Evaluation of the Project to Support PAV (Expanded Program on Immunization) In Northern Mozambique, 2001-2008:

Statistical Analysis

Field Work Results and Data Analysis from the Evaluation of the MISAU/FDC/VillageReach Project to Support PAV in the Cabo Delgado Province of Mozambique

October 2008

Prepared for VillageReach by:
Katie Leach-Kemon, Researcher
Mariana Dionísio, Researcher
Nelia Taimo, Researcher

Table of Contents

Abbreviations

DDS	Direcção Distrital de Saúde
DPS	Direcção Provincial de Saúde
DTP	Diphtheria-tetanus-pertussis
FDC	Fundação para o Desenvolvimento da Comunidade
HepB	Hepatitis B
MISAU	Ministerio da Saúde
OMS	Organização Mundial de Saúde
Polio	Vacina oral contra a poliomielite
PAV	Programa Alargado de Vacinação
US	Unidade Sanitária
VAS	Vacina Anti-Sarampo (Measles)
VAT	Vacina Anti-Tétano (Tetanus)
VR	VillageReach

Acknowledgements

VillageReach thanks our project partners MISAU and the FDC for making the Project to Support PAV possible. VillageReach is grateful for the commitment and dedication of these project partners. We are honored to support the important and significant work that MISAU and DPS Cabo Delgado perform everyday to operate a vaccination program serving millions of people in a challenging environment.

VillageReach thanks MISAU for making the evaluation possible. The evaluation would not have been possible without the support from Prof. Dr. Paulo Ivo Garrido, Dr. Mouzinho Saide, Dr. Leonardo António Chavane and Dr. Nuno Gaspar at MISAU. VillageReach also thanks Dr. Mussa I. Hagy, Dr. Cesario Augusto Suege, Francisco Paulo, Randinho Farnela Tongai and Zacarias Adolfo Quirinde, at the Cabo Delgado Provincial Department of Health, for their assistance and support of the evaluation. VillageReach thanks the FDC for its contributions, particularly Paula Monjane for sharing her knowledge and experience in the methodology design and field work implementation.

VillageReach extends our gratitude to everyone who participated in the Impact Evaluation including the communities, health workers, Project Staff and DPS Officials in Cabo Delgado and Nampula, who agreed to be interviewed. The evaluation would not have been possible without the countless hours of work and research expertise of Mariana Dionisio, Katie Leach-Kemon and Nélia Taimo. VillageReach thanks Dr. Mark Kane for reviewing and writing the final evaluation report and recommendations. The Mozambique WHO staff including Manuel Muianga, José Alexandre Chivale, Dr. Estela Lúcia Oliva Linares, and Dr. Manuel Novela provided valuable assistance with the evaluation methodology and training. VillageReach also thanks Dr. José Fumane as the director of the Instituto Nacional de Saude, do Comité de Etica, Ermeliano Graciano for his assistance with the data from Niassa and Dr. Paula Brentlinger and Dr. Julie Cliff for their on-going advice and support. Support from the University of Washington including from Dr. Mary Kay Gugerty, Dr. Sara Curran, Aaron Katz, Dr. Sanjeev Khagram, and Srinivas Chokkakula, and from Dr. Elizabeth Luman at the Centers for Disease Control, was instrumental at the start of the evaluation process. Finally, VillageReach thanks the Bill and Melinda Gates Foundation for their financial support of this evaluation.

For more information, please contact: VillageReach, 601 North 34th Street, Seattle, WA, 98103, USA, +1 206-925-5200; or VillageReach Maputo, Av. 25 de Setembro, 1123, 11 E, Maputo, Mozambique, +258-21-326-446. www.villagereach.org

I. Introduction

Immunization against vaccine-preventable diseases is regarded as one of the most successful and cost-effective public health interventions in history [1]. Immunization with the six traditional childhood vaccines is estimated to cost just US $7 per disability-adjusted life year (DALY) averted in Sub-Saharan Africa. Routine immunization of children and women of childbearing age also decreases infection rates and disease contagion, and lessens the burden on health systems. Immunization was responsible for the aversion of about 2 million deaths in the year 2003 [2].

Immunization in many hard-to-reach areas of the world is still an enormous challenge. The World Health Organization estimates that in 2002, 2.5 million children under the age of 5 died from basic vaccine preventable diseases such as polio, diphtheria, yellow fever, tetanus, pertussis, *Haemophilus influenzae* type b (Hib) and measles [3]. Of these deaths, 1.9 million (76%) occurred in Africa and South-East Asia.

Around the turn of the century, the international community made a new commitment to avoidance of vaccine-preventable deaths. In 1999, the WHO partnered with other UN agencies, civil society organizations, donor organizations, and others to create the Global Alliance for Vaccines and Immunization (GAVI). GAVI was formed to improve national vaccine programs in developing countries and to accelerate development of new vaccines and delivery methods, by providing time-limited funding to the world's 72 poorest countries to strengthen country-level immunization programs. The world's poorest countries responded overwhelmingly to this newly available support – more than 50 developing countries applied for GAVI funding in the first year and global coverage of the DTP3 vaccine jumped from 20% in 1980 to 78% in 2003 [4, 5]. Mozambique applied for GAVI funding to support its EPI program in 2001 and will have received over USD$38 Million in support by the end of 2009 [6]. In 2002, the WHO's Expanded Program on Immunization also introduced its Reaching Every District (RED) approach, in order to guide developing countries in their efforts to minimize the gaps in their national vaccine programs [7].

Mozambique's national EPI program was established in 1979, but it experienced a slow start due to the civil war 1975-1992 and devastating floods affecting the country's Southern and Central regions in 2001-2002. A review conducted in 2002 identified several obstacles to increasing vaccination rates, especially in rural areas, including the limited coverage of the national health services (including EPI), the lack of financial resources and equipment, including spare refrigerators and other equipment to support the cold chain, and insufficient trained staff for vaccination activities [8].

The Project to Support PAV

VillageReach and the Foundation for Community Development (FDC) approached the Mozambique Ministry of Health (MISAU) and initiated a yearlong study that included a review of public health systems in Mozambique, other African countries, Europe and the USA. Based on the study, VillageReach and FDC found that a focus on transport, logistics, stock management, and strengthening the cold chain would be an appropriate set of interventions to solve to the barriers to immunization services for the people of northern Mozambique. In March 2002, VillageReach, FDC, and MISAU signed a Memorandum of Understanding for a five-year health infrastructure and logistics project to support the EPI program in Cabo Delgado, the northernmost region of Mozambique and one of the poorest.

With a population of 1.5 million, Cabo Delgado has one of the lowest per capita incomes in the country. Vaccination rates were well below national averages. All health facilities experienced frequent stock-outs of critical vaccines and supplies, and 85% of the clinic refrigerators suffered from breakdowns and fuel shortages. Less than 6% of households have access to electricity. Almost half the population lives more than a two hours' walk from a health facility.

The Program to Support PAV was implemented in phases, first targeting a small cluster of health facilities. This small initial target allowed the project activities to be clearly defined, implemented, and refined before rolling out to the rest of the province. The project initially focused on strengthening the cold chain and supplied the health facilities and provincial warehouse with gas refrigerators. Gas refrigerators were chosen because they were found to be reliable, easy to maintain, and propane is a clean-burning energy source. The health workers and DPS maintenance team were trained on their use and maintenance. The project worked with DPS and other partners to only replace the refrigerators that needed to be replaced. Well-functioning solar and electric refrigerators were not replaced because they did not pose threats to the cold chain. In addition, the project developed relationships with other refrigerator donors in the province. These relationships allowed other donors to call the project if one of their refrigerators broke, and the project could replace it with a new gas refrigerator.

After the cold chain was strengthened, the transport and logistics system was refined and the project began monthly deliveries of vaccines in July 2002. With the onset of monthly deliveries, the project found two major problems that had to be resolved. First, the ideal stock levels for the health facilities required adjustment. Stock needs were based on outdated population numbers (from the 1997 national census) and as the public learned of the regular and reliable supply of vaccines and supplies at health facilities, the demand for vaccines increased. To resolve this problem, the ideal stock numbers were continuously re-evaluated and a detailed analysis of the stock usage history was completed and used to

inform the ideal stock levels. The second problem related to upstream supply logistics. Often, it was not possible to conduct deliveries to the health facilities, because the required stock did not arrive in time or at full levels from the national warehouse. The solution to this problem was to refine and further systematize the process of quarterly orders of vaccines.

In November 2004, two and a half years after the start of the project, the project was completely rolled out to all 88 fixed vaccination posts in Cabo Delgado province. Also in 2004, the project implemented a systematized data system with nine key indicators to regularly monitor project activities. Throughout the project implementation time period, activities expanded to include providing equipment (gas powered lamps and burners, bicycles, motorcycles, satellite phones, and fire extinguishers), improving infrastructure (waste pits and latrines), conducting social mobilization activities, training in cold chain and vaccine freezing, and supporting DPS with vaccine campaigns.

The Impact Evaluation

In July 2008, VillageReach conducted an evaluation to assess the impact, sustainability, replicability and cost-effectiveness of the Project to Support PAV in Cabo Delgado.

Evaluation Objectives

The evaluation was designed to test hypotheses:

1. The Project to Support PAV will increase vaccination coverage in the Cabo Delgado province of Mozambique.
2. The project will increase the quality of health services and access to vaccines.
3. Among communities served by health facilities benefiting from the project, knowledge of, trust in, and use of health services will increase.
4. The positive impacts of the project will be sustainable.
5. The project will be replicable in Mozambican provinces other than Cabo Delgado.

Data Collection and Analysis

The evaluation fieldwork consisted of a representative household survey of the entire Cabo Delgado province, including the WHO Immunization Coverage Cluster Survey, a household survey developed by VR, and qualitative interviews with health workers, community leaders, and Project staff and DPS officials in both Cabo Delgado and Nampula.

The 1997 and 2003 Demographic and Health Surveys (DHS) were used as baseline information and an immunization coverage cluster survey conducted by DPS in the neighboring province of Niassa in 2007 was used as a comparison.

An independent team of investigators completed the data collection and field work in July 2008. Ms. Katie Leach-Kemon, Ms. Mariana Dionisio, and Ms. Nelia Taimo analyzed the data from August-September, 2008 and provided a Statistical Analysis in October, 2008.

Dr. Mark Kane completed the evaluation by conducting an independent review of the survey results, including the Statistical Analysis and a five-year Project report, in October, 2008 (available under separate cover.)

Endnotes

[1] GAVI Alliance. Evaluation of the First Five Years of GAVI Immunization Services Support Funding

[2] Global Immunization Vision and Strategy 2006–2015. Geneva, Switzerland, World Health Organization/United

[3] WHO, International Agency for Research on Cancer. GLOBOCAN database 2002.

[4] GAVI Alliance. New Global Vaccine Alliance Draws Overwhelming Interest from Developing World. March, 2000. Available at: http://www.gavialliance.org/media_centre/press_releases/2000_03_02_en_press_release.php

[5] WHO. Immunization against diseases of public health importance. Available at: http://www.who.int/mediacentre/factsheets/fs288/en/index.html

[6] GAVI Alliance. Mozambique Country Fact Sheet. May 2008. Available at: http://www.gavialliance.org/performance/country_results/index.php?contID=1&countID=46

[7]Bulletin of the World Health Organization, vol. 86 no. 3, Geneva, Mar. 2008

[8] Mozambique Ministry of Health. Expanded Program on Immunization Multi-Year Plan, Jan 2003.

II. Vaccination Coverage and Household Surveys

I. METHODS

A. Baseline Surveys: 1997 and 2003 Mozambique Demographic and Health Surveys (DHS)

Study Design

This study used data from the 2003 Mozambique Demographic and Health Survey (DHS 2003) as baseline data. DHS surveys are cross-sectional household surveys that are representative on both a national and provincial level. DHS survey methodology is well described elsewhere [1]. 12,315 households were included in the study.

Participants

Children were selected for inclusion in the study based on the following criteria: alive at the time of the survey, between the ages of 12 and 23 months, and residing in the Cabo Delgado or Niassa provinces.

Statistical Methods

Survey data were cleaned and analyzed using SPSS version 16.0 for Macintosh (SPSS Inc., Chicago, IL, USA). Initial frequencies were plotted to identify potential outliers.

Variables

The variable "DTP 3" was computed using the following variables from the Mozambique DHS 2003 dataset: "received DTP 1," "received DTP 2," and "received DTP 3." "DTP 3" was defined as those children who received all DTP doses (DTP 1-3) according to card or history. The variable "all vaccinations" was computed using the variables "received measles," "received BCG," "received polio 1," "received polio 2," "received polio 3," "received DTP 1," "received DTP 2," and "received DTP 3." "All vaccinations" was defined as those children who received BCG, three doses of DTP, three doses of polio (excluding dose given shortly after birth), and measles according to card or history. "Measles vaccination" was re-coded into a dichotomous variable; "yes" was defined as those children who received the vaccine according to card or history.

B. Endline Survey: VillageReach Household and Immunization Coverage Cluster Survey

Study Design

The Village Reach Household and Immunization Coverage Cluster Survey ("Household Questionnaire") was a cross-sectional, community-based survey that assessed immunization coverage rates and individual- and household-level characteristics.

Setting

The study population consisted of children aged 12-23 months and 24-35 months and their caretakers or another adult household member residing in communities in the Cabo Delgado province of Mozambique, all of whom were served by health units that participated in the Project to Support PAV.

Participants

The sample used the WHO 30x7 immunization coverage cluster design [2]. The sample was representative of the Cabo Delgado province. 30 clusters were selected using probability proportional to size. In each cluster, 14 to 16 households were chosen using the EPI random walk method. 7 to 8 households with children between the ages of 12-23 months and 7 to 8 households with children between the ages of 24-35 months were included in each cluster.

Only those households that had at least one living 12 to 35 month-old and a caretaker or other household member 14 years or older who was knowledgeable about the child's vaccine status were eligible. The selected household's child was not required to be present for the household to be eligible for inclusion in the study. If there was more than one eligible child, the youngest child within the 12-35 month age range was chosen. If interviewers randomly selected households with more than one eligible child once the sample size requirement for 12-23 month age group was fulfilled for a given cluster, the youngest child within the 23-35 month age group would be selected. No more than one child between the ages of 12 and 35 months was selected per household. A total of 474 children, 237 between the ages of 12 and 23 months and 237 between the ages of 24 and 35 months, were included in the study.

Sample Size

The sample size was calculated using the EPI cluster survey method. The sample was based on 70% immunization coverage, 10% type I error, and a cluster design effect of two.

Ethics Approval

The MISAU Bioethics Committee and the Minister of Health granted approval for the evaluation.

