support the Reach Every District (RED) immunization strategy now being implemented by MISAU and its partners. Furthermore, it will enable MISAU to refine its medical supply system to rural health centers based on lessons learned during the expansion.

¹ In Portuguese-speaking Mozambique, the Expanded Program on Immunization is called Programa Alargado de Vacinação or PAV.

I. Statement of Need

Each year 2.4 million children die from vaccine preventable diseases, such as pneumonia. The vast majority are in countries such as Mozambique where poverty and infrastructural constraints limit access to good quality health services. A major problem is distribution: getting vaccines and medical supplies out into the rural areas of developing countries. Up to 70% of the developing world lives in rural areas where threats to good health are the greatest due to limited access to clean water, reliable food supplies, and healthcare. Reaching those rural areas makes the cost of delivering and administering medical supplies five times higher than in urban areas because of the complex logistics and lack of infrastructure.

At the initiation of VillageReach activities in Mozambique, an analysis of impediments to the effectiveness of the immunization system demonstrated that logistics and supply, information management and lack of supportive supervision were major constraints in Mozambique. Like many developing countries, Mozambique faces the challenges of infrastructure, systems, and capacities in order to successfully combat preventable diseases. In Mozambique, health facilities experience frequent stock outs of vaccines and supplies. For example, the 2009-2013 PAV Strategic Plan reports national stock outs of BCG vaccine for measles in 2008. Many rural facilities lack access to energy to provide the most basic necessities: lights for nighttime medical emergencies, refrigeration to store vaccines, and proper sterilization and disposal of needles and other medical equipment. Nearly half of the population lives more than ten kilometers from the nearest health facility. The variability of health services and undependable availability of supplies have resulted in decreased confidence in the health system, particularly at the rural level. The PAV 2009-2013 PAV Strategic Plan also notes a 52% drop out rate of more than 10% for DPT1-DPT3.

The Government of Mozambique, specifically MISAU, recognizes the importance of addressing issues of logistics and management of medical commodities in order to be prepared to accommodate the existing and new technologies and medicines that can help save lives in the 21st century. New technologies and innovations are in the pipeline to address major public health issues, but these technologies will be more demanding on health systems due to more difficult cold chain and storage requirements, larger physical size, higher cost of introduction, and increasingly complex logistics challenges. As a result, an “innovation pile-up” or “technology traffic jam,” where the existing health system is unable to incorporate innovations in medicine and technology, is predicted for most developing countries. Without strong logistics and distribution systems, the coming beneficial innovations may not reach those who need them most. Mozambique’s national introduction of the pentavalent vaccine is an example of this type of technology traffic jam because of the multitude of new logistics and cold chain demands the vaccine requires.

II. Background

The Cabo Delgado Pilot Project

After a year-long study, in March 2002, MISAU, VillageReach and FDC began a five-year pilot project (extending from April 2002 to March 2007). In the project, MISAU, VillageReach and FDC, in coordination with PAV and the Provincial Directorate of Health (DPS) of Cabo Delgado established three teams of one field coordinator and one driver to oversee the vaccine logistics system. Once a month this team distributed vaccines, liquefied petroleum gas (also known as propane or LPG), syringes, medicines and other essential medical supplies to all health facilities providing immunization, approximately five or six districts and their outreach workers per distribution team.

The functional teams utilized methodologies and management information system (MIS) tools developed by MISAU, FDC, and VillageReach. Field coordinators were staff allocated by DPS, which was a program refinement for the expansion to Nampula designed to increase sustainability. VillageReach trains and manages the field coordinators until the system is in place, understood, and working effectively. This functional team is flexible and can operate at a provincial and/or district level, depending on the existing infrastructure and the distances to the health centers. It capitalizes on building the capacity of the workers at the health unit level. In August 2006, the pilot project was expanded into a second northern province, Nampula.

To develop the infrastructure necessary to support the cold chain of the health system VillageReach and FDC formed VidaGas, a social business to import and distribute propane for gas refrigerators in northern Mozambique. Through a public-private initiative with MISAU, VidaGas supplied propane to health centers and hospitals, as well as to private customers, in Cabo Delgado.

The pilot project in Cabo Delgado and expansion into Nampula, referred to in Mozambique as the Project to Support PAV, developed and implemented a system that strengthened the management, reliability and quality of the health system through improvements in the following areas:

- Service Infrastructure: to ensure a well functioning cold chain throughout the distribution system.
- Distribution and Logistics: stock control and security, forecasting and reporting, inventory management, distribution of medicines and health supplies.
- Management Information System: tools to record, track, and analyze specific logistics and PAV indicators.
- Supportive supervision: field coordinators provide supportive supervision to district and health center workers, including reviewing data, answering questions, providing on-the-job training.
- Social Mobilization – involving the community in taking charge of their health. For example, trainings for community leaders, health workers, and mothers.

While there are other projects that have worked in the field of medical logistics and transportation, the Cabo Delgado pilot project addressed this issue by focusing on reaching the “last mile.” Whereas other projects focus on the “top” of the distribution system, the pilot projects’ unique, innovative approach focused on strengthening the “bottom” or periphery of the health system where real impact was achieved. In November 2008, VillageReach released the results of an impact evaluation of the Project to Support PAV in Cabo Delgado (Cabo Delgado Evaluation).² In 2003, the Demographic and Health Survey (DHS) reported a DPT3 coverage rate in Cabo Delgado of 68.9%. In the 2008 evaluation, DPT3 coverage had increased to 95.4% for children aged 24-35 months. All other vaccines had similar increases resulting in a 92.8% coverage rate for all vaccinations given to children age 24-35 months. Regularly less than 1% of health centers reported a stock-out in 2006 compared to almost 80% in 2004. Field coordinators reliably visited over 90% of the health centers every month. 92.6% of the health centers visited had reliable and easy to maintain gas or gas/electric refrigerators provided by the project. Overall the impact evaluation found the following:

² Kane, M., Leach-Kemon, K., Dionisio, M., & Taimo, N. (2008). *Evaluation of the Project to Support PAV (Expanded Program on Immunization) In Northern Mozambique, 2001-2008: Statistical Analysis*. Seattle: VillageReach.