Variables

The first section of the survey contained questions about household characteristics and public health services. Variables for each included:

Household Characteristics:	**Health Services:**
Age group of child	Distance from health facility
Respondents sex	Mode of transportation to health facility
Age of respondent	Time since respondent's most recent health facility visit
Respondent's relationship to child	What respondent did last time he or she visited a health facility
Education level of mother or caretaker of child	Ever heard of vaccines,
Sex of head of household	Source of information about vaccines (community leaders, radio, mobile brigades, friends and family, health workers, activists or non-governmental organizations, theater groups, other)
Household size	Knowledge of vaccines' purpose
Number of children under 5 living in household (1-4)	Source of last vaccine child received
Building materials of house	Whether respondent had ever been to a health unit for vaccines but was not able to get them
Ownership of agricultural land	Reasons for inability to obtain vaccines when sought at health facility
Radio ownership	Health worker communication during last vaccine session
Ownership of livestock (chickens, ducks, pigeons, rabbits, pigs, goats, sheep cows)	Any differences seen in health services in last 5 years

The questions in the second part of the survey were derived from the WHO Immunization Coverage Cluster Survey Reference Manual [3]. Variables included:

WHO Immunization Coverage Variables:
Child's date of birth
Child's sex
Child's possession of vaccination card
Fully immunized by 12 months of age
Fully immunized at or after 12 months of age
Vaccination status of child, reasons for vaccination failure
BCG vaccination
Presence of BCG scar
Polio 1 vaccination, polio 2 vaccination, polio 3 vaccination
DTP1 plus HepB1 vaccination, DTP2 plus HepB2 vaccination, DTP3 plus HepB3 vaccination
Measles

Measles vaccine received before 9 months of age
Lack of 28-day interval between polio or DTP doses
Missing at least one vaccine
Original vaccination card lost—new card stated "vaccination completed"

Coding: Type of Variable

Household characteristics and health services variables were coded as dichotomous, categorical, continuous or open-ended as follows:

Dichotomous variables	**Categorical Variables**	**Continuous variables**	**Open-ended Qualitative**
Age group of child ("12-23 months" or "24-35 months")	Respondent's relationship to child (mother, father, brother/sister (14-21 years), grandparent, or other adult)	Age of respondent	What respondent did last time he or she visited the health facility
Respondent's sex	Education level of mother or caretaker of child (none, some primary, completed primary, some secondary, completed secondary, and superior (university))	Household size	Differences seen in last 5 years (if any)
Sex of head of household	Building materials of house (straw, stick with grass roof, stick with zinc/metal roof, and cement block with zinc/metal roof)	Number of Livestock owned	
Number of children under 5 living in household (1-4)	Distance from health facility (less than 1 hour, 1-2 hours, over 2 hours, don't know, or never went)		
agricultural land ownership	Mode of transportation to health facility (walk, bicycle, motorcycle, car, chapa (bus), other, and never went)		
Radio ownership	Time since respondent's most recent health facility visit (this week, last week, last month, last year, last time was in 1999, don't know, don't remember, and never went)		
Ever heard of vaccines	Source of last vaccine the child received (health unit, mobile brigade, forgotten, don't know, don't remember, never, never went, and never was vaccinated)		
Source of information about vaccines	Ever been to a health unit for a vaccine but not able to get a vaccine (yes, no, never was vaccinated, and never went)		
Knowledge of vaccines' purpose (prevent illness, or don't know)	Reasons for inability to obtain vaccine when sought at health facility (health unit closed, health worker not present, vaccines not being offered, stock out of vaccines, equipment problems, don't know, and mobile brigade was on its way from the village and therefore did not give vaccine)		
Differences in health services in last 5 years			

Similarly, the WHO immunization coverage variables were coded as follows:

Dichotomous variables	**Categorical Variables**	**Continuous variables**
child's sex	BCG vaccination (date of vaccination, immunization reported by interviewee, or immunization not given)	child's date of birth
child's possession of vaccination card	Polio 1 vaccination, polio 2 vaccination, polio 3 vaccination (date of vaccination, immunization reported by interviewee, or immunization not given)	

presence of BCG scar	DTP1 plus HepB1 vaccination, DTP2 plus HepB2 vaccination, DTP3 plus HepB3 vaccination (date of vaccination, immunization reported by interviewee, or immunization not given)	
Fully immunized by 12 months of age and fully immunized at or after 12 months of age	Measles vaccination (date of vaccination, immunization reported by interviewee, or immunization not given)	
Measles vaccine received before 9 months of age, lack of 28-day interval between polio or DTP doses, missing at least one vaccine, and original vaccination card lost—new card stated "vaccination completed"	Vaccination status of child (non-vaccinated, partially vaccinated, or fully vaccinated)	
	Reasons for vaccination failure (*lack of information*--unaware of need for immunization, unaware of need to return for 2nd or 3rd dose, place and/or time of immunization unknown, fear of side reactions, wrong ideas about contraindications, other; *lack of motivation*--postponed until another time, no faith in immunization, rumors, other; *obstacles*--place of immunization too far, time of immunization inconvenient, vaccinator absent, vaccine not available, mother too busy, family problem, including illness of mother, child ill--not brought, child ill--brought but not given immunization, long waiting time, other)	

Data Sources/Measurement

The dataset from the household survey/WHO immunization coverage cluster survey contained structured interview data. Trained field workers conducted interviews with caretakers of young children and focused on the topics described in the "variables" section above.

Date of birth for children was assessed through health cards, birth certificates, or a calendar of local events. Age of interviewee was verified through birth certificates, and, in one case, through a local events calendar.

Vaccination coverage for each antigen was obtained via health cards or interviewee's report. In the case of invalid or missing dates of vaccinations on cards, mother's report was used to assess vaccination status.

Definitions

"Vaccination status of child" was defined as follows:

Fully-vaccinated child	Receipt of BCG vaccination verified by history plus scar, card plus scar, or card only and all other vaccinations; and all other vaccinations as verified by card or history
Partially-vaccinated child	Receipt of at least one of the vaccines according to the criteria described for "fully-vaccinated child."
Non-vaccinated child	Not having received any of the vaccines according to the "fully-vaccinated child" criteria.

Vaccination failure	Children who qualify as partially- or non-vaccinated.

"Fully immunized by 12 months of age" was defined as a child who received valid doses of all vaccinations before the age of 12 months. Criteria for receipt of valid doses of all vaccinations were:

- BCG vaccination verified by history plus scar, card plus scar, or card only;
- all three polio vaccinations received a minimum of 28 days apart as verified on card;
- all three DTP/HepB vaccines received a minimum of 28 days apart as verified on card; and,
- measles vaccination received after 9 months of age as verified on card.

"Fully immunized at or after 12 months of age" was a child who received valid doses of all vaccinations in the manner described above at or after the age of 12 months.

The variables polio1, polio2, and polio3 were used to compute the variable "Polio 3 vaccination." The DTP 3 variable was computed in a similar manner. Confirmed BCG vaccination was computed using the following variables: BCG scar, BCG vaccination plus scar, or BCG vaccination only. BCG confirmation was defined as receipt of BCG vaccination as verified by history plus scar, card plus scar, or card only.

Dropout rates were calculated by subtracting vaccination coverage of the following antigens: BCG - Measles, DTP1 – Measles, and DTP1 – DTP3.

Statistical Methods

Survey data were cleaned and analyzed using SPSS version 16.0 for Macintosh. Initial frequencies were plotted to identify potential outliers. Bivariate analysis was performed using cross-tabulations and Pearson chi-squared tests with fully vaccinated child, child fully immunized by 12 months, DTP3/Hep B3 vaccination, and measles vaccination as dependent variables and age group of child as the independent variable.

Age of respondent was re-coded into a categorical variable: "less than or equal to 22 years," "23-27 years," "28-32 years," "greater or equal to 33 years," and "don't know." Household size was re-coded into the following categories: less than or equal to 4 members, 5-6 members, and greater than or equal to 7 members. Number of chickens, ducks, pigeons, rabbits, pigs, goats, sheep, and cows owned were re-coded as dichotomous variables. One child under 5 living in household, two children under 5 living in household, three children under 5 living in household, and four children under 5 living in household

were coded as dichotomous variables were re-coded into a continuous variable, "number of children under 5 living in household."

Time since respondent's most recent health facility visit was re-coded into the following categories: "this week," "last week," "last month," "last year," "over 1 year ago," "don't know," "don't remember," and "never went." Source of last vaccine child received was also recoded: "health unit," "mobile brigade," "forgotten," "don't know," don't remember," and "never was vaccinated." What interviewee did last time he/she visited a health facility was re-coded into the following variables: "child weighed," "scheduled an appointment," "appointment," "child was sick," "child was vaccinated," "malaria treatment," "child's mother was sick," "relative was sick," "does not remember/does not know," "child weighed and vaccinated," "child weighed plus appointment," "prenatal consultation," "child delivery," "family planning," "surgery," and "never went to health center."

The variables "fully immunized by 12 months of age" and "fully immunized at or after 12 months of age" were combined to form the category "fully immunized children."

BCG vaccination, polio 1 vaccination, polio 2 vaccination, polio 3 vaccination, DTP1 plus HepB1 vaccination, DTP2 plus HepB2 vaccination, DTP3 plus HepB3 vaccination, and Measles vaccination were re-coded into the following variables: "confirmed by card," "confirmed by history," and "not vaccinated."

"3 doses of polio" was computed using the variables polio 1 vaccination, polio 2 vaccination, and polio 3 vaccination, while "3 doses of DTP/Hep B" was computed using the variables DTP1 plus HepB1 vaccination, DTP2 plus HepB2 vaccination, and DTP3 plus HepB3 vaccination.

The variable "confirmed BCG vaccination" was computed using the variables "BCG vaccination" and "presence of BCG scar," and defined as receipt of BCG vaccination as verified by history plus scar, card plus scar, or card only.

Immunization system utilization/drop-out rate variables were calculated by subtracting the following variables: BCG vaccination-measles vaccination, DTP1 vaccination –measles vaccination, and DTP1 vaccination-DTP3 vaccination.

Qualitative Methods and Themes

Descriptive analysis was conducted using health workers', community leaders', DPS Officials' and Project staff responses to open-ended questions. Subjects' responses were hand-coded. Major themes were identified based on their usefulness in answering the evaluation's main hypotheses (see introduction).

C. Comparison Survey: DPS Immunization Coverage Cluster Survey, Niassa Province

Study Design

The WHO Immunization Coverage Cluster Survey that was carried out by DPS in the Niassa province was a cross-sectional, community-based study that assessed immunization coverage rates [12]. In addition, the study gathered data on individual- and household-level characteristics. Only the immunization coverage rates from the DPS study are described in this evaluation.

Setting

The study population included children under the age of 5 years and the head of the child's household or other household member living in the Niassa province. Data obtained from children ages 12-23 and 24-35 months of age are used in the following evaluation.

Participants

The sample used the modified WHO 20x10 immunization coverage cluster design. The following districts of Niassa were selected for inclusion in the original DPS study since they reflected the varied socio-economic conditions in the province: Mecanhelas, Marrupa, Mecula, Sanga, Lichinga and Mandimba. Within these districts, clusters were selected using probability proportional to size, and 10 households were chosen in each cluster using the EPI random walk method.

To be eligible for inclusion in the study, households had to have one living child under the age of five and a parent or other caretaker who was available for interview.

A total of 1200 children were included in the study. 338 children in the 12-23 month age group and 233 children in the 24-35 month age group were selected for inclusion in this evaluation.

Sample Size

The sample size was calculated using the EPI cluster survey method. The sample was based on 50-60% immunization coverage, 10% type I error, and a cluster design effect of 2.

Statistical Methods

Survey data were cleaned and analyzed using SPSS version 16.0 for Macintosh. Frequencies were plotted to identify potential outliers.

Variables

The following variables from the DPS survey in Niassa were selected for analysis in this evaluation: BCG vaccination, polio 1 vaccination, polio 2 vaccination, polio 3 vaccination, DTP1/HepB1 vaccination, DTP2/HepB2 vaccination, DTP3/HepB3 vaccination, and measles vaccination. BCG vaccination, polio 1 vaccination, and DTP1/HepB1 vaccination were coded as categorical variables: "yes," "no," and "don't know." Polio 2 vaccination, polio 3 vaccination, DTP2/HepB2 vaccination, DTP3/HepB3 vaccination, and measles vaccination were also coded as categorical variables: "yes," "no," "not applicable," and "don't know."

Data Sources/Measurement

The dataset from the WHO immunization coverage cluster survey conducted by DPS in the Niassa province contained structured interview data. Trained field workers conducted interviews with caretakers of young children and focused on the topics described in the "variables" section above as well as topics that are further described in the DPS survey report, entitled Inquerito De Cobertura Vacinal Em 6 Distritos Da Provincia Do Niassa.

The method used to measure date of birth of the child could not be discerned from available data.

Vaccination coverage for each antigen was obtained via health cards or interviewee's report. In the case of invalid or missing dates of vaccinations on cards, mother's report was used to assess vaccination status.

Measles vaccination was re-coded into a dichotomous variable with the case "not applicable" being re-coded as "no." DTP1/HepB1, DTP2/HepB2, DTP3/HepB3 were used to compute the variable "3 doses of DTP." BCG vaccination, polio 1 vaccination, polio 2 vaccination, polio 3 vaccination, DTP1/HepB1 vaccination, DTP2/HepB2 vaccination, DTP3/HepB3 vaccination, and measles vaccination were used to compute the variable "full vaccination." For the "full vaccination" variable, those cases that had "don't know" for any of the antigens were reclassified as "incomplete information." Those cases with "don't know" for any antigen were treated as missing in the bivariate analysis.

D. Comparison of DHS Baseline, VR Endline and Niassa Comparison Surveys

Study Design

To estimate the impact of the Project to Support PAV, the Mozambique DHS 2003 dataset and the Village Reach Household Survey and Immunization Coverage Cluster Survey were compared.

Participants

All children from the 12-34 and 24-35 month age group VR surveys were included in the study. From the Mozambique 2003 DHS, only children who met the following criteria were included in the analysis: alive at the time of the survey, between the ages of 12 and 23 months, and residing in the Cabo Delgado province.

Statistical Methods

Survey data were cleaned and analyzed using SPSS version 16.0 for Macintosh. Prior to comparing the DHS 2003 and VR data, the DHS data was weighted using the sample weight in the dataset divided by 1,000,000. Cross-tabulations and Pearson chi-squared tests were used to compare the 3 datasets (Mozambique DHS 2003 and the 12-23 and 24-35 month age groups from the VR survey).

Variables

The following variables from Mozambique DHS 2003 dataset and the VR survey were used in the comparison of the two datasets: "DTP 3" and "measles vaccination." The DHS definition of the variable "all vaccinations" was computed using the following variables from the VR survey: "BCG vaccination," "measles vaccination," "polio 1 vaccination," "polio 2 vaccination," "polio 3 vaccination," "DTP 1 vaccination," "DTP 2 vaccination," and "DTP 3 vaccination."

To compare the 2 DHS surveys (1997 and 2003), and the DHS 2003 survey to the VR Household survey and to the DPS Niassa survey, bivariate analysis was performed using logistic regression models with all vaccination coverage, DTP 3, and measles vaccination as dependent variables and the dataset as the independent variable.

In addition, administrative data, including from the WHO Joint Reporting Form (JRF) and the UNICEF Multiple Indicator Cluster Survey (MICS) was reviewed for comparison coverage rates.

II. RESULTS

A. Results of Endline Survey: Village Reach Household and Immunization Coverage Survey

Household Characteristics and Participant Demographics

474 children, 237 in the 12 to 23 month age group and 237 in the 24 to 35 month age group and their caretakers or other adult household member who was knowledgeable about the child's vaccination status, were included in the study. The response rate was 100%.

Tables 1-1 through 1-15 describe the study populations. As illustrated in Table 1, the majority of interviewees in each age group were the children's mothers (95.4% in the 12-23 month age group and 94.9% in the 24-35 month age group).

As shown in Tables 1-1 and 1-2, children's caretakers were largely uneducated (70.0% in the 12-23 month age group and 66.2% in the 24-35 month age group) and poor, as indicated by the building materials of respondents' houses (91.1% of the 12-23 month age group and 86.5% of the 23-35 month age group lived in houses made from sticks with a grass roof). Table 1-3 shows that nearly half of each the age groups reported owning a radio (45.6% for the 12-23 month age group and 47.3% for the 24-35 month age group) and 89.5% of the 12-23 month age group and 90.3% of the 24-35 month age group owned agricultural land.

Utilization of Health Services

Table 1-4 describes respondents' access to health facilities. Most respondents lived over 1 hour from the nearest health facility (70.0% in the 12-23 month age group and 70.3% in the 24-35 month age group) and traveled to the health center on foot (85.7% for the 12-23 month age group and 85.2% for the 24-35 month age group).

Concerning participants' use of health facilities (Table 1-5), large proportions of respondents had visited the health facility in the last month or even more recently (89.0% of the 12-23 month age group and 92.4% of the 23-35 month age group). Most respondents reported attending well-child visits (65.0% of 12-23 month age group and 47.7% of respondents reported "child weighed" as the purpose of their most recent visit to a health facility). The majority of respondents reported that their child had received their last vaccine at a health unit (77.5% of the 12-23 month age group and 75.5% of the 23-35 month age group). The second most frequent source was mobile brigades (21.2% of the 12-23 month age group and 22.8% of the 23-35 month age group).

Knowledge of Vaccines

When asked to list different sources from which they had received information on vaccines (Table 1-6), most respondents cited health workers (44.5% in the 12-23 month age group and 46.0% in the 24-35 month age group), followed by community leaders (32.6% % in the 12-23 month age group and 30.0% in the 24-35 month age group), and mobile brigades (24.2% in the 12-23 month age group and 20.8% in the 24-35 month age group). Only 7.2% of the 12-23 month age group and 9.7% of the 23-35 month age group reported having received information about vaccines through the radio.

While most respondents had heard of vaccines, less than half could identify vaccines' purpose (Table 1-7). 94.5% in the 12-23 month age group and 94.1% in the 24-35 month age group reported having ever heard of vaccines. However, only 40.1% in the 12-23 month age group and 43.6% in the 24-35 month age group correctly reported that vaccines' purpose was to prevent disease.

Household Perceptions/Quality

Table 1-8 summarizes variables that relate to the quality of health services. Concerning the availability of vaccines, 20.7% of respondents in the 12-23 month age group and 19.8% in the 24-35 month age group reported having ever gone to a health unit for vaccines and being unable to obtain them. Of those reporting inability to obtain vaccines, the majority cited stock outs of vaccines as the culprit (81.6% in the 12-23 month age group and 67.4% in the 24-35 month age group).

Immunization Status

Table 1-9 summarizes the immunization status of the two age groups by valid immunization coverage. In total, 73.0% of the 12-23 month age group and 72.2% of the 24-35 month age group were fully immunized. 61.2% of the 12-23 month age group and 54.9% of the 24-23 month age group were fully immunized by 12 months, while 11.8% of the 12-23 month group and 17.3% of the 24-35 month group were fully immunized at or after 12 months of age.

Vaccination Status

Table 1-10 describes overall vaccination status and coverage for each age group based on history or card. Table 1-11 summarizes some of the key indicators from Table 1-10 with "by card" and "by history" categories combined.

DTP 3, the indicator generally reported as representative of full vaccination, was 92.8% in the 12-23 month group and 95.4% in the 24-35 month group. Polio 3 was 92.8%

for the 12-23 month group and 95.8% for the 24-35 month group, while measles vaccination was 90.3% for the 12-23 month group and 95.4% for the 24-35 month group.

Table 1-11 also presents indicators of full vaccination and confirmed BCG vaccination. 87.8% of the 12-23 month age group and 92.8% of the 24-35 month age group were fully vaccinated. Confirmed BCG was 97.9 for the 12-23 month group and 98.7% for the 24-35 month group.

Table 1-12 describes the results of bivariate analyses of age group associations with vaccination coverage. The only significant difference (p=0.03) between the two age groups was a higher level of measles vaccination coverage in the 24-35 month age group (95.4 [91.6-99.2]) compared to the 12-23 month age group (90.3 [85.0-95.6]). The difference in percentage of fully vaccinated children between the 24-35 month age group (92.8 [88.2-97.5) and 12-23 month age group (87.8 [81.9-93.7]) was nearly significant (p=0.06).

Drop-out Rates

Table 1-13 summarizes various measures of immunization system utilization, or drop-out rates, which are often considered proxies for quality of services. All rates are under 10%, ranging from 5.1% to 8.0% in the 12-23 month group, and 1.7% to 3.8% in the 24-35 month age group.

Reasons Children Didn't Qualify as "Fully Immunized"

Table 1-14 describes the study population's main problems in immunization status and assessment. This table describes the primary reasons why children in the two age groups did not qualify as "fully immunized children." Only a small percentage of children lacked vaccination cards in the 12-23 month age group (0.8%) and 24-35 month age group (3.0%). 12.2% of the 12-23 month age group and 7.2% of the 24-35 month age group were missing at least one vaccine. 7.6% of the 12-23 month age group and 8.4% of the 24-35 month age group received the measles vaccine before 9 months of age. Only 1.7% of children from both age groups lacked the minimum 28-day interval between polio and DTP vaccinations. 9.3% of the 24-35 month age group and 3.8% of the 24-35 month age-group had lost their original vaccination cards and had a replacement card that stated "vaccinations completed."

Reasons for Vaccination Failure

Table 1-15 describes the reasons for vaccination failure among partially and non-vaccinated children in each age group. The most common reason for vaccination failure in both the 12-23 month age group (24.1%) and the 24-35 month age group (29.4%) was "place of immunization too far."

B. Results -- Comparison of Baseline Surveys in Cabo Delgado and Niassa: DHS 1997 & 2003

Vaccination coverage in the Cabo Delgado province increased dramatically between 1997 and 2003 (Table 2-1, 2-2). The 1997 DHS reported 25.4% coverage rates for "all vaccinations," 28.9% for "3 doses of DTP," and 40.2% for measles vaccination (Table 2-1). In 2003, "all vaccinations" coverage increased to 57.9%, DTP 3 coverage increased to 68.9%, and measles vaccination increased to 80.2%. In the bivariate analyses (Tables 2-3, 2-4, and 2-5), children in Cabo Delgado aged 12-23 months were significantly more likely to receive all vaccinations (OR 4.1, 95% CI 2.2-7.5), DTP 3 (OR 5.5, 95% CI 3.0-10.0), and measles vaccinations (OR 6.0, 95% CI 3.3-11.0) in 2003 than they were in 1997.

Although in 1997, the coverage rates in Niassa were almost twice as high as the coverage rates in Cabo Delgado (Table 2-1), by 2003 this trend was reversed and Cabo Delgado's coverage rates were higher than those in Niassa (Table 2-2). According to the DHS, vaccination rates in Niassa declined from 1997 to 2003, but not significantly (Tables 2-3, 2-4, and 2-5). All vaccination coverage went from 48.2 to 46.6%, DTP 3 went from 59.3 to 54.6, and measles coverage went from 59.4 to 51.9% (Table 2.1 and 2.2).

C. Results -- Comparison of Baseline and Endline Surveys: DHS 2003 and VillageReach Household/Immunization Coverage Survey

Comparing vaccination coverage in Cabo Delgado between 2003 (DHS) and 2008 (VillageReach Household Survey) reveals that coverage significantly increased during this period (Tables 2-3, 2-4, 2-5; Figures 2-2, 2-3, 2-4, 2-5).

- In the 24-35 month age group, which represented children vaccinated during the peak of project activities, "all vaccination" coverage increased from 57.9% in 2003 to 92.8% in 2008 (OR 9.4, 95% CI 5.3-16.8).

- In the 12-23 month group, which represented children vaccinated primarily during the project's final year in Cabo Delgado and the year after the project ended, "all vaccination" coverage increased from 57.9% to 86.0% (OR 4.8, 95% CI 3.0-7.8).

Similarly, in 2008, children in both age groups in the VR Household Survey were significantly more likely to have received all 3 doses of DTP and measles vaccinations than they were in 2003 (Figure 2-5).

- For children age 24-35 months, DTP3 vaccination coverage increased from 68.9% in 2003 to 95.4% in 2008 (OR 9.3, 95% CI 4.7-18.4). For children age 12-23 months, DTP3 coverage increased from 68.9% in 2003 to 92.8% in 2008 (OR 5.8, 95% CI 3.2-10.5). (Table 2-4, Figure 2-3)

- Measles vaccination coverage increased from 80.2% in 2003 to 95.4% for children age 24-35 months (OR 5.1, 95% CI 2.5-10.4), and to 90.3% for children age 12-23 months in 2008 (OR 2.3, 95% CI 1.3-4.1). (Table 2-5, Figure 2-4).

D. Results -- Baseline and Comparison Surveys: DHS 1997 & 2003 and DPS Immunization Coverage Survey, Niassa

Table 2-6 summarizes vaccination coverage in the study carried out by DPS in the Niassa province. Comparison of this vaccination coverage survey with the DHS 2003 data indicates that vaccination coverage significantly increased for almost all vaccines from 2003-2008 (Tables 2-3, 2-4, and 2-5). All vaccination coverage only increased significantly in the 24-35 month age group from the DPS study (OR 1.8, 95% CI 1.1-3.0). DTP 3 coverage increased in both the 24-35 month group (OR 1.9, 95% CI 1.1-3.3) and the 12-23 month group (OR 2.1, 95% CI 1.3-3.5). In addition, measles coverage also significantly increased in both groups: 24-35 months (OR 1.9, 95% CI 1.2-3.4) and 12-23 months (OR 1.9, 95% CI 1.1-3.1].

E. Results – Comparison to Administrative Data

Administrative data from the WHO Joint Reporting Form (JRF) and the UNICEF Multiple Indicator Cluster Survey (MICS) for the period 2003 – 2007 estimates national coverage rates in Mozambique for DTP3 to be 72%.[1] For this same period, all other vaccine coverage rates ranged between 60% and 88%. Similarly, drop-out rates for DTP1-DTP3 were reported to be 12% in 2007.

[1] WHO-UNICEF August 2008 estimates reported in: *Immunization Profile – the Republic of Mozambique* and *Review of National Immunization Coverage 1980-2007 -- Mozambique.*

III. Discussion

A. Village Reach Household and Immunization Coverage Survey

Access to Health Services

The data describe a population in which nearly half of the study group in each age group must travel for over 2 hours to access health services (Table 1-4). Since a trip to the health center takes longer than 4 hours roundtrip for so many caretakers of young children in Cabo Delgado, it is not surprising that 24.1% of the respondents in the partially- and non-vaccinated 12-23 month age group and 29.4% in the partially- and non-vaccinated 24-35 month age group cited "place of immunization too far" as the reason for vaccination failure (Table 1-15). These findings suggest that increased access to health centers or increased numbers of mobile brigades could reduce barriers to health services and improve vaccination coverage.

Knowledge about Vaccines

The nearly universal awareness of vaccines in both age groups is encouraging. Without baseline measurements, however, it is uncertain how much of this knowledge can be attributed to the Project to Support PAV. Since less than half of respondents in each age group correctly responded that the purpose of vaccines was to prevent illness (Table 1-7), it is clear that more work should be done to sensitize the population about the purpose of vaccines.

Only 10% of respondents in each age group reported receiving information about vaccines from the radio (Table 1-6), while nearly half of respondents in each age group owned radios (Table 1-3). In future projects, VR, FDC, and MISAU should expand efforts to inform communities about vaccines through radio messages.

Quality of Health Services and Access to Vaccines

In Table 1-8, the nearly 20% of respondents who reported ever seeking vaccines at a health unit and being unable to obtain them and the fact that the majority of those experiencing difficulties in accessing vaccines at health centers cited vaccine stock-outs as the culprit may demonstrate need for further improvement in the supply chain management of vaccines. This data is difficult to interpret, however, as no time frame was indicated in the question. If respondents answered "yes," they may have been referring to a time prior to, during, or after the intervention. The evidence of a drastic reduction in stock-outs in VillageReach's 5-year report, however, shows that those seeking vaccines in the last quarter of 2005 and later were less likely to have experienced vaccine stock outs than those seeking vaccines earlier in the program period [13].

Table 1-14 illustrates how measles vaccination prior to 9 months of age contributed to immunization failure in 7.6% of cases in the 12-23 month age group and 8.4% in the 24-35 month age group. These figures may indicate a need to further train health workers about the minimum age for measles vaccination. The small percentage of children whose polio or DTP/HepB doses were given less than 28 days apart in each age group seems to indicate that health workers were adequately trained in this area.

In Table 1-14, the 12.2% in the 12-23 month age group and 7.2% of children in the 24-35 month age group who were missing at least one vaccine highlight the need to continue to sensitize communities about the importance of bringing children to all necessary vaccination sessions in a timely manner. The 9.3% of children who had lost their original vaccination cards and received new cards and the 3.0% who lacked any vaccination card in the 24-35 month age group suggests that sensitizing mothers about the importance of retaining vaccination cards could lead to improved immunization coverage and assessment.

Sustainability of the Project

The significantly higher measles vaccination coverage in the 24-35 month group and the nearly-significantly higher percentage of fully-vaccinated children (Table 1-12) may indicate that the EPI program in Cabo Delgado performed better with the support MISAU/VR/FDC Project to Support PAV intervention than without it. While the small sample size of 237 children in each age group limits our ability to compare vaccination coverage across groups, these findings indicate that the quality of PAV activities may have declined in the post-project period following the withdrawal of project partners (FDC and VR). This may indicate that the Project to Support PAV is only sustainable with continued support from project partners.

Limitations

One of the primary limitations of this study is that the sample sizes of the 12-23 and 24-35 month age groups are not large enough to detect small changes in coverage between the groups. The slightly significant and nearly significant chi-squared tests for measles vaccination and full vaccination do indicate, however, that vaccination rates may have declined in the final year of the program and the first year after the program had ended.

A second major limitation of the study is the lack of a baseline survey done in the same manner and in the same clusters as the endline survey. Without a baseline, it is difficult to assess changes that were due to the program itself.

B. Baseline, Endline, and Comparison Surveys: DHS, VR Household and Niassa

Impacts of Project to Support PAV on Immunization Coverage in Cabo Delgado

In Cabo Delgado, DTP3 coverage increased dramatically from 68.9% in 2003 (24-35 month age group) to 95.4% and 92.4% (12-23 month age group) in 2008. Since VR and FDC were the only NGOs exclusively devoted to comprehensively supporting PAV in the Cabo Delgado province (see qualitative survey results, Section III), this increase seems to indicate that the Project to Support PAV positively impacted vaccination coverage in Cabo Delgado. VR and FDC were the only NGOs working to improve vaccination coverage in all districts of Cabo Delgado, while other NGOs operated in 3 or fewer districts.

Other factors may have contributed to the increase in vaccination coverage as well, such as other NGOs' support of mobile brigades in various districts within the province (see qualitative survey results, Section III).

In addition, the introduction of GAVI in 2001 may have also contributed to the rise in vaccination coverage during this period. A study by Lu et al. found that GAVI had a positive effect on vaccination coverage in countries with baseline DTP3 coverage of less than 65% when first approved for GAVI (DTP3 coverage in Cabo Delgado had 28.9% coverage in 1997) [6].

While the Project to Support PAV seems to have contributed to the increase in vaccination coverage from 2003 to 2008, the rapid upward trend in vaccination rates in Cabo Delgado from 28.9% in 1997 to 68.9% in 2003 suggests that the factors that led to this increase may have also contributed to the 2003 to 2008 increase.

From 1975 to 1991, the Mozambican civil war forced 48% of primary health care network to close [7]. Following the civil war, a variety of actions that were taken by the government of Mozambique and international donors likely contributed to the increase in vaccination coverage in Cabo Delgado. As of 2002, the Health Sector Recovery Program had rehabilitated and/or constructed over 400 health facilities, and health facilities' service outputs had increased by 50% [8]. At the end of fiscal year 2000, the government redistributed health spending across provinces to correct for the fact that the health expenditure in poor, northern provinces (including Cabo Delgado) was significantly less than the better-off provinces [8]. In addition, the Health Sector Recovery Program, a Mozambican government-led effort to rebuild the health system, and a plethora of international aid, may have also led to improvements in vaccination rates in Cabo Delgado [8]. Since these factors seem to have contributed to the rise in vaccination coverage from 1997 to 2003, the same factors may have contributed to the rise in vaccination coverage between 2003 and 2008.

Finally, the significantly higher measles vaccination coverage in the 24-35 month group and the nearly-significantly higher percentage of fully-vaccinated children in this age group compared to the 12-23 month age group in the VR survey (Table 1-12) further supports the hypothesis that the Project to Support PAV caused an increase in vaccination coverage. Now that the program has concluded, vaccination coverage appears to be decreasing (Figure 2-2, 2-3, 2-4).

Comparison of Intervention Site (Cabo Delgado) and Comparison Site (Niassa)

When comparing the change in DTP vaccination coverage in the Niassa province from 2003 DHS levels (54.6%) to those found in the 2008 DPS Niassa study (71.9% for the 12-23 month age group and 70.0% for the 24-35 month age group), then contrasting this with the change in vaccination coverage in Cabo Delgado from 2003 DHS levels (68.9%) to those recorded in the VR study (92.8% for the 12-23 month age group and 95.4% for the 24-35 month age group), one notices that the change was greater in the Cabo Delgado province. The odds ratios for the logistic regression models in Table 2-4 also reflect this trend. While these results could indicate the Project to Support PAV boosted the progress of vaccination rates in the Cabo Delgado province in comparison to the Niassa province, important limitations complicate efforts to compare the two provinces.

Limitations

First, the subjective manner in which districts were selected for the DPS Niassa study to reflect socioeconomic conditions of the province make it difficult to compare with the DHS 2003 data. Since the DHS survey is representative of the entire province while the Niassa study can only be assumed to be representative of the districts that were hand-selected by the researcher, this limits the comparability of the DHS 2003 study and the Niassa study. This may prevent the study from drawing reliable conclusions about changes in coverage in Niassa over time.

Second, the presence of 79 faith-based clinics in Niassa may also have influenced vaccination rates in the province [9]. Key differences between the samples and the provinces themselves also make it difficult to compare the data on vaccination coverage in Cabo Delgado and Niassa. Further limitations of this study are the lack of baseline surveys for both the VR study in Cabo Delgado and the DPS study in Niassa, the small sample size of each selected survey group, and the lack of ability to control for differences between the two provinces. A potential source of bias between the surveys includes the uncertainty surrounding the assessment of children's date of birth.