- Increased vaccination coverage for the last mile by improving stock control, forecasting and reporting, inventory management, distribution of health goods, data management, and supportive supervision of health workers.
- Improved quality of health services and access to vaccines by dramatically reducing stock outs and directly improving the cold chain by ensuring that refrigerators were in working order.
- Increased knowledge of, trust in, and use of health services.
- Replicable pilot, as seen in the replication in Nampula, currently being implemented by FDC.

As a result, MISAU officially accepted and promoted an expansion of the project to a national strategy and asked VillageReach to be a partner in the expansion. In December 2008, MISAU and VillageReach held a meeting with the primary governmental and non-governmental stakeholders of PAV, who endorsed the national expansion of the PAV Support System. This expansion is in direct support of MISAU's policies, priorities and goals related to vaccination services. The national expansion is best implemented province by province and multiple provincial implementations may occur simultaneously. FDC and VillageReach will pursue separate implementations of the expansion to facilitate a national rollout on the fastest possible timeline without compromising quality.

In close collaboration with MISAU, VillageReach will work with DPS and other organizations working in Niassa, Tete, and Cabo Delgado to avoid duplication of activities, identify special needs, and make adaptations to the project model as necessary. In addition, MISAU will determine the implementation sequencing of each province. One mechanism for determining expansion priorities is to review vaccination coverage and dropout rates. This information will be considered along with the status of PAV infrastructure and capacity, population, number of health units offering PAV services, and other MISAU priorities.

III. Overall Goal:

To improve access to immunization and other primary healthcare services by adopting innovative approaches to logistics and supply, information management, and supervision and expanding them nationally.

IV. Objectives:

Objective 1: To strengthen rural level health units by establishing a functioning system in Niassa and Tete to meet logistics, information, and supervision needs within three years.

Objective 2: To pilot an alternative logistics and supply system in Cabo Delgado to assess the effectiveness of a district-based distribution system in two years.

PAV Support System Description

This proposal outlines Phase I of the national expansion, i.e., into Niassa and Tete. The PAV Support System will be established in these two provinces in a similar manner to the implementation in Cabo Delgado. In collaboration with MISAU and DPS, VillageReach will begin implementation of the expanded strategy. Based on the experience and lessons learned during implementation of the pilot project in Cabo Delgado, the PAV Support System has been refined to focus on the core functional areas where VillageReach can provide effective technical support to MISAU and DPS. These

activities include an effective logistics system for distribution of medicines and supplies, a MIS for collecting and analyzing data, and a supportive supervision system for health workers. The key to the system is the field team consisting of one field coordinator and driver to cover 30-40 health units. Past successful field coordinators have been experienced PAV staff, including retired staff, who are willing to travel in the province 10-14 days/month.

During the monthly trips to each health center providing immunizations, the field teams restock vaccines, syringes, medicines and health supplies, gather data for the MIS, and provide supportive supervision to the health workers in health units. The supportive supervision has proved very effective in on-site training for health workers on technical, logistical, or data questions. VillageReach will provide training in logistics, management information systems, equipment repair, and other technical areas during the scale-up period.

The PAV Support System will initially implement a distribution system based on provincial warehouses, which worked successfully in Cabo Delgado. In support of MISAU's interest in evaluating the most effective logistics system, the PAV Support System will evaluate the effectiveness of a district based alternative model in Cabo Delgado and compare to the results obtained from the province-based system as outlined in Objective 2 under the Implementation section below..

The PAV Support System is designed to complement existing MISAU strategies and goals. While the technical support from VillageReach will end after the completion of Phase I in three years, the monthly site visits and MIS are designed specifically for long-term sustainability through integration into regular MISAU activities.

The PAV Support System represents a first step in establishing a functioning medical supply distribution system at the health units. Each health unit can then act as a platform to support outreach teams. Because actual distribution of inventory must occur each month, the PAV Support System establishes a regular network to and from the last mile. Equipment servicing, data/information/knowledge, training and supportive supervision are then also carried through PAV network and the MIS. This grass-roots network has great potential for supporting and complementing other strategies focused on rural healthcare access such as the RED strategy and will support the achievement of Millennium Development Goals #4 and #5.

V. Implementation

Complementary roles of MISAU, DPS and VillageReach

MISAU, DPS and VillageReach all share the common goal of improving healthcare services in rural Mozambique, specifically improving vaccination coverage to 80% in all districts. MISAU, DPS and VillageReach have developed a strong partnership during the PAV strengthening program in Cabo Delgado and Nampula. MISAU's assignment of experienced staff to serve as field coordinators was a critical contribution to the success of the Nampula implementation. During strategy implementation, the key partner in the field is DPS, responsible for successful coordination of all activities in the province and raising problems at an early stage. VillageReach's role is as technical support to MISAU and DPS. VillageReach will provide technical support during the deployment and implementation of the PAV Support System. While the level of engagement may vary by province, VillageReach will work closely with DPS PAV staff to establish the PAV Support System. This includes assistance hiring and training the appropriate staff, establishing monthly visit routes and

protocols, effectively using data to support supply chain management and decision making, and carrying out monitoring and supervision.

For the national expansion, based on the Cabo Delgado pilot project, VillageReach proposes to provide technical support based on its core competencies: logistics management, management information system, and supportive supervision as discussed below. The flexibility in the system will allow for maximum customization to make the system locally relevant in all provinces of Mozambique. While these three activities form the core components of the PAV Support System, additional activities could be added as need and funding allow. Relevant activities include supporting social mobilization efforts through training health workers on community outreach strategies and tactics, provision of critical cold chain infrastructure or implementation of communication networks for health centers.