Lessons Learned

The VR household survey illuminated areas where the Project to Support PAV could be improved, such as the need to expand efforts to sensitize the population about the importance of taking their children to be vaccinated and retaining their vaccination cards.

Since the MISAU/FDC/VR Project to Support PAV seems largely responsible for the impressively high vaccination rates in Cabo Delgado, this project should be used as a model to improve vaccination coverage in other provinces of Mozambique and in other low-income countries with viable government health systems. Quantitative data on immunization coverage in the province of Nampula, where another MISAU/FDC/VR Project to Support PAV is underway, will provide further information on the replicability of the program.

Furthermore, the declining trends in vaccination coverage found in Cabo Delgado in the late project/post-project period indicate that project activities and inputs should be renewed in Cabo Delgado to ensure continuation of high vaccination coverage in the province. In addition, this trend also suggests that the Project to Support PAV model of delivery is critical to sustainability.

Endnotes

[1] "DHS Surveys: Methodology". Calverton. MEASURE DHS, Macro International Inc. Sep. 17, 2008.

[2] "Evaluation Tool: Village Reach-FDC-MISAU Project to Support EPI in Mozambique, 2002-2007." Seattle: Village Reach, 2008.

[3] World Health Organization. Immunization Cluster Coverage Survey--Reference Manual. Geneva, 2005.

[4] Graciano, Ermelindo. Inquerito De Cobertura Vacinal Em 6 Distritos Da Provincia Do Niassa. Lichinga: Governo da Provincíncia do Niassa, Direcção Provincial de Saúde, 2008.

[5] 5-Year Assessment of the Project to Support PAV, Cabo Delgado Province. Seattle: VillageReach, FDC, MISAU, 2007.

[6] Lu, C., et al. "Effect of the Global Alliance for Vaccines and Immunisation on Diphtheria, Tetanus, and Pertussis Vaccine Coverage: An Independent Assessment." Lancet 368.9541 (2006): 1088-95.

[7] Cliff, Julie, and Abdul Razak Noormahomed. "The Impact of War on Children's Health in Mozambique." Social Science & Medicine 36.7 (1993): 843-48.

[8] Chao, S., and K. Kostermans. Improving Health for the Poor in Mozambique. Washington, DC: The International Bank for Reconstruction and Development; The World Bank, 2001.

[9] "Entrevista Com Comissão Diocesana De Saúde, Niassa." 2006.

III. Qualitative Surveys

Health Unit Employee Survey

I. Methods

Study Design

Structured, open-ended interviews were conducted with health unit employees based in health units providing vaccine services.

Setting

The health unit employee survey was conducted in the same clusters as the Village Reach Household Survey and Immunization Coverage Cluster Survey.

Participants

The sample used the WHO 30x7 immunization coverage cluster design described in the "Household Survey/WHO Immunization Coverage Cluster Survey" section above [1]. In the 30 clusters, each health unit that provided vaccine services to the cluster according to District Health Directorate records was selected for inclusion in the study. Both health posts and health centers were eligible for inclusion in the study. Two of the clusters, however, did not have health units that provided vaccine services, and two other clusters shared a health unit. A total of 27 health workers from 27 health units were included in the sample.

Upon arrival at the health unit, the person responsible for the PAV program or the refrigerator used for storing vaccines was selected for the interview. Only one health unit employee was interviewed per health unit.

Questionnaire Topics

The interview instruments focused on the following topics: vaccine delivery, vaccine stock, vaccine equipment, storage of vaccines, waste management, and collaboration with Project to Support PAV staff, cost of vaccine-related activities, self-efficacy, and perceived worker safety.

Data Sources/Measurement

The interview instruments used structured, open-ended questionnaires. The interviews were conducted with health unit employees and focused on the topics described in the previous section.

Interviews were conducted in private settings to ensure confidentiality. None of the people who administered the interviews were associated with the Project to Support PAV. All interviews were administered, recorded, and transcribed by one person in Portuguese.

Ethics Approval

Ethics approval was granted in the same manner as that of the Village Reach Household Survey and Immunization Coverage Cluster Survey.

Qualitative Methods and Themes

Health unit employees' responses were analyzed in Excel version 12.0.

II. Results – Health Unit Employee Survey

Table 3-1 describes the different titles of health unit employees who were interviewed. All but one, a servant, were trained health workers.

Table 3-2 summarizes the number of years that respondents had worked in their current job. Most health unit employees had been working in their current position for 2 years or less (76.9%), while nearly 20% had been working in their position for 2-6 years. 84.6% of respondents reported working in immunization in Cabo Delgado prior to December 2006 (Table 3-3), and had therefore collaborated with the Project to Support PAV before its culmination in March 2007.

Regarding vaccines, the majority of health units reported collecting vaccines at their respective DDS or DPS (55.6%) while 37.0% reported receiving vaccines that were delivered to the health unit (Figure 3-1). Of those health units who collected vaccines, only one reported that vaccine services sometimes stop at the health unit during trips to collect vaccines (Table 3-4). Most of the health units who collected vaccines themselves reported doing other health unit-related errands when collecting vaccines (82% reporting "yes," 12% reporting "sometimes").

Table 3-5 describes vaccine stock. Nearly half of the health units reported having ever experienced a vaccine stock out (48%). 37.0% reported having had any vaccine stock out in the survey year (2008), while 33.0% reported any vaccine stock-out in the previous year (2007).

100.0% of health units had refrigerators, and 26 out of the 27 were functioning at the time of the survey (Table 3-6). Only one health unit (the one whose refrigerator was not working) reported ever having experienced a refrigerator breakdown. 85.2% of the refrigerators were gas, and 7.4% were combination gas and electric refrigerators. Over half of respondents reported not having had any problems with refrigerators (51.9%). 18.5% reported that the refrigerator sometimes turned itself off, 7.4% reported gas leaks, and another 7.4% reported a lack of gas as the most common refrigerator problems.

Upon consultation of health unit records, 73.1% of health units had recorded recent refrigerator temperatures (Table 3-6). 25.9% of health units reported having any difficulty maintaining the correct temperature of the refrigerator. About half of the health units had a refrigerator operating and maintenance manual available (48.1%).

When asked if they felt safe working with vaccines, 15.4% stated that they did not feel safe working with vaccines, while 84.6% reported feeling safe (Table 3-7). When asked to explain why they felt unsafe, 6 out of the 26 health unit employees who worked with vaccines cited the fear of being pricked and/or infected. Nine mentioned that they felt confident delivering vaccine services as they had been trained, while 6 cited confidence due to extensive experience and "getting used to" providing vaccines. One cited protective equipment as a reason why he or she was comfortable giving vaccines.

Concerning waste management, 96.3% of health units possessed safety boxes for medical waste, and 92.6% had waste pits (Table 3-8). 14.8% of health units, however, had medical waste on the ground in or near the building. Of the 25 health units with waste pits, 76.0% had waste pits that were at least 1.5 meters deep, 28.0% were surrounded by a fence, 60.0% were at least 50 meters from fields used for food production and water sources, and 0.0% were covered.

III.Discussion

Quality of Health Services and Access to Vaccines

The fact that 55.6% of health unit employees reported picking up vaccines at the provincial or district level reveals that the discontinuation of the provincial-based system of delivery of vaccines by provincial-level staff has provoked problems within the vaccine distribution system. Once the responsibility of delivering vaccines was delegated to districts following the conclusion of the Project to Support PAV, it appears that the districts were unable to deliver vaccines to the health units. Since health units have limited capacity to travel to the district or provincial level to procure vaccines, the breakdown of the province-based vaccine delivery system seems to have led to vaccine stock outs in 2007

(33.3% of health staff confirmed stock-outs) and in the first six months of 2008 (37% of health staff reported vaccine stock-outs).

These findings help explain why vaccination coverage was lower in the 12-23 month age group compared to the 24-35 month age group in the VR Household Survey. Access to vaccines decreased in Cabo Delgado when the province-based model of vaccine delivery to health units was changed following the Project.

Sustainability of the Project

The fact that 26 out of 27 refrigerators in the health units were still functioning over one year after the project demonstrates the quality of the refrigerators that were initially provided by the project. The 48.1% of health units that still had refrigerator maintenance and operating manuals, however, highlights a way in which the sustainability of the project could be improved.

73.1% of health units regularly recorded refrigerator temperatures, which seems to demonstrate the effectiveness of the projects' capacity building activities for health unit staff. The 92.6% of health units with waste pits and the 96.3% with safety boxes may also demonstrate the effectiveness of project activities. Without baseline data, however, it is difficult to determine how much of an impact the Project to Support PAV had on health unit activities such as waste management and refrigerator management.

Limitations

Main limitations of the study included the fact that one of the respondents was a servant, not a health worker, and may or may not have been as informed about PAV activities as a health worker.

Lessons Learned

The interviews with health unit employees demonstrate the need for renewed funding for project activities and technical support in Cabo Delgado. Now that the project has withdrawn, the provincial model for delivery has been largely discontinued. This survey demonstrates that the health districts are unable to deliver vaccines to the majority of health centers, and vaccine stock-outs are threatening communities' access to vaccination services. Additional resources are needed to support the province's return to a provincial distribution system to ensure the availability of vaccines.

Concerning health units' waste pits, only a minority of health units had fences surrounding them, 40% of them were located closer than 50 meters from agricultural land, and none were covered. In both Cabo Delgado and future projects, MISAU, FDC and VR should work to further improve waste pits in health facilities.

Community Leader Survey

I. Methods

Study Design/Setting

Structured, open-ended interviews were conducted with community leaders in all of the same clusters as the Village Reach Household and Immunization Coverage Survey and the Health Unit Employee Survey.

Participants

Upon arrival in a village included in the cluster selection, the community leader was contacted and interviewed.

Data Sources/Measurement

The interview instruments used structured, open-ended questionnaires. Interviews were conducted in private settings to ensure confidentiality. In two communities, however, interviews with the community leader were conducted in the presence of other community leaders.

None of the people who administered the interviews were associated with the Project to Support PAV. Nineteen interviews were administered, recorded, and transcribed by one person in Portuguese, eight of which were with a translator. Eleven interviews were conducted by one person in local languages (Macua, Maconde, Swahili, and Kimuane) and transcribed directly into Portuguese during the time of the interview.

Ethics Approval

Ethics approval was granted in the same manner as that of the Village Reach Household Survey and Immunization Coverage Cluster Survey.

Qualitative Methods and Themes

Community Leaders' responses were analyzed in Excel version 12.0.

II. Results–Interviews with Community Leaders in Cabo Delgado

Knowledge about Vaccines

82.0% of leaders thought that community members understand the importance of vaccinating children. According to them, hospitals, mobile clinics, community leaders, activists, mobile brigades, and NGOs were key sources of information on vaccines for communities.

When asked to explain the purpose of vaccines, only 27.0% of leaders correctly identified vaccines' purpose to prevent illness.

Quality of Health Services and Access to Vaccines

When asked if they had witnessed any changes in health and vaccination services in the last 6 years, 70.0% answered yes. 30.0% of these reported improved access to vaccines.

When asked how health services could be improved, respondents were permitted to provide multiple answers. 60.0% of respondents requested that health care be made more accessible by building a health unit in their community, or, in one case, hiring a community health worker to meet the community's health needs. 33.3% recommended that improvements be made to existing health facilities, like providing ambulances, increasing human resources, improving health workers' treatment of patients, and increasing the size of health units. 16.7% recommended expanded health communication on topics such as hygiene, sanitation, HIV/AIDS, nutrition, and preventive health messages for the elderly.

Use of Health Services

All of the community leaders interviewed stated that mothers usually take their children to be vaccinated. 27.0% of leaders stated that, sometimes, mothers in their communities do not take their children to be vaccinated for the following reasons: failure to understand the importance of vaccines, distance to the health units, lack of time due to agricultural work, fear that vaccine will cause child to become ill, rumors (like "Frelimo wants to use vaccines to kill the opposition," neglect of children due to alcoholism of parents or children living away their parents. Community leaders recommended continued efforts to communicate the importance of vaccines to community members in order to increase usage of vaccine services.

Interviews with Project Staff and Provincial-Level Officials in Cabo Delgado and Nampula

I. Methods

Study Design

Structured, open-ended interviews were conducted with DPS officials and former project staff for the Project to Support PAV in Cabo Delgado. The DPS officials interviewed in Cabo Delgado included: the provincial chief MD, the EPI director, and the division chief of health. In Nampula, both project staff and DPS officials were interviewed. The following Nampula DPS officials were interviewed: the EPI director and the division chief of health.

Setting

The interviews with Project Staff and DPS Officials were conducted in both Cabo Delgado and Nampula.

Participants

Two out of the three project staff from Cabo Delgado were selected due to their direct role in project implementation. The remaining third project staff member from Cabo Delgado worked in Nampula at the time of the study and was interviewed in Nampula about his involvement in the Project.

DPS officials in both Cabo Delgado and Nampula were also selected for their roles as leaders of the provincial health system (provincial Medical Director, Division Director of Health and the EPI Director) in both Nampula and Cabo Delgado.

Questionnaire Topics

The interview instruments for the staff of the Project to Support PAV focused on the following topics: impact of the project, causes of stock-outs pre- and post-project, positive program impacts on areas besides EPI, recommendations for future Projects to Support PAV in other provinces, weaknesses of the project, and ideal duration period of the project. For the instruments used in interviews with DPS officials, topics included: impact of the project, identification of other NGOs and their scope of work in the project intervention area, vaccination campaigns occurring in the provinces in the last few years, recommendations for future Projects to Support PAV in other provinces, positive program impacts on areas besides EPI, and the respondent's perception of (in the case of Cabo Delgado) or recommendations for (in the case of Nampula) the transition from the project to post-project period.

Data Sources/Measurement

The interview instruments used structured, open-ended questionnaires that focused on the topics described above. The interviews were conducted with Project to Support PAV staff as well as DPS officials.

Interviews with DPS officials were conducted one-on-one while project staff was interviewed as a group.

All of the interviews were administered, recorded, and transcribed by one person in Portuguese.

Ethics Approval

Ethics approval was obtained in the same manner as that of the Village Reach Household Survey and Immunization Coverage Cluster Survey.

Qualitative Methods and Themes

A descriptive analysis was conducted using DPS officials', field workers', and project team members' responses to open-ended questions. Subjects' responses were hand-coded using axial coding techniques. Major themes were identified based on their usefulness in answering the main hypotheses of the evaluation (see introduction). Quotes that illustrated key themes were included in the qualitative results.

II. Results–Interviews with Project Staff and DPS Officials, Cabo Delgado

Knowledge about Vaccines

Most respondents reported increased knowledge about vaccines among community leaders and mothers as an impact of the project's social mobilization activities. Project staff noted that they had carried out social mobilization activities at the health units in an effort to raise mothers' and patients' awareness about vaccines.

A DPS official mentioned that a social mobilization officer joined the project team during the last year of the project and helped raise awareness of vaccines among community leaders, teachers, and other community members through regular educational activities. In addition, the DPS official mentioned that the social mobilization officer had trained other advocates in the district to promote awareness about vaccines. The official believed that the monthly arrival of a car delivering vaccines to the health center also raised communities' awareness of vaccines.

Quality of Health Services and Access to Vaccines

Project staff and DPS officials unanimously expressed that the Project to Support PAV had improved the conservation of vaccines due to installation of gas refrigerators in health units. All noted that the petrol refrigerators used in health units prior to the start of the project broke often and led to wastage of vaccines, as the following quote from a DPS official illustrates:

> *The project came about when we really needed it, as the petrol refrigerators were constantly having problems. Their substitution for gas refrigerators was welcomed.*

Project staff noted that they had helped maintain the gas refrigerators provided by the project in the health units. In addition to helping improve vaccine conservation in health units, project staff reported that some community members purchased gas stoves and reduced their consumption of wood, thereby helping the environment.

All respondents credited the project with a reduction in stock-outs of vaccines that led to a reliable supply of vaccines at health units. Before the project, DPS officials and project management staff discussed how the health units lacked the financial resources and means of transportation to collect vaccines at the district level. The centralization of vaccine delivery at the provincial level, and the project's provision of fuel, per diems, staff, and transportation made regular vaccine delivery to the health units possible. The project facilitated collaboration between provincial level staff and project management staff through vaccine distribution activities. A DPS official described how project staff had helped health unit staff analyze their vaccine usage data and estimate the amount needed for the next order.

In addition to improving vaccine supply and cold chain management, a DPS official discussed the program's contribution to waste management, the handling of medical waste, and sanitation.

All respondents mentioned the training of health workers as a project activity that improved the quality of vaccine services. Two DPS officials and project staff also mentioned how this training played a crucial role in increasing the capacity of the large number of newly graduated health workers within the health system.

Project staff and two of the three DPS officials interviewed described how the project's training of health workers in the use and conservation of vaccines, maintaining equipment, collecting and analyzing data, and planning skills led to a decrease in vaccine stock-outs and better vaccine consumption management. Project staff explained that, at the beginning of the project, vaccination workers forgot to factor in mobile brigades in vaccine orders and instead used vaccines ordered for the health units, leading to stock outs. As the

project progressed and health workers were trained, the coordinators noticed that health workers began to include vaccines for mobile brigades in their vaccine orders.

The following quote from a project staff member illustrates one of the many planning challenges that the project helped health workers overcome:

> *The health centers did not know how to plan: for instance, the most distant health centers, and with ill conserved access roads, would go for 2 or 3 months without vaccines due to the rain season. After the project, they learned to request a 3 months' worth of gas and vaccines, taking into consideration the rain and the bad conditions of the roads.*

In addition to assisting PAV activities, the Project to Support PAV aided the health unit and the community in other areas. Both project staff and DPS officials noted how the project helped maintain lighting for the maternity ward, and noted how the project assisted with functions like the delivery of medicines, equipment, mosquito nets, and documents from the provincial level to the district level and health units.

Both DPS officials and project staff noted that the project facilitated a connection between the health units and DPS. The project staff described how, upon encountering problems at the health unit level that could not be solved locally, they communicated these problems to DPS. A DPS official described his experience accompanying delivery team on monthly visits to health units:

> *Through the visits, we could be aware of what was going on overall, not only with the PAV, and we were able to solve problems timely and to avoid other potential problems.*

The project allowed the DPS to become more aware of issues at the health unit level.

When asked to recommend other areas of the health system to which the project should expand in the future, DPS officials and project staff suggested water and sanitation, especially in those health units with little or no access to clean water, as an additional area of focus. One official recommended that training for preventive medicine technicians, provision of mosquito nets, and funding for mobile brigades be added to the project's scope.

Use of Health Services

Project staff reported that the increased availability of vaccines at health units that was associated with the project led to fewer dropouts among children who had not yet received all the necessary vaccinations to become fully immunized. According to the coordinators,

[Mothers] did not risk traveling great distances with their children and not be able to have them vaccinated for lack of vaccines at the health center.

MISAU/FDC/VillageReach Partnership

One DPS official cited the Memorandum of Understanding's failure to clearly describe the roles of VR and FDC, which the official felt contributed to a lack of harmonization between the two organizations and confusion on the part of the DPS.

Another DPS official felt that the overall collaboration between the three partners was effective, but cited FDC's lack of knowledge of VR's vaccination coverage survey as an example of miscommunication between the partners.

Transfer of Project

Perceptions of the transfer of responsibility from FDC to DPS were mixed. Two DPS officials felt that the transfer was well done and that there was a clear change of responsibility from FDC to DPS, while another described how meetings between project partners clarified the date of transfer and the steps that DPS should follow to take over effective management of the project. In contrast, project staff felt that the transition was "very quick" and that the transfer should have been more gradual.

Sustainability of the Project

When discussing the sustainability of the Project to Support PAV, a major theme that emerged was the DPS' failure to continue the policy of provincial vaccine distributions to health units. After the project ended, the DPS discontinued deliveries, and the districts were tasked with obtaining vaccines from the provincial-level depots. Therefore, vaccine distribution and supportive supervision were not continued in their original form. The project staff and DPS officials all cited the importance of returning to the provincial distribution system to avoid stock outs of vaccines in the health units.

Two DPS officials cited the DPS' inability to fund centralized vaccine distribution to health units as the cause of the policy reversal. One official stated:

If the province, or even the district, had enough material and financial resources, it would be ideal to deliver the vaccines to each health center as there used to be done by the project. However, there are no resources for that.

In contrast, another DPS official believed that the DPS had sufficient funds in the state budget to fund vaccine distribution to health units, yet lacked the leadership and vision to continue the provincial model of vaccine distribution.

In order to remedy a situation of perceived financial resource shortages in the state budget, one DPS official recommended that VR allocate funds directly to MISAU, earmarking them for vaccine delivery by DPS staff. The official used Medicos de Mundi as an example of a NGO that already does this. This DPS official also suggested that VR could financially support the districts to facilitate vaccine delivery to health units.

To ensure that resources would remain available to sustain the centralized distribution system in future project, both project staff and DPS officials expressed the need for the project to further train DPS officials to plan and budget for materials needed for vaccination services and monthly visits to health units.

The health system's general lack of resources also seemed to jeopardize the continuity of project activities. Respondents mentioned lack of vehicle repairs and use of PAV-designated vehicles for non-PAV related activities as threats to the sustainability of the project. Project staff discussed how motorcycles were used for non-PAV health activities after the culmination of the project, and that several had broken down and were not repaired. A DPS official described how, after the project ended, 3 vehicles were "taken" from the PAV program, two vehicles had been rendered unusable due to accidents, and another had been transferred to the district for use at that level. In an environment where resources are scarce, it may be difficult for the DPS to designate vehicles and other means of transportation for exclusive use by the PAV program.

Two DPS officials discussed the importance of utilizing DPS staff in future projects instead of hiring staff outside of the project in order to increase the sustainability of the project:

> *Next time, the province should involve DPS directly since the beginning, to avoid having an almost independent project, suddenly, be taken over by DPS.*

One DPS official recommended providing per-diems and equipment to DPS staff in lieu of salaries.

General Weaknesses of the Project

Among the weaknesses encountered during the project, DPS officials reported that health unit employees experienced difficulties using the satellite phones provided by the project, but were uncertain of the cause of these difficulties. In addition, one DPS official noted how delivery of vaccines to health centers required extensive planning, and the lack of vaccine warehouses in the districts presented further challenges.

Another weakness was identified by a DPS official who expressed the opinion that the project decreased health workers' capacity for management of vaccine stock as they relied on the project staff to conduct the planning and fill out the vaccine order forms. The official recommended that the project increase responsibility of district and health center workers in order to address this weakness.

One DPS official reported that stock outs in gas were a weakness of the project. The official attributed this weakness to poor management and planning on the part of the district and health units, not VR and FDC. The official recommended conducting further training on gas stock management and repair for district and health unit staff to help correct this weakness.

Roles of Non-Governmental Organizations in the Province

Out of the two DPS officials with whom this topic was explored, one did not know the answer, and another gave a detailed description of the 12 NGOs working in the Province. VR and FDC were the only NGOs who provided comprehensive support to PAV in all districts, while other NGOs engaged in activities such as health systems strengthening, HIV/AIDS, behavior change communication, capacity building and training of health workers, and water and sanitation infrastructure. Vaccination campaign funding was provided by Medicus Mundi Catalunha in the districts of Montepuez, Namuno, and Balama; by Solidarms in the district of Chiure; by the Aga Khan Foundation in the districts of Pemba Metuge, Macomia, and Ibo; and by Medicus Mundi Aragon in the districts of Meluco, Ancuabe, and Macomia.

Vaccination Campaigns Launched in the District in the Last Few Years

Two DPS officials reported that a national measles and polio campaign had been conducted in 2005, as well as a VAT campaign in 2006.

III.Results–Interviews with Project Staff and DPS Officials, Nampula

Knowledge about Vaccines

The project staff reported assisting in informing community leaders and mothers about the availability of vaccines, and encouraged pregnant women to seek prenatal care at local health units. They also described how the budget for social mobilization had also financed radio programs about vaccination and maternal health. One of the DPS officials interviewed noted that the project's contribution to an increase in vaccination posts and mobile brigades helped raise communities' awareness of vaccines.

Quality of Health Services and Access to Vaccines

As in Cabo Delgado, respondents reported how the Project to Support PAV dramatically improved the cold chain by replacing the petrol refrigerators, which often malfunctioned, with reliable gas refrigerators. In addition to their reliability, the program management team noted that the gas refrigerators provided by the project were easy to repair.

One DPS official noted that, prior to the project, the districts' inability to pick up vaccines and deliver them to health centers due to resource limitations led to frequent stock outs. This official painted a picture of the state of rural health units before the project started: "The most distant health centers could go for 2 or 3 months without vaccines to use." The project staff described how, pre-project, vaccines would often expire at the district level due to lack of resources and poor road conditions.

All respondents noted that the project had assured the availability of vaccines at health units. A DPS official spoke of the project's role in providing resources, like motorcycles and bicycles that facilitated the delivery of vaccines to health centers and improved the population's access to vaccines.

In order to further improve vaccination management, DPS officials recommended that the project follow MISAU's recommendations for motorcycle purchases. The official noted that the brand of motorcycles purchased by the project were not the "XL" model recommended by MISAU for use in rural areas and would be more likely to break.

Similar to respondents in Cabo Delgado, one of the DPS officials and the project staff reported that the project had helped train health workers in the following areas: refrigerator maintenance, vaccine management, social mobilization, and waste management. As in Cabo Delgado, project staff noted how the project played an important role in training newly graduated health workers.

Respondents identified management training at both the health unit and provincial level as one of the project's major contributions. According to project staff, the DPS' failure to place vaccine orders in a timely manner was a source of stock outs before the project, and the project helped strengthen the DPS' capacity for planning in order to prevent further stock outs. In addition, a DPS official described how the project improved health workers' ability to plan multiple mobile brigades, which in turn lowered the number of vaccine dropouts.

Both DPS officials described the program's role in improving health workers' skills by increasing the frequency and improving the quality of supervisory visits by project staff. In a change from the Cabo Delgado Project to Support PAV, the Nampula project employed

DPS staff as project staff instead of employing non-MISAU staff. One DPS official said that supervisory visits were rare before the project due to lack of financial resources. The official reported that the project had trained 4 DPS staff as project staff and provided the financial resources to enable them to conduct supervisory visits to health units on a monthly basis. According to DPS officials, the supervisory visits allowed for "frequent on-the-job training" for health workers.

Other Areas of Improvement

In addition to strengthening vaccination services, improving the cold chain, and training health workers, the project also helped build capacity in other areas. The project staff reported training teachers and students from the Centers for Training in Health in social mobilization techniques and helping promote the importance of prenatal care and giving birth at a health center. According to DPS officials, the project renovated DPS premises for PAV offices and purchased computers.

Project staff reported delivering other medicines and mosquito nets along with vaccines to health units, as was done in Cabo Delgado. The team also described how the project established collaborative relationships with other NGOs working in the district such as Medicus Mundi.

MISAU/FDC/VillageReach Partnership

In order to improve the collaboration between VR, FDC, and MISAU, one of the DPS officials recommended working more closely with the DPS to avoid confusion caused by giving conflicting orders to staff, especially regarding vehicles and drivers.

Transfer of Project

Respondents advocated a gradual transfer of project responsibilities from VR and FDC to the DPS. The project staff recommended that the two final years of the Project to Support PAV should be devoted to monitoring and gradual handover of the project to DPS. A DPS official recommended that the transfer of responsibility from VR and FDC to the DPS be "gradual and with constant assessments."

Sustainability of the Project

Although the Nampula project has not yet come to an end, respondents expressed opinions about sustainability that were similar to respondents in Cabo Delgado. DPS officials spoke of the need to establish better collaboration between the project and DPS to make the project sustainable: "Integrate the project and DPS well at the beginning so that the objectives, strategies, and activities are well-known by everyone…hold regular meetings to evaluate the performance of the project." The DPS official also highlighted the

importance of training personnel to the point where they can lead project activities once the responsibility is transferred to the DPS.

As in Cabo Delgado, DPS officials mentioned that the primary issue in the sustainability of the project was ensuring funding for the project once the responsibility is transferred to DPS. In order to make funding feasible for the DPS post-project, officials recommended cutting costs over the course of the program. DPS officials recommended establishing regional vaccine warehouses and placing project staff in these areas, and changing per diems to "stipends" and reducing the amount in order to reduce program costs.

Finally, a DPS official recommended that future projects integrate project expenses into their budget prior to taking over responsibility for the program. The official recommended following the example set by Nampula, who included project expenses in their 2009 budget. One official recommended that the funds be given directly to the DPS to manage as other NGOs working in Nampula do (like Heifer and CUAMM).

General Weaknesses of the Project

The project staff reported that some stock outs have occurred during the project due to health workers forgetting to factor vaccines required for mobile brigades into their vaccine orders, then taking vaccines that were designated for use in the health unit. Project staff from Cabo Delgado had highlighted this as a challenge that was overcome over the course of the project.

Challenges

A DPS official described one of the major challenges faced by the project: overburdened health workers. The official noted that some health centers only have one health worker.

The project staff cited personnel turnover among health workers as another challenge to the success of the project. In order to address this issue, team members recommended reaching an agreement with DPS to have health workers who are being transferred to train his or her replacement in project focus areas.

Roles of Non-Governmental Organizations in the Province

One DPS official named 18 NGOs that were working in the Nampula province. The official reported that VR and FDC were the only NGOs who focused solely on vaccines in the province. He also mentioned that FDC and VR were the only NGOs who were currently working in all districts in the province. Other NGOs that supported vaccination activities

included CARE and Save the Children USA, who supported vaccination campaigns in 14 provinces.

Vaccination Campaigns Launched in the District in the Last Few Years

In addition to the national measles and polio vaccination campaign for children launched in 2005, one DPS official reported a VAT campaign in 2007 as well as an additional vaccination campaign in 2008.

Discussion—Community Leaders, Project Staff and DPS Officials

Knowledge of Vaccines

Similar to the respondents in the household survey, few community leaders could name the purpose of vaccines. While most thought that people in their community recognized the importance of vaccines, low levels of awareness of vaccines' purpose among community leaders and the respondents of the household survey may speak to a need for expanded efforts to inform the community about the purpose of vaccines.

Quality of Health Services and Access to Vaccines-Cabo Delgado

Interviews with project staff and DPS officials from Cabo Delgado shed light on the ways in which the Project to Support PAV improved vaccine conservation, vaccine services, and health workers' capacity to deliver vaccine services in a safe and effective manner. This feedback supports the theory that the project was implemented as planned, and that these activities contributed to increased vaccination coverage in Cabo Delgado.

Interviews with community leaders provided some evidence of changes in vaccine services, as 30% noted that the availability of vaccines had improved. Since few, if any, community leaders regularly took infants to be immunized at health centers, they may not be as informed about changes in vaccine services as caretakers of young children would be.

Replicability-Nampula Province Project to Support PAV

The similarities of themes in interviews with the project staff and DPS officials from Nampula with those from Cabo Delgado speaks to the replicability of the project. As in Cabo Delgado, respondents in Nampula noticed a decrease in stock-outs of vaccines thanks to the introduction of a centralized distribution system, improved vaccine conservation due to

reliable gas refrigerators, and health workers' increased ability to manage vaccine services due to regular training and supervision.

Sustainability

Project staff' and DPS officials' reports of a reversal in the provincial distribution system of the project may explain the significant difference in measles coverage between the 12-24 and 25-34 month age groups and the nearly significant difference in full vaccination found in the household survey and immunization coverage cluster survey.

The findings of the household survey, health unit employee survey, and qualitative interviews indicate that the quality of vaccination services may have declined due to stock-outs of vaccines. Prior to the project, district health centers lacked the resources to distribute vaccines to health units. Therefore, the discontinuation of the project-initiated province-based vaccine distribution system represented a return to pre-project conditions that had initially led to frequent stock outs of vaccines in health units.

The quote from the Cabo Delgado DPS official regarding the districts' inability to deliver vaccines to health units and the health units' inability to procure vaccines at the district level on a regular basis supports this hypothesis. In addition, the fact that over half of the health units interviewed in the health unit employee survey had to pick up vaccines at the district level speaks to the districts' inability to make regular deliveries to health units. These results help explain the declining trends in vaccination coverage between the 12-24 and 25-34 month age groups in the VR survey and indicate that high vaccination coverage cannot be sustained if the centralized vaccine distribution model is discontinued.

Limitations

Regarding the interviews with project staff, it is possible that they may have been reluctant to say negative things about the project for fear of losing their jobs (Nampula) or a desire to regain their employment (Cabo Delgado project staff). Furthermore, the fact that project staff were interviewed in a group may have led to a reluctance to say anything critical of colleagues' performance. Concerning interviews with DPS officials, more information was obtained from the Cabo Delgado province than in the Nampula province. In Nampula, one DPS official was not available for an interview, and another interview was cut short due to professional activities.