Objective 1: To strengthen rural level health units by establishing a functioning system in Niassa and Tete to meet logistics, information, and supervision needs within three years.

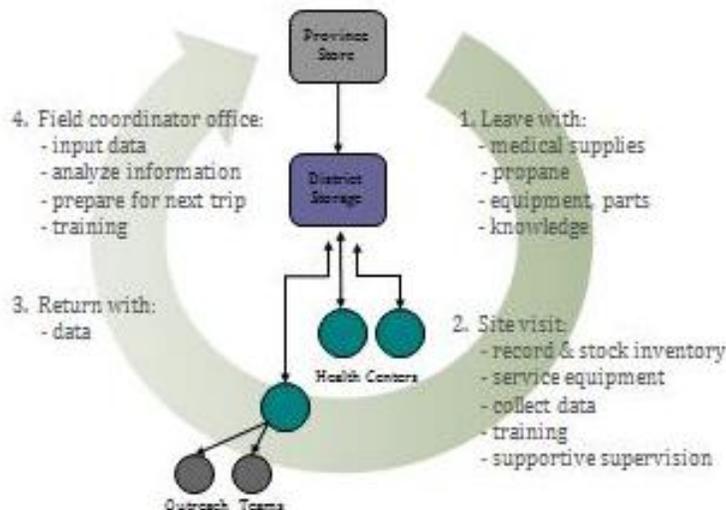
A. Logistics Management

Each field coordinator is responsible for a group of health units and related outreach teams and visits each health unit for which he is responsible on a monthly schedule. Diagram I below shows the activities and responsibilities of a field coordinator, shown as *groups 1-4*. He leaves his provincial office with the items shown in *group 1*, which includes vaccines, syringes, diluents, safety boxes, and energy for cold chain and other health center infrastructure use. The quantity of each item is based on forecasted need plus a small buffer. The field coordinator also distributes other goods, such as data forms, mosquito nets, other medicines, spare parts, and etc. The PAV Support System can systematically incorporate the distribution of these additional goods. Each field coordinator is also prepared with knowledge as he leaves the provincial store. He must have comprehensive knowledge of PAV policies, practices, systems and procedures at the health units.

At each health unit, the field coordinator performs a site visit covering activities identified in *group 2*. He distributes stock and records the inventory. Before distributing the goods, he works with the health worker responsible for PAV to review the ideal stock amounts for the health unit. They review any changes to forecasted need for the month (e.g., How will the planned mobile brigades affect the amount of stock needed during the month? How much top-up stock should be left to account for difficult access during the rainy season?) and adjusts the ideal stock amounts accordingly. Then, the field coordinator and health worker count the existing stock and he distributes the delta between existing and ideal stock. In this process, he records the ideal, existing, and distributed stock.

During the health unit visit, the field coordinator also collects data on other PAV activities including the status of the cold chain and other equipment, reasons for stock outs, and PAV data such as the number of children vaccinated, overall stock flow through the health unit, wastage rates, and coverage rates. The process of filling out the data forms aids in the training and supportive supervision activities.

Diagram 1: Responsibilities of the Field Coordinator



B. Deployment of a Management Information System

After visiting all the health units in his catchment, the field coordinator returns to the provincial office with data and information. When he leaves the provincial store, he leaves with information about policies and news from the provincial level and feeds that information to the district level. Similarly, he leaves the districts with information to share with the health units. The cycle continues as he moves back up from the health units to districts to province. As he moves, he carries information about the happenings and status of the health units and shares that information. This regular, cyclical sharing of real-time information leads to a greater understanding of the status of PAV services throughout the province and within the districts and therefore, the knowledge necessary to resolve problems and spread best practices.

Upon returning to his office with data and information collected during the site visit, the field coordinator will perform the tasks in *group 4*. Field coordinators use a MIS tool developed by VillageReach to enter and analyze data.³ The tool provides two types of reports that add to the field coordinator’s knowledge referred to in *group 1*. First, the tool produces an indicator report tracking the following indicators:

- Stock outs;
- Refrigerator problems;
- Health units visited;
- Delivery interval (the number of days between health unit visits)
- Complete delivery (the percentage of health units that received the full ideal stock amounts);
- Delivery costs;

³ The tool is an Internet-enabled, SQL, form-based application where customized code performs the complex data entry validations and analysis. Temporary internet connection and USB sticks are used to synchronize non-connected computers with the online database.

- Wastage rates;
- Vaccines administered;
- Dropout rates; and
- Supplies delivered and used.

The tool can produce reports over any time period requested to allow for identifying trends. The tool can also report on the indicators from a national level down to the health unit level to target problem areas. Reports on the indicators can be accessed through the application or via an internet browser.

The second report produced by the tool is an “auto evaluation report.” These reports identify health unit trends and actions to be taken by the field coordinator at each health center during the next visit. For example, if the health unit had a refrigerator problem at any given time for three months or more or at least three refrigerator problems in the last six months, the “auto evaluation report” will tell the field coordinator to follow-up to resolve the problem. Another example is when a health center receives their full ideal stock amount, yet experiences a stock out. In this situation, the report advises the field coordinator to review the ideal stock amounts for the health unit.

After producing the automated reports, the field coordinators meet with the PAV Chief for the province to review their activities and findings. They discuss and document what they found going well and the problems they discovered and they provide recommendations for resolving problems. With this analysis, they prepare for the next month’s health unit visits.