Lessons Learned

As both the household survey and community leader interviews indicated lack of knowledge of vaccines' purpose among community members, the project could expand efforts to improve communities' understanding of the importance of vaccines.

As in the household survey, the issue of long distances separating health services and communities arose in interviews with community leaders. 70% of respondents lived over 1 hour from a health unit and distance from health center was the most frequent reason for vaccination failure among respondents of the VillageReach Household and WHO Immunization Coverage Surveys. The 60% of community leaders surveyed who recommended making health care more accessible to communities by building health units or hiring community health workers in order to improve health services reflect the need for more accessible health care in Cabo Delgado.

Endnotes

[1] "Evaluation Tool: Village Reach-FDC-MISAU Project to Support EPI in Mozambique, 2002-2007." Seattle: Village Reach, 2008.

IV. Figures and Tables

LIST OF FIGURES

Figure Number

Page

LIST OF TABLES

Table Number

Table 1-1: Select Characteristics of Respondents and Children, Village Reach Household Survey and Immunization Coverage Cluster Survey

Characteristic	12-23 Month Age Group (n=237)		24-35 Month Age Group (n=237)	
	n	%	n	%
Child's sex				
M	117	49.4	122	51.5
F	120	50.6	115	48.5
Total (valid n)	237		237	
Child's possession of vaccination card				
Yes	235	99.2	230	97.0
No	2	0.8	7	3.0
Total (valid n)	237		237	
Interviewee's sex				
M	4	1.7	5	2.1
F	233	98.3	232	97.9
Total (valid n)	237		237	
Age of respondent				
≤ 22 years	61	25.7	48	20.3
23-27 years	52	21.9	58	24.5
28-32 years	48	20.3	46	19.4
≥ 33 years	55	23.2	62	26.2
Don't know	21	8.9	23	9.7
Total (valid n)	237		237	
Respondent's relationship to child				
Mother	226	95.4	224	94.9
Father	4	1.7	4	1.7
Brother/sister	3	1.3	3	1.3
Grandparent	4	1.7	3	1.3
Other adult	0	0.0	1	0.8
Total (valid n) a	237		235	
Education level of mother or caretaker of child				
None	166	70.0	157	66.2
Some primary	61	25.7	62	26.2
Completed primary	7	3.0	12	5.1
Some secondary	2	0.8	5	2.1
Completed secondary	1	0.4	1	0.4
Total (valid n)	237		237	

[a] Missing data due to errors in data collection.

Table 1-2: **Household Characteristics, VillageReach Household Survey and Immunization Coverage Cluster Survey**

	12-23 Month Age Group, (n=237)		24-35 Month Age Group, (n=237)	
	n	%	n	%
Sex of head of household				
M	205	86.5	206	86.5
F	32	13.5	31	13.5
Total (valid n)	237		237	
Household size				
≤ 4 members	82	34.6	62	26.2
5-6 members	92	38.8	92	38.8
≥ 7 members	63	26.6	83	35.0
Total (valid n)	237		237	
Number of children under 5 living in household				
1 child	117	49.4	123	51.9
2 children	118	49.8	113	47.7
3 children	2	0.8	1	0.4
Total (valid n)	237		237	
Building materials of house				
Straw	2	0.8	8	3.4
Stick, grass roof	215	91.1	205	86.5
Stick, zinc/metal roof	15	6.4	18	7.6
Cement, zinc/metal roof	4	1.7	6	2.5
Total (valid n) [a]	**236**		**237**	

[a] Missing data due to errors in data collection.

Table 1-3: Household Characteristics, VillageReach Household Survey and Immunization Coverage Cluster Survey (continued)

	12-23 Month Age Group (n=237)		24-35 Month Age Group (n=237)	
	n	%	n	%
Own agricultural land				
Yes	212	89.5	214	90.3
No	25	10.5	23	9.7
Total (valid n)	237		237	
Own radio				
Yes	108	45.6	112	47.3
No	129	54.4	125	52.7
Total (valid n)	237		237	
Own animals				
Chickens				
Yes	108	45.6	121	51.1
No	129	54.4	116	48.9
Total (valid n)	237		237	
Ducks				
Yes	23	9.7	26	11.0
No	214	90.3	211	89.0
Total (valid n)	327		237	
Pigeons				
Yes	3	1.3	3	1.3
No	234	98.7	234	98.7
Total (valid n)	237		237	
Rabbits				
Yes	3	1.3	1	0.4
No	234	98.7	236	99.6
Total (valid n)	237		237	
Pigs				
Yes	14	5.9	16	6.8
No	223	94.1	221	93.2
Total (valid n)	237		237	
Goats				
Yes	24	10.1	35	14.8
No	213	89.9	202	85.2
Total (valid n)	237		237	
Sheep				
Yes	1	0.4	1	0.4
No	236	99.6	236	99.6
Total (valid n)	237		237	
Cows				
Yes	1	0.4	0	0.0
No	236	99.6	237	100.0
Total (valid n)	**237**		**237**	

Table 1-4: Access to Health Facilities, Household Survey and Immunization Coverage Cluster Survey

	12-23 Month Age Group (n=237)		24-35 Month Age Group (n=237)	
	n	%	n	%
Distance from health facility				
<1 hour	71	30.0	69	29.1
1-2 hours	54	22.8	53	22.4
>2 hours	112	47.3	113	47.7
Don't know	0	0.0	1	0.4
Never went	0	0.0	1	0.4
Total (valid n)	237		237	
Mode of transportation to health facility				
Walk	203	85.7	202	85.2
Bicycle	23	9.7	22	9.3
Motorcycle	3	1.3	1	0.4
Car	3	1.3	6	2.5
Chapa (bus)	5	2.1	2	0.8
Other	0	0.0	3	1.3
Never went	0	0.0	1	0.4
Total (valid n)	237		237	

Table 1-5: Use of Health Facilities, Household and Immunization Coverage Survey

	12-23 Month Age Group, (n=237)		24-35 Month Age Group (n=237)	
	n	%	n	%
Time since respondent's most recent health facility visit				
This week	27	11.4	31	13.1
Last week	48	20.3	53	22.5
Last month	136	57.4	134	56.8
Last year	20	8.4	15	6.4
Over 1 year ago	0	0.0	1	0.4
Don't know	4	1.7	1	0.4
Don't remember	2	0.8	0	0.0
Never went	0	0.0	1	0.4
Total (valid n) [a]	237		236	
What respondent did last time he/she visited a health facility				
Child weighed	154	65.0	113	47.7
Scheduled an appointment	17	7.2	5	2.1
Appointment	24	10.1	39	16.5
Child was sick	10	4.2	12	5.0
Child was vaccinated	13	5.5	12	5.0
Malaria treatment	7	3.0	10	4.2
Child's mother was sick	2	0.8	4	1.7
Relative was sick	1	0.4	1	0.4
Does not remember/know	9	3.8	9	3.8
Child weighed and vaccinated	0	0.0	8	3.4
Child weighed + appointment	0	0.0	6	2.5
Prenatal consultation	0	0.0	11	4.6
Child delivery	0	0.0	3	1.3
Family planning	0	0.0	1	0.4
Surgery	0	0.0	1	0.4
Never went to health center	0	0.0	1	0.4
Total (valid n)	237		237	
Source of last vaccine child received				
Health unit	185	77.5	179	75.5
Mobile brigade	49	21.2	54	22.8
Don't know	1	0.4	0	0.0
Don't remember	0	0.0	2	0.8
Never was vaccinated	2	0.8	2	0.8
Total (valid n)	237		237	

[a] Missing data due to errors in data collection.

Table 1-6: Dissemination of information about vaccines, VillageReach Household Survey and Immunization Coverage Cluster Survey

	12-23 Month Age Group (n=237)		24-35 Month Age Group (n=237)	
	n	%	n	%
Source of information about vaccines				
Community leaders				
Yes	77	32.6	71	30.0
No	159	67.4	166	70.0
Total (valid n) [a]	236		237	
Radio				
Yes	17	7.2	23	9.7
No	219	92.4	214	90.3
Total (valid n) [a]	236		237	
Mobile brigades				
Yes	57	24.2	49	20.8
No	179	75.8	187	79.2
Total (valid n) [a]	236		236	
Friends and family				
Yes	12	5.1	17	7.2
No	224	94.9	220	92.8
Total (valid n)	237		237	
Health workers				
Yes	105	44.5	109	46.0
No	131	55.5	128	54.0
Total (valid n) [a]	236		237	
Activists or NGOs				
Yes	0	0.0	1	0.4
No	236	100.0	235	99.6
Total (valid n) [a]	236		236	
Theater groups				
Yes	0	0.0	1	0.4
No	236	100.0	236	99.6
Total (valid n) [a]	236		237	
Other				
Yes	3	1.3	1	0.4
No	233	98.7	236	99.6
Total (valid n) [a]	236		237	

[a] Missing data due to errors in data collection.

Table 1-7: Respondents' Knowledge About Vaccines, Household Survey and Immunization Coverage Cluster Survey

	12-23 Month Age Group (n=237)		24-35 Month Age Group (n=237)	
	n	%	n	%
Ever heard of vaccines				
Yes	224	94.5	223	94.1
No	13	5.5	14	5.9
Total (valid n)	237		237	
Knowledge of vaccines' purpose				
Prevent illness	95	40.1	103	43.6
Don't know	142	59.9	133	56.4
Total (valid n)	237		237	

Table 1-8: Quality of Health Services, Village Reach Household Survey and Immunization Coverage Cluster Survey

	12-23 Month Age Group (n=237)		24-35 Month Age Group (n=237)	
	n	%	n	%
Ever been to a health unit for vaccines but not able to get vaccines?				
Yes	49	20.7	47	19.8
No	187	78.9	188	79.3
Never went	0	0.0	2	0.8
Never was vaccinated	1	0.4	0	0.0
Total (valid n)	237		237	
Reasons for inability to obtain vaccines when sought at health facility				
Health unit closed	2	4.1	0	0.0
Health worker not present	3	6.1	7	15.2
Vaccines not being offered	0	0.0	4	8.7
Stock out of vaccines	40	81.6	31	67.4
Equipment problems	1	2.0	1	2.2
Don't know	3	6.1	2	4.3
Mobile brigade was on its way from the village and therefore did not give vaccine	0	0.0	1	2.2
Total (valid n)†	49		46	
Any differences in health services in last 5 years?				
Yes	34	14.4	31	13.1
No	202	85.6	205	86.5
Total (valid n)	237		237	

† Only those who answered "yes" to the question "Ever been to a health unit for a vaccine but not able to get a vaccine," were asked about the reasons for inability to obtain vaccines. For the 12-23 month age group, n=49; for the 24-35 month age group, n=47. Missing data in the 24-35 month age group due to errors in data collection.

Table 1-9: Summary of Valid Immunization Coverage Among 12-23 Month and 24-35 Month Age Groups in Cabo Delgado Province, VillageReach Household Survey and Immunization Coverage Cluster Survey

	12-23 Month Age Group (n=237)		24-35 Month Age Group (n=237)	
	n	% [95% CI]	n	% [95% CI]
Fully-immunized[a]	**174**	**73.0**	**171**	**72.2**
Fully immunized by 12 months of age [b]	145	61.2 [52.4-70.0]	130	54.9 [45.9-63.8]
Fully immunized at or after 12 months of age [c]	28	11.8 [6.0-17.6]	41	17.3 [10.5-24.1]
Non-immunized	**64**	**27.0**	**66**	**27.8**
Total (valid n)	**237**		**237**	

[a] Defined as receiving the following doses of valid vaccines prior to, at, or after 12 months of age: BCG vaccination verified by history plus scar, card plus scar, or card only; all three polio vaccinations received a minimum of 28 days apart as verified on card, all three DTP/HepB vaccines received a minimum of 28 days apart as verified on card; and measles vaccination received after 9 months of age as verified on card.

[b] Total number of fully immunized children who received vaccinations according to "fully immunized children" criteria prior to 12 months of age.

[c] Defined as receiving vaccinations according to the "fully immunized child" criteria at or after 12 months of age.

<u>Table 1-10:</u> Vaccination Coverage by Card or History Among 12-23 Month and 24-35 Month Age Groups in Cabo Delgado Province, VillageReach Household Survey and Immunization Coverage Cluster Survey

	12-23 Month Age Group (n=237)		24-35 Month Age Group (n=237)	
	n	% [95% CI]	n	% [95% CI]
Presence of BCG scar				
Yes	222	94.5 [90.3-98.6]	223	94.1 [89.8-98.3]
No	13	5.5 [1.4-9.7]	14	5.9 [1.7-10.1]
Total (valid n) [a]	235		237	
BCG vaccination				
Confirmed by card	220	92.8 [88.2-97.5]	207	87.3 [81.4-93.3]
Confirmed by history	13	5.5 [1.4-9.6]	27	11.4 [5.7-17.1]
Not vaccinated	4	1.7 [-0.6-4.0]	3	1.3 [-0.7-3.3]
Total (valid n)	237		237	
Polio-1 vaccination				
Confirmed by card	222	93.7 [89.3-98.1]	211	89.0 [83.4-94.7]
Confirmed by history	11	4.6 [0.9-8.4]	24	10.1 [4.7-15.6]
Not vaccinated	4	1.7 [-0.6-4.0]	2	0.8 [-0.8-2.5]
Total (valid n)	237		237	
Polio-2 vaccination				
Confirmed by card	221	93.2 [88.7-97.8]	209	88.2 [82.4-94.0]
Confirmed by history	10	4.2 [0.6-7.8]	23	9.7 [4.4-15.0]
Not vaccinated	6	2.5 [-0.3-5.4]	5	2.1 [-0.5-4.7]
Total (valid n)	237		237	
Polio-3 vaccination				
Confirmed by card	210	88.6 [82.9-94.3]	204	86.1 [79.8-92.3]
Confirmed by history	11	4.6 [0.9-8.4]	24	10.1 [4.7-15.6]
Not vaccinated	16	6.8 [2.2-11.3]	9	3.8 [0.4-7.2]
Total (valid n)	237		237	
Polio 3 (3 doses of polio) [b]				
Confirmed by card alone	208	87.8 [81.9-93.7]	203	85.7 [79.3-92.0]
Confirmed by history alone	10	4.2 [0.6-7.8]	23	9.7 [4.4-15.0]
Confirmed by history + card	2	0.8 [-0.8-2.5]	1	0.4 [-0.7-1.6]
Not vaccinated	17	7.2 [2.5-11.8]	10	4.2 [0.6-7.8]
Total (valid n)	237		237	
DTP-1 + Hep B-1 vaccination				
Confirmed by card	220	92.8 [88.2-97.5]	211	89.0 [83.4-94.7]
Confirmed by history	11	4.6 [0.9-8.4]	23	9.7 [4.4-15.0]
Not vaccinated	6	2.5 [-0.3-5.4]	3	1.3 [-0.7-3.3]
Total (valid n)	237		237	

DTP-2 + Hep B-2 vaccination				
Confirmed by card	220	92.8 [88.2-97.5]	208	87.8 [81.9-93.7]
Confirmed by history	10	4.2 [0.6-7.8]	23	9.7 [4.4-15.0]
Not vaccinated	7	3.0 [-0.1-6.0]	6	2.5 [-0.3-5.4]
Total (valid n)	237		237	
DTP-3 + Hep B-3 vaccination				
Confirmed by card	210	88.6 [82.9-94.3]	204	86.1 [79.8-92.3]
Confirmed by history	11	4.6 [0.9-8.4]	24	10.1 [4.7-15.6]
Not vaccinated	16	6.8 [2.2-11.3]	9	3.8 [0.4-7.2]
Total (valid n)	237		237	
DTP 3 (3 doses of DTP/Hep B)				
Confirmed by card alone	208	87.8 [81.9-93.7]	202	85.2 [78.8-91.6]
Confirmed by history alone	10	4.2 [0.6-7.8]	23	9.7 [4.4-15.0]
Confirmed by card + history	2	0.8 [-0.8-2.5]	1	0.4 [-0.7-1.6]
Not vaccinated	17	7.2 [2.5-11.8]	11	4.6 [0.9-8.4]
Total (valid n)	237		237	
Measles vaccination				
Confirmed by card	204	86.1 [79.8-92.3]	203	85.7 [79.3-92.0]
Confirmed by history	10	4.2 [0.6-7.8]	23	9.7 [4.4-15.0]
Not vaccinated	23	9.7 [4.4-15.0]	11	4.6 [0.9-8.4]
Total (valid n)	237		237	

[a] Missing data due to errors in data collection.