C. Supportive Supervision

VillageReach has defined supportive supervision as the process in which experienced technical staff assesses other staff members’ job performance, give positive and negative feedback and then work cooperatively with the staff to improve weaker performance areas. The field coordinators perform supportive supervision in all areas of PAV services as they identify the needs. They systematically perform supportive supervision in cold chain management, data collection and reporting, safe waste management, stock conservation, and general services management (e.g., is the area clean and organized?). As the field coordinator and health worker identify problems together, they also work to solve the problems together. For example, if they find that the refrigerator is not maintaining the correct temperature, the field coordinator will verify that the health worker knows the correct temperature for the refrigerator and teach the health worker how to maintain the refrigerator at the correct temperature. The Cabo Delgado Evaluation found supportive supervision one of the most important and memorable activities for the health workers, because they learned a lot from the field coordinators and gained a greater sense of empowerment in their jobs as health workers.

D. Support of RED

The PAV Support System will directly strengthen and complement the activities of RED in Niassa and Tete. For example, cluster surveys on vaccine coverage could be shared with districts where RED is being implemented. During the national expansion, MISAU, VillageReach and DPS will identify possible areas of collaboration with RED strategy activities. The improvements in logistics and supply, information system, and supportive supervision supported by VillageReach will improve the performance of districts implementing the RED strategy. VillageReach remains open to more extensive and specific work to improve RED performance if desired by MISAU and

partners. For example, VillageReach could expand its monitoring and evaluation activities to monitor outcomes in RED Districts. VillageReach is currently exploring the possibilities of an expanded role in relation to the RED strategy.

E. Steps towards implementation in Niassa and Tete:

- 1. Convene Stakeholder Meeting:** Convene a multiple stakeholder meeting in each province to facilitate a discussion of lessons learned from the project in Cabo Delgado and Nampula in the context of planning the current and future implementation of the PAV Support System while building ownership for the project in the province.
- 2. Customize the PAV Support System for the Province:** The meeting will be followed by an assessment during which the DPS and VillageReach will work closely together to deeply understand and analyze the challenges and needs of PAV in the province and jointly customize the PAV Support System for the provincial needs.
- 3. Create PAV Support System Implementation Plan:** The result of the assessment will be a detailed project implementation plan owned by the DPS as well as progress in some logistical activities to begin implementation.
- 4. Formalize Partnership and Roles:** Following approvals and adoption of the implementation plan, MISAU and DPS will sign memorandums of understanding with VillageReach and other system implementation partners as appropriate.
- 5. Secure Staff:** Once the above activities are complete, PAV Support System staff will be hired/assigned and trained. This includes three field coordinators and drivers in each province employed by DPS to operate the PAV Support System and a local VillageReach technical support staff person.
- 6. Conduct Baseline Assessment:** Implement a baseline assessment consisting of collecting data through cluster surveys for district level coverage rates and basic health center information. This baseline will be used to judge impact of the PAV Support System. The field coordinators will lead the data collection teams, which will further familiarize the field coordinators with the districts, build additional capacity at DPS to implement coverage rate studies, create ownership of the data to maximize the use of the data in operating and improving PAV, and serve as a mechanism for communicating the upcoming PAV Support System activities at the districts and health centers in the province. Other PAV and project staff and management will be involved in the baseline preparation, implementation, and completion activities. As such, the baseline study is an integrated component of the PAV Support System.
- 7. Establish PAV Support System Procedures:** During the baseline activities, DPS and VillageReach staff will set up the PAV Support System procedures including distribution routes, coordinating equipment inventory to ensure functioning cold chain equipment at each health center, and partnership roles and responsibilities.
- 8. Conduct PAV Support System Training:** DPS staff undergo training to implement the PAV Support System including the system methodology and operations, techniques for supportive supervision, and use of the MIS.

- 9. Implement Monthly Site Visits from Field Staff:** The field staff will begin the vaccine distribution and the accompanying supportive supervision, and data collection. During this phase, districts and health units will receive monthly visits for vaccine and other medical supply distribution, supportive supervision, and data collection and analysis.
- 10. Deploy Management Information System:** Once the monthly site visits begin, the field coordinators and other DPS and MISAU staff will use the MIS for data collection and analysis to support better inventory management and forecasting.
- 11. Design On-the-Job Health Worker Trainings:** The PAV Support System staff will offer additional trainings each year to advance and formalize the health worker skills in PAV operations and management. Activities specifically targeted to build district capacity will also be carried out including trainings for financial management and execution and building district capacity in PAV logistics, supportive supervision, and data analysis and use.
- 12. Phase Out VillageReach Province Staff Person:** At the end of the agreed upon timeline, generally three years, the VillageReach technical support staff person will transition out of the PAV Support System activities. As is indicated in the system staffing and activities, the transition will be planned from the beginning of the project. The transition to will be closely monitored by VillageReach to ensure DPS maintains a high-quality system without on-site technical support.
- 13. Conduct Final Evaluation:** Following the transition, a final evaluation will be conducted including a district level coverage rate survey to discern the impact of the implementation of the PAV Support System.

F. Timeline for Objective 1

The duration of Phase I of the national expansion will be three years for Niassa and Tete. The timeline for the activities in Cabo Delgado follows in the section describing Objective 2 below.

Table 1: Timeline for Niassa and Tete

Activities	Year 1				Year 2				Year 3			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
New Province 1												
Sign MOU with MISAU for provincial activities												
Sign MOU with DPS												
Hire / assign system staff												
Conduct baseline and collect basic information for activity planning												
Coordinate equipment placement												
Set up system and partnership procedures												
System Staff Training												
Train DPS Staff												
Implement monthly site visits												
Transition out VillageReach on-site technical support												

Objective 2: To pilot an alternative logistics and supply system in Cabo Delgado to assess the effectiveness of a district-based system in two years.

As described above, the Cabo Delgado pilot project was implemented using a province-based distribution system, and the success of the project was proven with an extensive and rigorous evaluation. During and after the project, Mozambique has made great strides to decentralize health and general government activities to the district level. VillageReach believes the PAV Support System can be operated at different levels of the health system. As a result of the five-year pilot project, significant capacity exists in Cabo Delgado for proper management of vaccine logistics activities. Therefore, Cabo Delgado is a prime location for testing the effectiveness and efficiency of district-based distribution systems.

A. Steps towards implementation in Cabo Delgado:

- 1. Convene Stakeholder Meeting:** Convene a multiple stakeholder meeting in the province to facilitate a discussion of lessons learned from the project in Cabo Delgado in the context of planning the institutionalization of the PAV Support System and study of the effectiveness of an alternative distribution system. The meeting will discuss any refinements that need to be made to the activities to fit the current state of PAV and logistics in the province.

2. **Create PAV Support System and Study Implementation Plan:** The result of the stakeholder meeting will be a detailed project implementation plan owned by the DPS as well as progress in some logistical activities to begin implementation.
3. **Formalize Partnership and Roles:** Following approvals and adoption of the implementation plan, MISAU and DPS will sign memorandums of understanding with VillageReach and other system and study implementation partners as appropriate.
4. **Institutionalize the PAV Support System:** As a foundation for the study, VillageReach will help Cabo Delgado institutionalize the PAV Support System. This will allow comparison between the different distribution systems within the province. Having comparison groups within the same province is essential to the study as they will enable comparing different systems operating within similar circumstances and environments.

To institutionalize the PAV Support System, VillageReach proposes that the following activities take place:

- a. Re-assign field coordinators the responsibility for PAV Support System activities.
 - b. Re-assign the vehicles from the pilot project for the use of PAV Support System activities and designate the use of the vehicles to ensure they are maintained and available for the activities.
 - c. Disburse funds for fuel and per diems for the monthly site visits.
 - d. Deploy the MIS in the province.
5. **Build District Capacity to Operate a District-Based System:** After Cabo Delgado institutionalizes the PAV Support System activities, the districts in the South Zone will undergo formal and on-the job training to operate a district-based system. The capacity building will start with formal training to understand the activities, processes, and skills required for the logistics, information management, and supportive supervision. Following the training, district PAV staff will accompany the field coordinators to the site visits for three months. By accompanying the field coordinators for the site visits in their district, they will gain on-the-job training and perform the activities with the support of the field coordinator.
 6. **Operate a District-Based Distribution System:** For 15 months, the PAV Support System for the South Zone will operate based out of the districts. During this period, district PAV staff will travel to the provincial warehouse and pick up the vaccines and supplies for the province and then distribute them to the health units in their districts. The field coordinator based out of the zone will then provide supervision of the process. During this period, the logistical and PAV indicators described in the Monitoring and Evaluation section of this proposal will be closely monitored and the activities will be reviewed monthly to understand the advantages and disadvantages of this district-based distribution system.
 7. **Report on the District-Based Distribution System:** VillageReach will prepare a report on the effectiveness and efficiency of the district-based distribution system at the conclusion of the 15 months of operation. The evaluation will examine the effect of the system on the

project indicators as well as qualitative feedback from DPS PAV management, the field coordinators, and health units in the South Zone. The evaluation will also examine the efficiency using a cost model to determine the logistics costs of distributing one vaccine (vial and dose) using the district-based distribution system. This cost information will then be carefully compared against the indicators to place it in context.

8. **Use Study Results to Refine the PAV Support System:** Based MISAU’s evaluation of the results and availability of resources, the successful elements of the district-based distribution system will be extended to the other locations where the PAV Support System is implemented.

B. Timeline for Objective 2

The pilot of alternative distribution will take place over two years in Cabo Delgado. The activities will begin with the availability of funding.

Table 2: Timeline for Alternative Distribution System Study

Activities	Year 1				Year 2			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Sign MOU with MISAU for Cabo Delgado activities								
Sign MOU with DPS								
Institutionalize PAV Support System								
Build district capacity to operate a district-based system								
Operate a district-based distribution system								
Report on the District-Based Distribution System								

VI. Outcomes

For Objective 1, the specific outcomes of the expansion of PAV into Niassa and Tete are the following:

- Increase healthy worker productivity at the district and health center levels
- Increase quality of health services
- Increase access to and reach of health services
- Increase trust in and use of health services
- Decrease morbidity and mortality from vaccine-preventable diseases

For Objective 2, the specific outcomes of the PAV Support System and alternative distribution systems in Cabo Delgado are the same as above for Objective 1 and the following:

- Improve knowledge of the most effective and efficient distribution system in Mozambique.

VII. Monitoring and Evaluation

The baseline study will determine vaccination coverage rates as a starting point for the expansion of the PAV Support System. The following indicators will be reported, analyzed, and monitored each month: vaccine stock outs, regular health center visits, regular and consistent vaccine supply, refrigerator “up” time, wastage rates, cost-effectiveness, and data management. They form the basis of the monthly report from each health center, which is fed into the data management system at the provincial level and serves as the basis for project monitoring and measuring outcomes.

The Cabo Delgado pilot project showed significant impact on the designated indicators. Similar outcomes are to be expected in Niassa and Tete and in future provinces in which the expansion is implemented. As has been done in the Cabo Delgado pilot project, indicators will be reported, analyzed and monitored every month as part of the project’s data management activities. Based on the success of the pilot project, the following targets have been set for all provinces where the system will operate:

- *Vaccine Stock Outs.* In Cabo Delgado, vaccine stock outs were reduced from over 80% at the start of the project to regularly 1% or below. Similarly in Nampula, vaccine stock outs were reduced from 40% to 4% or below. Accordingly, the goal of maintaining vaccine stock out rates below 4% on a monthly basis in all provinces has been set.
- *Regular Health Unit Visits.* The PAV Support System seeks to visit 100% of all health units every month for the distribution and supportive supervision. Due to inaccessibility during the rainy season, however, this goal is often not achievable. Consequently, the goal is to visit at least 90% of all health centers every month. This target was met in the pilot project in Cabo Delgado and is a key factor in its success.
- *Regular and Consistent Vaccine Supply.* The PAV Support System expects to visit every health unit within an interval of 33 days or less. Frequent visits are a way to prevent stock outs while minimizing wastage. Pilot project performance held up to this high standard with some exceptions for upstream supply problems and holiday seasons.
- *Refrigerator Up-Time.* With the regular visits and training of health unit staff, the pilot project successfully kept the percent of refrigerators experiencing a problem during a month below 4%. This same outcome is expected in all future provinces.
- *Wastage Rates.* Based on success in Cabo Delgado, the open and closed vial wastage rates will remain within MISAU criteria for each vaccine type. Regular health unit visits ensure this indicator goal is feasible.
- *Cost-Effectiveness.* In Cabo Delgado, the cost of deliveries over the full project period was \$0.68 per child fully vaccinated. The costs of deliveries should stay at \$0.65 or less per child fully vaccinated during the project period in all provinces where the PAV Support System is implemented. This cost includes only the costs of distributing the vaccines from DPS to the health units. Included in this amount are per diems, fuel, vehicle maintenance and supplies. The figure does not include salary costs of field coordinators/drivers or the cost of vaccines.

- *Data Management.* The MIS will be installed to support data-based decision making in 100% of the districts where the PAV Support System operates.

In addition to the monthly collection and monitoring of data, a household survey will be implemented at both the beginning and end of the project to assess vaccination coverage rates by district. Based on the increase seen in Cabo Delgado as a result of the pilot project, the following outcome can be expected:

- *Vaccination Coverage Rate.* The impact evaluation shows the pilot project increased DPT3 vaccination rates in Cabo Delgado province to over 95%. During the national expansion, it is expected that vaccination rates will increase in each participating province to reach at a minimum MISAU's goal 80% coverage in each district.

VillageReach will conduct additional monitoring and evaluation activities for objective two. To monitor the district-based distribution system in Cabo Delgado, VillageReach will evaluate the above 9 indicators monthly and conduct monthly review meetings of the activities to analyze the indicator data and qualitative feedback from DPS PAV management, field coordinators, and health workers in the zone where the systems are piloted.

VillageReach will not conduct vaccination coverage rate studies in the Cabo Delgado, having recently completed a study in late 2008. However, it will conduct a cost study to understand the incremental logistics cost of distributing a vaccine (vial and dose) in the district-based distribution system. Together with the indicator and qualitative data analyzed above, the effectiveness and efficiency of the two alternative distribution systems will be evaluated. At the conclusion of the district-based distribution system study, an evaluation report will be produced.

VIII. Budget and Justification

The PAV Support System consists of a core set of activities that can be combined and refined for effective implementation in every province of Mozambique. For each provincial activity there are three main categories of expenses:

- Infrastructure (e.g., vehicles)
- Operating Costs (e.g., salaries and fuel costs)
- VillageReach Management Expenses

Below is a total budget with costs for PAV Support System expansion in Niassa and Tete and for a district-based distribution study in Cabo Delgado. These figures are based on the costs from the implementation of the pilot in Cabo Delgado and projected for these provinces. These PAV Support System expansion costs will be shared by MISAU and VillageReach. As a step towards long-term sustainability, it is proposed that the PAV Support System infrastructure and operating costs be supported by MISAU. The VillageReach technical support costs will be funded through donors and contributions from partners. The respective budgets for Niassa, Tete, and Cabo Delgado and their justifications are presented in the following sections. It should be noted that these costs will vary according to which province is undertaken first (i.e., start-up costs in the first province will not need to be repeated in the subsequent provinces). This is particularly applicable to the VillageReach technical support costs. The detailed budgets are sequenced with Niassa as the start-up province, followed by Tete, and then Cabo Delgado. If the implementation is conducted in any other order, the budgets must be adjusted accordingly.

PAV Support System Expansion: Budget Summary

Province	Year 1	Year 2	Year 3	Total Expense by Province
Niassa				
Activities Supported by MISAU	\$309,344	\$78,800	\$172,984	\$561,128
Activities Supported by VillageReach	\$445,807	\$368,462	\$371,847	\$1,186,116
Sub-total				\$1,747,244
Tete				
Activities Supported by MISAU	\$309,344	\$78,800	\$172,984	\$561,128
Activities Supported by VillageReach	\$316,800	\$296,004	\$295,766	\$908,570
Sub-total				\$1,469,698
Cabo Delgado				
Activities Supported by MISAU	\$47,000	\$47,000	\$0	\$94,000
Activities Supported by VillageReach	\$120,000	\$98,928	\$0	\$218,928
Sub-total				\$312,928
Sub-total: MISAU Expenses	\$665,688	\$204,600	\$345,968	\$1,216,256
Sub-total: VillageReach Expenses	\$882,607	\$763,394	\$667,613	\$2,313,614
Total	\$1,548,295	\$967,994	\$1,013,581	\$3,529,870

A. Niassa: First Province for National Expansion Supported by VillageReach

Niassa is Mozambique’s largest geographic province and least populated. Niassa’s population of 1,178,117 is spread over an area of 129,050 km², which corresponds to a density of 9 inhabitants per km². With a life expectancy of 44.7 years and a GDP per capita of \$87, Niassa is very poor and rural province. Over 65% of the population in the province is illiterate and the average woman has 7.2 children in her lifetime.

Niassa has 98 health units in 15 districts. Although 75.4% of births take place in a health facility, the health units are few and far between and there is an average of only 0.7 hospital beds per 1,000 people in the province. The difficult access to healthcare is evidenced in high a maternal mortality rate of 0.2% and infant mortality rate of 18.4%. Nearly half of the children under five years in the province are malnourished. A 2005 survey found Niassa had a 55.6% DPT3 coverage rate and a 24.4% drop out rate (BCG – Measles). The low coverage rate and high dropout rate indicates that PAV services in the province will benefit from the PAV Support System working in coordination with other efforts to improve services in the province.