[b] Excluding dose given shortly after birth

Table 1-11: Vaccination Coverage by Card and/or history among 12-23 Month and 24-35 Month Age Groups in Cabo Delgado Province, VillageReach Household Survey and Immunization Coverage Cluster Survey

	12-23 Month Age Group (n=237)		24-35 Month Age Group (n=237)	
	n	% [95% CI]	n	% [95% CI]
Vaccination status of child				
Fully-vaccinated child[a]	208	87.8 [81.9-93.7]	220	92.8 [88.2-97.5]
Partially-vaccinated child[b]	27	11.4 [5.7-17.1]	15	6.3 [1.9-10.7]
Non-vaccinated child[c]	2	0.8 [-0.8-2.5]	2	0.8 [-0.8-2.5]
Total (valid n)	237		237	
Confirmed BCG vaccination[d]	232	97.9 [95.3-100.5]	234	98.7 [96.7-100.7]
Polio 3[e]	220	92.8 [88.2-97.5]	227	95.8 [92.2-99.4]
DTP3[e]	220	92.8 [88.2-97.5]	226	95.4 [91.6-99.1]
Measles vaccination[f]	214	90.3 [85.0-95.6]	226	95.4 [91.6-99.1]

[a] Defined as receipt of BCG vaccination verified by history plus scar, card plus scar, or card only and all other vaccinations as verified by card or history.

[b] Defined as receiving at least one of the vaccines according to the criteria described for "fully- vaccinated child."

[c]Defined as not having received any of the vaccines according to the "fully-vaccinated child" criteria.

[d]Defined as receipt of BCG vaccination as verified by history plus scar, card plus scar, or card only.

[e]Defined as receipt of all polio or DTP/HepB vaccinations as verified by card, history, or history plus card, and excluding dose given shortly after birth.

[f]Defined as receipt of measles vaccinations as verified by card or history.

<u>Table 1-12:</u> Estimates and Differences between Children 12-23 Months Old and 24-35 Months Old[a] in Immunization and Vaccination Coverage at the Time of the Survey from Card and/or History in Cabo Delgado, Mozambique from the VillageReach Household Survey and Immunization Coverage Cluster Survey

	24-35 months (n=237) % [95% CI]	12-23 months (n=237) % [95% CI]	Difference (24-35 mo – 12-23 mo)	P-value[b]
Fully immunized by 12 months	54.9 [45.9-63.8]	61.2 [52.4-70.0]	-6.3	0.16
Fully vaccinated*	**92.8 [88.2-97.5]**	**87.8 [81.9-93.7]**	**5.0**	**0.06**
DTP 3	95.4 [91.6-99.1]	92.8 [88.2-97.5]	3.0	0.24
Measles vaccination*	**95.4 [91.6-99.1]**	**90.3 [85.0-95.6]**	**5.4**	**0.03**

[a] The 12-23 month age group from the VR survey represents children vaccinated in the year following the project's conclusion. The 24-35 month age group represents those children vaccinated at the peak of project activities in Cabo Delgado.

[b] Pearson's chi-square test

*Coverage rate differences between the two age groups was statistically significant for measles vaccination and nearly significant for "fully vaccinated" children

Figure 1-1: **Differences in Vaccination Coverage Between the 24-35 Month Age Group and the 12-23 Month Age Group from Both Card and History in Cabo Delgado, Mozambique from the VillageReach Household Survey and Immunization Coverage Cluster Survey**

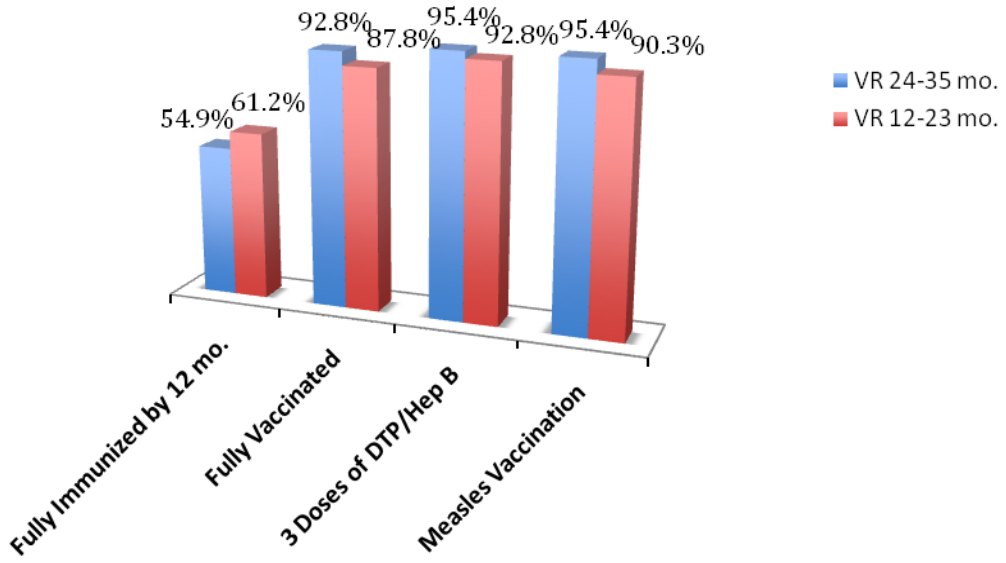


Table 1-13: **Immunization System Utilization (Drop-Out Rates)**

Differences in Coverage	12-23 Month Age Group (n=237)	24-35 Month Age Group (n=237)
	%	%
BCG - Measles		
By card	6.8	1.7
By card + history	8.0	3.4
DTP-1 - Measles		
By card	6.8	3.4
By card + history	7.2	3.4
DTP-1 - DTP-3		
By card	5.1	3.8
By card + history	5.5	3.8

<u>Table 1-14:</u> Main Reasons for Not Qualifying as Fully Immunized Among Children Aged 12-23 Month and 24-35 Months in Cabo Delgado Province, VillageReach Household Survey and Immunization Coverage Cluster Survey

	12-23 Month Age Group (n=237)		24-35 Month Age Group (n=237)	
	n	(%) [95% CI]	n	(%) [95% CI]
Measles vaccine received before 9 months of age[a]				
Yes	18	7.6 [2.8-12.4]	20	8.4 [3.4-13.4]
No	219	92.4 [87.6-97.2]	217	91.6 [86.6-96.6]
Total (valid n)	237		237	
Lack of 28-day interval between polio or DTP/Hep B doses[a]				
Yes	4	1.7 [-0.6-4.0]	4	1.7 [-0.6-4.0]
No	233	98.3 [96.0-100.6]	233	98.3 [96.0-100.6]
Total (valid n)	237		237	
Missing at least one vaccine[a]				
Yes	29	12.2 [6.3-18.1]	17	7.2 [2.6-11.9]
No	208	87.8 [81.9-93.7]	218	92.8 [88.1-97.4]
Total (valid n) [b]	237		235	
Child possesses vaccination card				
Yes	235	99.2 [97.5-100.8]	230	97.0 [94.0-100.1]
No	2	0.8 [-0.8-2.5]	7	3.0 [-0.1-6.0]
Total (valid n)	237		237	
Original vaccination card lost--new card stated "vaccinations completed" [a]				
Yes	9	3.8 [0.4-7.3]	22	9.3 [4.1-14.5]
No	226	95.4 [91.6-99.2]	215	90.7 [85.5-95.9]
Total (valid n) [b]	235		237	

[a] "Yes" are those who do not qualify as "fully immunized children."

[b] Missing data due to errors in data collection.

Table 1-15: Reasons for Vaccination Failure[a] Among Partially- and Non-Vaccinated Children Aged 12-23 Month and 24-35 Months in Cabo Delgado Province, VillageReach Household Survey and Immunization Coverage Cluster Survey

	12-23 Month Age Group (n=29)		24-35 Month Age Group (n=17)	
	n	%	n	%
Lack of information-				
Unaware of need for immunization	1	3.5	2	11.8
Unaware of need to return for 2nd or 3rd dose	0	0.0	0	0.0
Place and/or time of immunization unknown	5	17.2	1	5.9
Fear of side reactions	0	0.0	0	0.0
Wrong ideas about contraindications	0	0.0	0	0.0
Other	1	3.5	0	0.0
Lack of motivation				
Postponed until another time	2	6.9	3	17.7
No faith in immunization	0	0.0	0	0.0
Rumors	0	0.0	0	0.0
Other	0	0.0	0	0.0
Obstacles				
Place of immunization too far	7	24.1	5	29.4
Time of immunization inconvenient	0	0.0	0	0.0
Vaccinator absent	1	3.5	1	5.9
Vaccine not available	6	20.7	2	11.8
Mother too busy	4	13.8	2	11.8
Family problem, including illness of mother	0	0.0	0	0.0
Child ill—not brought	0	0.0	0	0.0
Long waiting time	0	0.0	0	0.0
Other	2	6.9	1	5.9
Total (valid n)	29		17	

[a] Partially- or non-vaccinated children (see Table 10)

Table 2-1: Vaccination Coverage by Card and/or History among Children 12-23 Months of Age, DHS 1997

	12-23 age group	
	n	(%) [95% CI]
Cabo Delgado (n=71)		
All vaccinations	18	25.4 [12.0-38.7]
DTP 3	20	28.9 [15.1-42.7]
Measles vaccination	28	40.2 [23.4-57.0]
Niassa (n=70)		
All vaccinations	34	48.2 [29.7-66.7]
DTP 3	42	59.3 [40.0-78.5]
Measles vaccination	42	59.4 [40.6-78.2]

Table 2-2: Vaccination Coverage by Card and/or History among Children 12-23 Months of Age, DHS 2003

	12-23 age group	
	n	(%) [95% CI]
Cabo Delgado (n=169)		
All vaccinations	98	57.9 [46.9-69.0]
DTP 3	117	68.9 [58.5-79.3]
Measles vaccination	136	80.2 [72.5-87.8]
Niassa (n=78)		
All vaccinations	36	46.6 [36.8-56.3]
DTP 3	42	54.6 [45.7-63.5]
Measles vaccination	40	51.9 [42.3-61.5]

Table 2-3: Logistic Regression Models Examining Associations between "All Vaccinations" Coverage and Survey by Time Period and Province. (Significant associations in bold)

		All vaccinations	Difference	Crude OR	
Province & time period	n	n_{yes} (%)	survey 2-survey 1	(95% CI)	P-value
Cabo Delgado, 1997-2003					
DHS (1997)	71	25.4		Reference	
DHS (2003)	**169**	**57.9**	**32.5**	**4.1 [2.2-7.5]**	**< .001**
Cabo Delgado, 2003-2006					
DHS (2003)	169	57.9		Reference	
VR 24-35 months[a]	**237**	**92.8**	**34.9**	**9.4 [5.3-16.8]**	**< .001**
Cabo Delgado, 2003-2008					
DHS (2003)	169	57.9		Reference	
VR 12-23 months[a]	**237**	**86.9**	**29.0**	**4.8 [3.0-7.8]**	**< .001**
Niassa, 1997-2003					
DHS (1997)	70	48.2		Reference	
DHS (2003)	78	46.6	-1.6	0.9 [0.5-1.8]	0.769
Niassa, 2003-2008					
DHS (2003)	78	46.6		Reference	
MISAU 24-35 months	**233**	**60.9**	**14.3**	**1.8 [1.1-3.0]**	**0.027**
Niassa, 2003-2008					
DHS (2003)	78	46.6		Reference	
MISAU 12-23 months	337	58.3	11.7	1.6 [1.0-2.7]	0.058

[a]While the survey was conducted in 2008, the 24-35 month age groups represent those children who were vaccinated from 2005-2006, which coincided with the peak of Project to Support PAV activities. The 12-23 month age group in the VR study represents those children who were vaccinated over the last year of the project and the year after the project ended.

Table 2-4: Logistic Regression Models Examining Associations between DTP 3 Coverage and Survey by Time Period and Province. (Significant associations in bold)

Province & time period	n	DTP 3 n_{yes} (%)	% Difference survey 2-survey 1	Crude OR (95% CI)	P-value
Cabo Delgado, 1997-2003					
DHS (1997)	71	28.9		Reference	
DHS (2003)	**169**	**68.9**	**40.0**	**5.5 [3.0-10.0]**	**< 0.001**
Cabo Delgado, 2003-2006					
DHS (2003)	169	68.9		Reference	
VR 24-35 months	**237**	**95.4**	**26.5**	**9.3 [4.7-18.4]**	**< 0.001**
Cabo Delgado, 2003-2008					
DHS (2003)	169	68.9		Reference	
VR 12-23 months	**237**	**92.8**	**23.9**	**5.8 [3.2-10.5]**	**< 0.001**
Niassa, 1997-2003					
DHS (1997)	70	59.3		Reference	
DHS (2003)	78	54.6	-4.7	0.8 [0.4-1.6]	0.572
Niassa, 2003-2008					
DHS (2003)	78	54.6		Reference	
MISAU 24-35 months	**233**	**70.0**	**15.4**	**1.9 [1.1-3.3]**	**0.014**
Niassa, 2003-2008					
DHS (2003)	78	54.6		Reference	
MISAU 12-23 months	**338**	**71.9**	**17.3**	**2.1 [1.3-3.5]**	**0.003**

Table 2-5: Logistic Regression Models Examining Associations between Measles Coverage and Survey by Time Period and Province. (Significant associations in bold)

Province & time period	n	Measles vaccination n_{yes} (%)	Difference survey 2-survey 1	Crude OR (95% CI)	P-value
Cabo Delgado, 1997-2003					
DHS (1997)	71	40.2		Reference	
DHS (2003)	**169**	**80.2**	**40.0**	**6.0 [3.3-11.0]**	**< 0.001**
Cabo Delgado, 2003-2006					
DHS (2003)	169	80.2		Reference	
VR 24-35 months	**237**	**95.4**	**15.2**	**5.1 [2.5-10.4]**	**< 0.001**
Cabo Delgado, 2003-2008					
DHS (2003)	169	80.2		Reference	
VR 12-23 months	**237**	**90.3**	**10.1**	**2.3 [1.3-4.1]**	**0.004**
Niassa, 1997-2003					
DHS (1997)	70	59.4		Reference	
DHS (2003)	78	51.9	-7.5	0.7 [0.4-1.4]	0.326
Niassa, 2003-2008					
DHS (2003)	78	51.9		Reference	
MISAU 24-35 months	**233**	**68.2**	**16.3**	**1.9 [1.2-3.4]**	**0.010**
Niassa, 2003-2008					
DHS (2003)	78	51.9		Reference	
MISAU 12-23 months	**338**	**66.9**	**15.0**	**1.9 [1.1-3.1]**	**0.014**

Figure 2-2: Coverage across Time and Location: All Vaccinations

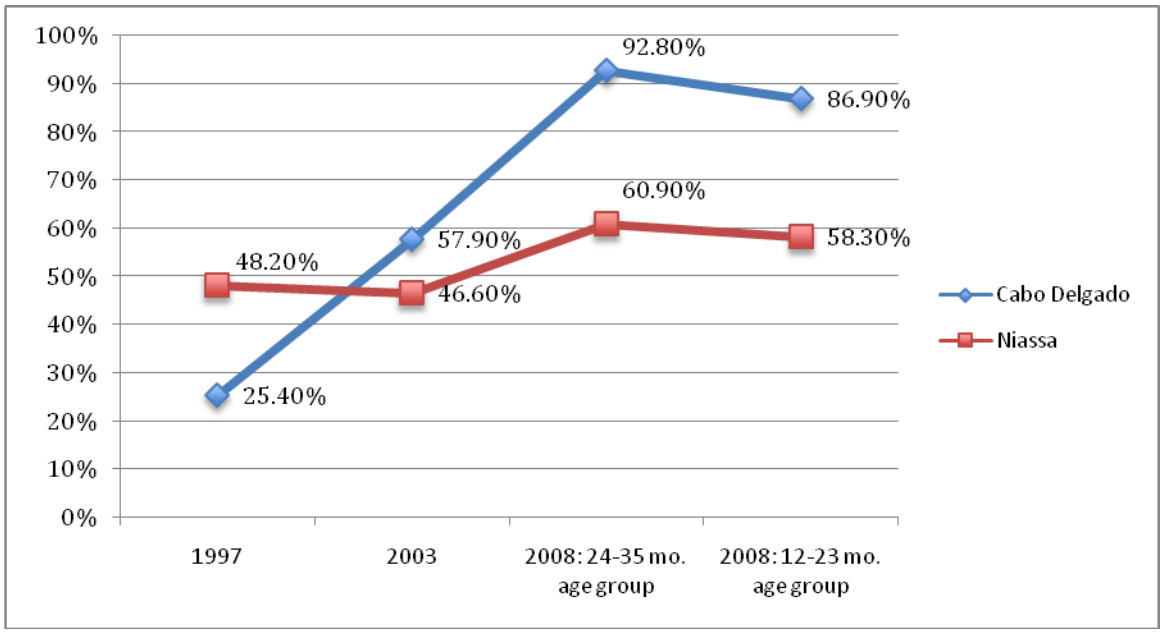


Figure 2-3: Coverage across Time and Location: DTP 3 (3 doses DTP)