PAV Support System: Expansion to Niassa Province Budget

Activities	Year 1	Year 2	Year 3	Category Total
Supported by MISAU				
Ongoing Operating Expenses				
Field Coordinators and Drivers	\$9,000	\$9,000	\$9,000	\$27,000
Field Operations Costs	\$38,000	\$38,000	\$38,000	\$114,000
Delivery Vehicles	\$126,360	\$0	\$0	\$126,360
Coverage Rate Studies	\$104,184	\$0	\$94,184	\$198,368
Trainings	\$31,800	\$31,800	\$31,800	\$95,400
Sub-total	\$309,344	\$78,800	\$172,984	\$561,128
Supported by VillageReach				
VillageReach Management Expenses				
VillageReach Technical Support	\$328,607	\$328,432	\$342,347	\$999,386
Field Training, Monitoring, Supervision, & Support	\$42,200	\$35,030	\$24,500	\$101,730
MIS3	\$75,000	\$5,000	\$5,000	\$85,000
Sub-total	\$445,807	\$368,462	\$371,847	\$1,186,116
Total	\$755,151	\$447,262	\$544,831	\$1,747,244

Budget Justification: Niassa

Ongoing operating expense: Ongoing operating expenses include the salaries of the field staff as well as the field operations costs. The field staff consists of three field coordinators at an annual salary of \$1,800 each and three drivers at an annual salary of \$1,200 each. The field operations costs include fuel (\$13,500 annually), per diems (\$15,700 annually), supplies (\$4,600 annually) and vehicle maintenance (\$4,200 annually) for the monthly health center visits. The cost estimates in this budget are based on the Cabo Delgado pilot project costs. Actual expenses may vary or be significantly reduced based upon MISAU’s ability to re-allocate resources to support these activities.

Delivery vehicles: The PAV Support System requires one delivery vehicle for each field team. Therefore, Niassa will require three dedicated vehicles for delivery and supportive supervision. This budget includes estimates for three Land Rover trucks that are appropriate for travel in harsh, rural conditions and equipped with radios for communication. Each truck is budgeted at \$42,120 for a total of \$126,360. It is also possible these vehicles could be re-allocated from other MISAU activities.

Coverage rate studies: In order to assess need and impact, coverage rate studies must be performed at the initial implementation of the program as well as in the third year of implementation. The costs in the coverage rate studies line item are based on VillageReach estimates for comprehensive coverage rate studies, which include travel costs for the field work (\$8,200), consultant expenses to manage the study (\$5,000), and field staff and equipment expenses for the field work (\$90,984).

Trainings: The trainings category includes expenses for one health worker training per zone per year (\$7,500 per training with 25 attendees per training, 3 trainings a year) and two district trainings per zone per year (\$1,550 per training with 8 attendees per training, 6 trainings a year). The main expenses for trainings are per diems and training materials.

VillageReach management expenses: VillageReach management expenses include VillageReach technical support and field training, monitoring, supervision and support. VillageReach technical support includes all of the VillageReach organizational expenses necessary to support the program; this includes VillageReach staff time and resources from both Mozambique and Seattle. This budget includes a portion of the program manager and administrative support from Seattle, the country director and accountant in Maputo as well as a project manager in Niassa. In addition to staff time, this budget includes a portion of the VillageReach operational expenses necessary to support these staff members. The field training, monitoring, supervision and support include travel expenses for four trips to the Niassa field sites by international staff and four trips to by domestic staff.

MIS3: This budget includes development expenses to refine the MIS for deployment in Niassa in the initial year of implementation. After this deployment, the budget includes maintenance and technical support expenses for the remaining two years.

B. Tete: Second Province for National Expansion Supported by VillageReach

Tete has a population of 1,832,339 spread over an area of 100,724 km², which corresponds to a density of 18 inhabitants per km². With a life expectancy of 44.3 years and a GDP per capita of \$86, Tete is very poor and rural province. 57% of the population in the province is illiterate and the average woman has 6.9 children in her lifetime.

Tete has 81 health units in 12 districts. Less than half of births in the province take place in a health facility and the health units are great distances with an average of only 0.9 hospital beds per 1,000 people in the province. A maternal mortality rate of 0.1% and infant mortality rate of 12.5% are symptoms of the health problems in the province. Nearly half of the children under five years in the province are malnourished. A 2005 survey found that Tete had a 60.5% DPT3 coverage rate and a 29.6% drop out rate (BCG – Measles). The low coverage rate and high dropout rate indicates that PAV services in the province will benefit from the PAV Support System working in coordination with other efforts to improve services in the province.

PAV Support System: Expansion to Tete Province Budget

Activities	Year 1	Year 2	Year 3	Category Total
Supported by MISAU				
Ongoing Operating Expenses				
Field Coordinators and Drivers	\$9,000	\$9,000	\$9,000	\$27,000
Field Operations Costs	\$38,000	\$38,000	\$38,000	\$114,000
Delivery Vehicles	\$126,360	\$0	\$0	\$126,360
Coverage Rate Studies	\$104,184	\$0	\$94,184	\$198,368
Trainings	\$31,800	\$31,800	\$31,800	\$95,400
Sub-total	\$309,344	\$78,800	\$172,984	\$561,128
Supported by VillageReach				
VillageReach Management Expenses				
VillageReach Technical Support	\$249,600	\$255,974	\$266,266	\$771,840
Field Training, Monitoring, Supervision, & Support	\$42,200	\$35,030	\$24,500	\$101,730
MIS3	\$25,000	\$5,000	\$5,000	\$35,000
Sub-total	\$316,800	\$296,004	\$295,766	\$908,570
Total Expenses	\$626,144	\$374,804	\$468,750	\$1,469,698

Budget Justification: Tete

Ongoing operating expense: Ongoing operating expenses include the salaries of the field staff as well as the field operations costs. The field staff consists of three field coordinators at an annual salary of \$1,800 each and three drivers at an annual salary of \$1,200 each. The field operations costs include fuel (\$13,500 annually), per diems (\$15,700 annually), supplies (\$4,600 annually) and vehicle maintenance (\$4,200 annually) for the monthly health center visits. The cost estimates in this budget are based on the Cabo Delgado pilot costs. Actual expenses may vary or be significantly reduced based upon MISAU's ability to re-allocate resources to support these activities.

Delivery vehicles: The PAV Support System in Tete requires three dedicated vehicles for delivery and supportive supervision. This budget includes estimates for three Land Rover trucks that are appropriate for travel in harsh, rural conditions and equipped with radios for communication. Each truck is budgeted at \$42,120 for a total of \$126,360. It is also possible that these vehicles could be re-allocated from other MISAU activities.

Coverage rate studies: In order to assess need and impact, coverage rate studies must be performed at the initial implementation of the program as well as in the third year of implementation. The expenses included in the budget are based on VillageReach estimates for comprehensive coverage rate studies including travel costs for the field work (\$8,200), consultant expenses to manage the study (\$5,000) and field staff and equipment expenses for the field work (\$90,984).

Trainings: The trainings category includes expenses for one health worker training per zone per year (\$7,500 per training with 25 attendees per training, 3 trainings a year) and two district trainings per zone per year (\$1,550 per training with 8 attendees per training, 6 trainings a year). The main expenses for trainings are per diems and training materials.

VillageReach management expenses: VillageReach management expenses include VillageReach technical support and field training, monitoring, supervision and support. VillageReach technical support includes all of the VillageReach organizational expenses necessary to support the program; this includes VillageReach staff time and resources from both Mozambique and Seattle. This budget includes a program officer in Seattle, a program officer and a part-time logistics officer in Maputo as well as a project manager in Tete. In addition to staff time, this budget includes a portion of the VillageReach operational expenses necessary to support these staff. The field training, monitoring, supervision and support include travel expenses for four trips to the field sites in Tete by international staff and four trips domestic staff.

MIS3: This budget includes development expenses to refine the MIS3 for deployment in Tete in the initial year of implementation. After this deployment, the budget includes maintenance and technical support expenses for the remaining two years.

C. Cabo Delgado: Piloting District-Based Warehouses in the PAV Support System

Cabo Delgado is Mozambique's northernmost province and has a population of 1,632,809 spread over an area of 77,867 km², which corresponds to a density of 21 inhabitants per km². With a life expectancy of 41.9 years and a GDP per capita of \$82, Cabo Delgado is one of the poorest and most rural provinces in Mozambique. Over 77% of the population in the province is illiterate and the average woman has 5.9 children in her lifetime.

Cabo Delgado has 89 health units in 17 districts. Less than 40% of births in the province take place in a health facility and the health units are separated by great distances with an average of only 0.6 hospital beds per 1,000 people in the province. A high maternal mortality rate of 0.3% and infant mortality rate of 17.8% are the results of severe health problems in the province. Over 55% of the children less than five years old in the province are malnourished. Despite these health problems, the Cabo Delgado Evaluation conducted in 2008 found high vaccination coverage rates with 95.4% of children receiving DPT3. Similarly the dropout rate was a low 3.8% (DPT1-3). With a well performing PAV system, the province is well positioned to pilot an alternative distribution system.

PAV Support System: Piloting district-based warehouses in Cabo Delgado

Activities	Year 1	Year 2	Category Total
Supported by MISAU			
Ongoing Operating Expenses			
Field Coordinators and Drivers	\$9,000	\$9,000	\$18,000
Field Operations Costs	\$38,000	\$38,000	\$76,000
Sub-total	\$47,000	\$47,000	\$94,000
Supported by VillageReach			
VillageReach Management Expenses			
VillageReach Technical Support	\$48,800	\$46,728	\$95,528
Field Training, Monitoring, Supervision, & Support	\$34,200	\$34,200	\$68,400
MIS3	\$25,000	\$5,000	\$30,000
Alternative Distribution Systems Study	\$12,000	\$13,000	\$25,000
Sub-total	\$120,000	\$98,928	\$218,928
Total	\$167,000	\$145,928	\$312,928

Budget Justification: Cabo Delgado

Since coverage rate studies were most recently conducted in Cabo Delgado in 2008 and trainings were conducted throughout the pilot program, these activities are not included in the scope of work for Cabo Delgado and therefore have not been included in this budget.

Ongoing operating expense: Ongoing operating expenses include the salaries of the field staff as well as the field operations costs. The field staff consists of three field coordinators at an annual

salary of \$1,800 each and three drivers at an annual salary of \$1,200 each. The field operations costs include fuel (\$13,500 annually), per diems (\$15,700 annually), supplies (\$4,600 annually) and vehicle maintenance (\$4,200 annually) for the monthly health center visits. The cost estimates in this budget are based on the Cabo Delgado pilot costs. Actual expenses may vary or be significantly reduced based upon MISAU's ability to re-allocate resources to support these activities.

VillageReach management expenses: VillageReach management expenses include VillageReach technical support and field training, monitoring, supervision and support. VillageReach technical support includes all of the VillageReach organizational expenses necessary to support the program; this includes VillageReach staff time and resources from both Mozambique and Seattle. This budget includes a portion of a program manager in Seattle as well as a project manager in Cabo Delgado. In addition to staff time, this budget includes a portion of the VillageReach operational expenses necessary to support these staff.

MIS3: This budget includes development expenses to refine the MIS3 for deployment in Cabo Delgado in the initial year of implementation. After this deployment, the budget includes maintenance and technical support expenses for the remaining two years.

Alternative distribution system study: The expenses for the alternative distribution system study include consultant time and travel expenses totaling \$25,000 over two years.