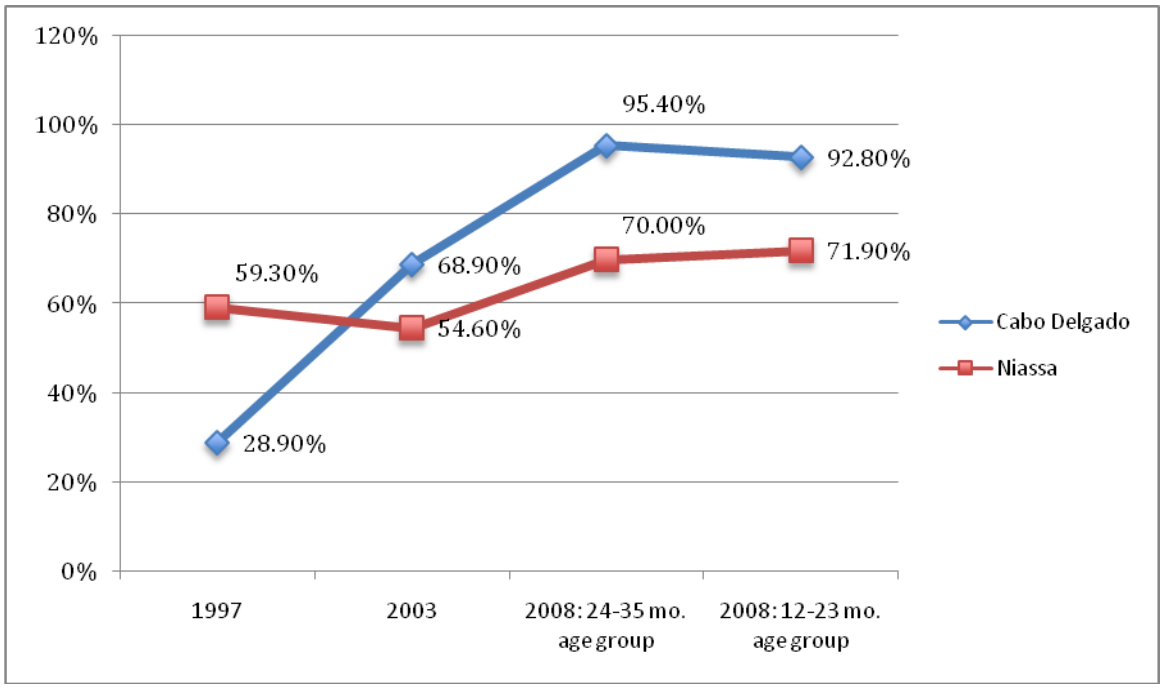
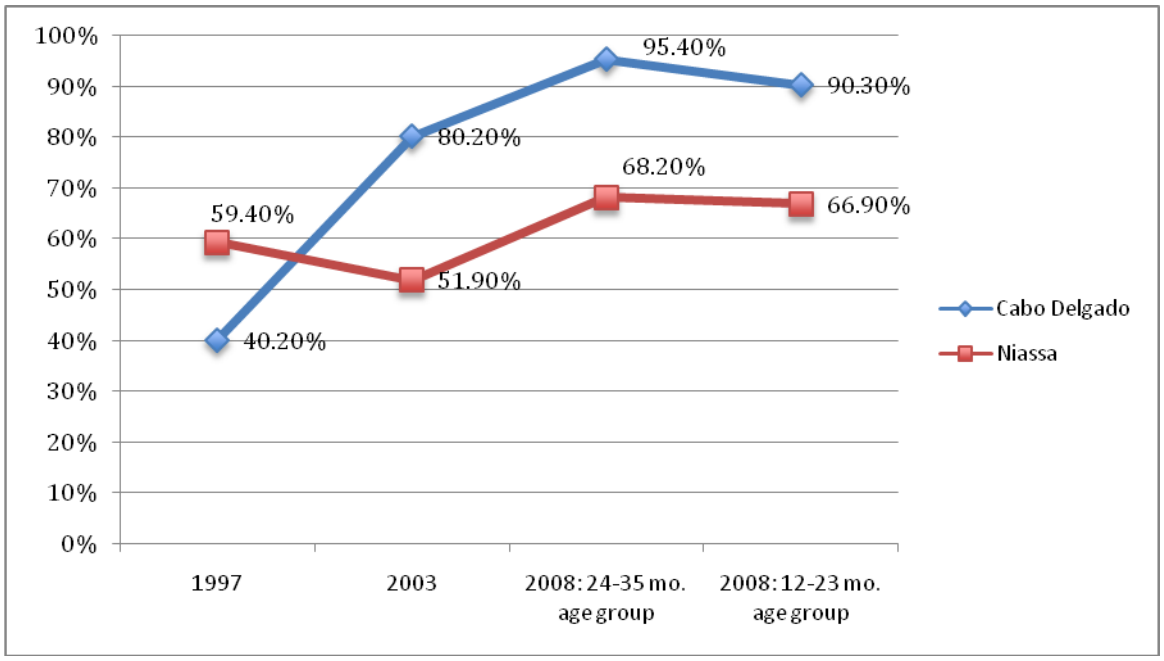


Figure 2-4: Coverage across Time and Location: Measles Vaccination



<u>Figure 2-5:</u> Differences in vaccination coverage between children 12-23 months old (2003 DHS Survey & VR Survey) and 24-35 months old (VR Survey) from both card and history in Cabo Delgado, Mozambique

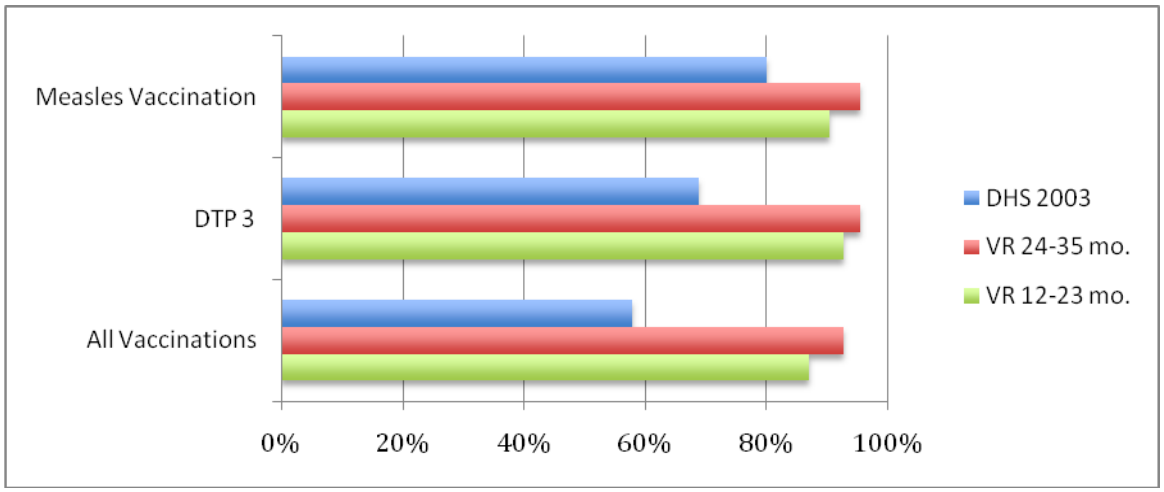


Table 2-6: Vaccination Coverage by Card and/or History among Children 12-23 Months of Age, Niassa Study

	12-23 month age group (n=338)		24-35 month age group (n=233)	
	n	(%) [95% CI]	n	(%) [95% CI]
All vaccinations				
Yes	197	58.3 [50.8-65.7]	142	60.9 [52.1-69.8]
No	140	41.4 [34.0-48.8]	91	39.1 [30.2-47.9]
Total (valid n) [a]	337		233	
DTP 3				
Yes	243	71.9 [65.1-78.7]	163	70.0 [61.6-78.3]
No	95	28.1 [21.3-34.9]	70	30.0 [25.8-34.3]
Total (valid n)	338		233	
Measles vaccination				
Yes	226	66.9 [59.8-74.0]	159	68.2 [59.8, 76.7]
No	106	31.4 [24.4-38.3]	72	30.9 [22.5-39.3]
Don't know	0	0.0	0	0.0
Not applicable	6	1.8 [-0.2-3.8]	2	0.9 [-0.8-2.5]
Total (valid n)	338		233	

[a] The one missing case was due to errors in data collection.

QUALITATIVE HEALTH WORKER SURVEY

Table 3-1: Official Titles of Health Unit Employees, VillageReach Health Unit Employee Survey (n=27)

Title	n	%
Responsible for PAV	4	15.4
Nurse	5	19.2
Preventive Medicine Agent	1	3.8
Medical Agent	5	19.2
Health Center Director	3	11.5
PAV technician	3	11.5
Health Post Director	1	3.8
Clinical Director	1	3.8
Medical Technician	1	3.8
Technical Assistant for PAV	1	3.8
Servant	1	3.8
Total (valid n) [a]	26	

[a] Missing data due to errors in data collection.

Table 3-2: Number of Years in Current Job, VillageReach Health Unit Employee Survey (n=27)

Years	n	%
≤ 2 years	20	76.9
+2 – 6 years	5	19.2
+6 years	1	3.8
Total (valid n)[a]	26	

[a] Missing data due to errors in data collection.

Table 3-3: Respondent Worked in Immunization in Cabo Delgado Prior to December 2006, VillageReach Health Unit Employee Survey (n=26)[a]

	n	%
Yes	22	84.6
No	4	15.4
Total (valid n)	26	

[a] Question was not posed to the servant since he/she never worked in immunization.

Figure 3-1: Method of Vaccine Delivery, VillageReach Health Unit Employee Survey (n=27)

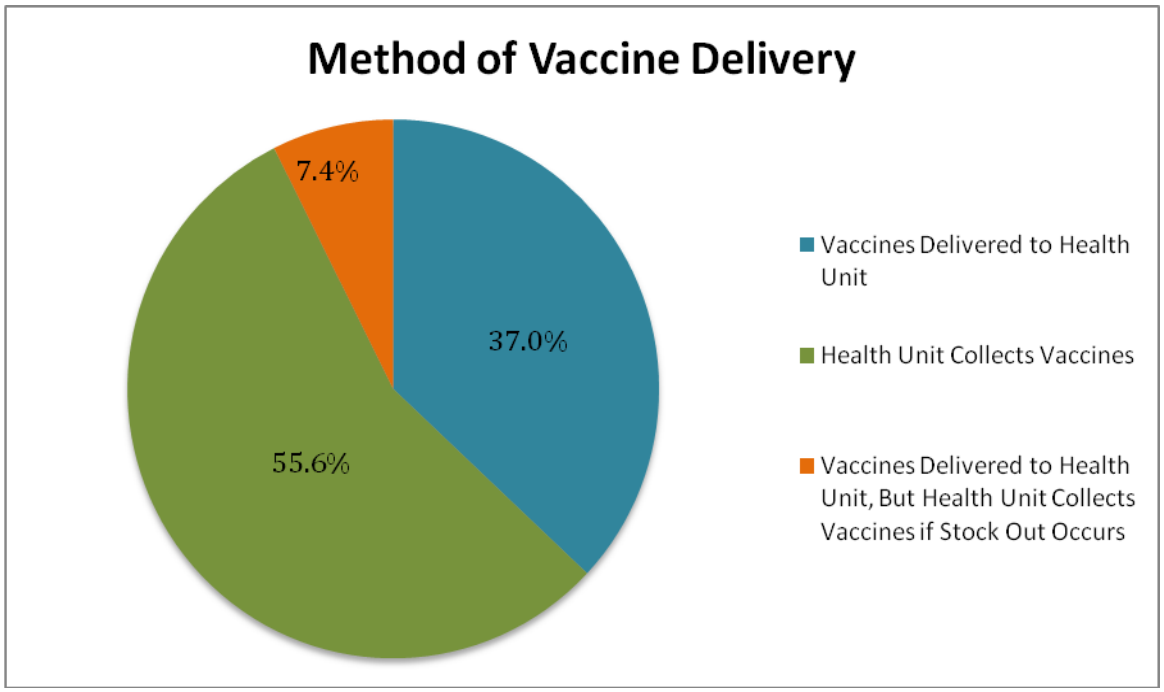


Table 3-4: Information Regarding Vaccine Collection, VillageReach Health Unit Employee Survey (n=17)[a]

	n	%
Vaccine services stop during vaccine collection		
Yes	0	0.0
No	16	94.1
Sometimes	1	5.9
Total (valid n)	17	
When collecting vaccines, do you do other things related to the health unit?		
Yes	14	82.3
No	1	5.9
Sometimes	2	11.8
Total (valid n)	17	

[a] The 17 cases are those health units who reported that they picked up vaccines for their health unit.

Table 3-5: Vaccine Stock, VillageReach Health Unit Employee Survey (n=27)

	n	%
Is the vaccine stock replenished every month?		
Yes	25	92.6
No	1	3.7
Sometimes	1	3.7
Total (valid n)	27	
Ever had a stock-out of vaccines?		
Yes	13	48.1
No	14	51.9
Total (valid n)	27	
Stock out of vaccines this year		
Yes	10	37.0
No	17	63.0
Total (valid n)	27	
Stock out of vaccines last year		
Yes	9	33.3
No	17	63.0
Don't know	1	3.7
Total (valid n)	27	

Table 3-6: Refrigerator Ownership, Function, and Monitoring, VillageReach Health Unit Employee Survey (n=27)

Health unit has a refrigerator	n	%
Yes	27	100.0
No	0	0.0
Total (valid n)	27	
Type of refrigerator		
Gas	23	85.2
Solar	2	7.4
Gas + Electric	2	7.4
Total (valid n)	27	
Refrigerator was working at time of survey		
Yes	26	96.3
No	1	3.7
Total (valid n)	27	
Did refrigerator ever break down?		
Yes	1	3.7
No	26	96.3
Total (valid n)	27	
Have any trouble keeping refrigerator at correct temperature?		
Yes	7	25.9
No	20	74.1
Total (valid n)	27	
Most frequent problems with the refrigerator (current or past)		
Lack of gas	2	7.4
Lack of maintenance	1	3.7
Refrigerator turns itself off	5	18.5
Gas leaks	2	7.4
Refrigerator broke	1	3.7
No problems	14	51.9
Rubber around refrigerator sometimes comes out of place	1	3.7
Temperature control	1	3.7
Total (valid n)	27	
Health unit recorded recent refrigerator temperatures[a]		
Yes	19	73.1
No	8	30.8
Total (valid n)	27	
Instructional manual available for operating and maintaining refrigerator?		
Yes	13	48.1
No	14	51.9
Total (valid n)	27	

Table 3-7: Self-Reported Comfort Level of Working With Vaccines, VillageReach Health Unit Employee Survey (n=26)

	n	%
Do you feel safe working with vaccines?		
Yes	22	84.6%
No	4	15.4%
Total (valid n) [a]	26	

[a] Question was not posed to the servant since he/she never worked in immunization.

Table 3-8: Waste Management, VillageReach Health Unit Employee Survey (n=27)

	n	%
Health unit has safety boxes		
Yes	26	96.3
No	1	3.7
Total (valid n)	27	
Medical waste on ground in or near health unit		
Yes	4	14.8
No	23	85.2
Total (valid n)	27	
Health unit has a waste pit		
Yes	25	92.6
No	2	7.4
Total (valid n)	27	
Waste pit is at least 1.5m deep (n=25)		
Yes	19	76.0
No	6	24.0
Total (valid n)	25	
Waste pit has a fence (n=25)		
Yes	7	28.0
No	18	72.0
Total (valid n)	25	
Waste pit is covered (n=25)		
Yes	0	0.0
No	25	100.0
Total (valid n)	25	
Waste pit is at least 50m from water sources or fields growing food (n=25)		
Yes	15	60.0
No	10	40.0
Total (valid n)	25	