ODK Scan Product Recommendations Report

White Paper

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VILLAGEREACH®

VillageReach is a global health innovator that develops, tests, implements and scales new solutions to critical health system challenges in low-resource environments, with an emphasis on strengthening the "last mile" of healthcare delivery.

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1 Introduction

The purpose of this document is to identify the real-world data collection needs of global health organizations in order to inform development and deployment of Open Data Kit (ODK) Scan. General use cases for ODK Scan have been previously identified[1], such as digitization of child health cards and health registers. Building on that broad understanding, this report examines the specific needs of organizations actively seeking data digitization solutions and proposes improvements to ODK Scan in order to meet these needs.

To conduct this evaluation, the VillageReach team reached out to relevant global health organizations to gauge interest in participating in an ODK Scan field trial. For each organization, we assessed data collection needs, proposed a process for collecting data with ODK Scan, and identified any needed features that ODK Scan currently does not support. From these engagements we chose four illustrative examples for inclusion in this report (see Appendix A for a full list of contacts).

The second portion of this document analyzes the findings from the partner engagements to provide key recommendations for ODK Scan moving forward. This analysis takes into account current software development, priority user needs, as well as product research on similar software platforms. These recommendations will form a basis for the product roadmap and deployment strategy for ODK Scan over the next two years.

1.1 Background

The Open Data Kit (ODK) project, led by the University of Washington Computer Science Department (UW CSE), is a suite of open source Android applications purpose-built for collecting and managing data in low- and middle-income countries (LMICs). ODK applications are designed to run on inexpensive mobile phones in low resource environments.

With the support of a Grand Challenges Exploration award granted in April 2011, UW CSE and VillageReach partnered to create, develop, and field test ODK Scan. Part of the newer generation of ODK tools, ODK Scan is a mobile phone application that pairs custom image recognition algorithms with a phone's built-in camera to automatically digitize handwritten data. Using ODK Scan, health workers can automatically digitize primary health data collected on paper-based forms, simply by taking a picture.

Based on the promising results of the Grand Challenges award, the Bill & Melinda Gates Foundation is supporting continued development of ODK Scan via the Enhancing ODK Scan Grant (2013-2015). Through this grant, VillageReach and UW CSE are improving the usability, maturity and functionality of ODK Scan to enable digitization of the most important service delivery level repositories of paper-based data. This work includes a) improving the usability and maturity of the ODK Scan application, b)

[1] VillageReach. (2014). *ODK Scan Use Cases: Bill & Melinda Gates Foundation Grant.* Seattle, WA.

conducting ODK Scan field trials to evaluate effectiveness and gather feedback, and c) engaging with partner organizations and ministries of health to build interest in ODK Scan.

1.2 ODK Suite

While ODK Scan is the core technology used to digitize paper-based data, additional ODK Suite tools are used as part of the ODK Scan digitization, validation, aggregation, and dissemination workflows. Together, the ODK Suite products work to offer a platform that allows health workers to digitize data, and health workers and administrators higher in the system to access data for patient care and reporting. These products are referred to throughout the remainder of the document, and thus a brief description of each products is provided in the table below.

TABLE 1: ODK SUITE PRODUCTS

Product	ODK Scan Use Case Application	Platform
ODK Scan Form Designer	Create ODK Scan-compatible form	Web
ODK Scan	Digitize data from paper health forms	Android phone application
ODK Survey	Validate and edit scanned data	Android phone application
ODK Tables	View reports and search for data	Android phone application
ODK Sync	Sync data between mobile phone and ODK Aggregate (in the cloud)	Android phone application
ODK Aggregate	Store scanned data in centralized database in the cloud	Web

2 User Analysis

In order to determine the actual features and functionalities needed by NGOs working in low-resource environments, we engaged multiple global health organizations and worked with them to explore specific use cases for ODK Scan. The examples that follow were selected for this report because they illustrate diverse paper-to-digital scenarios that showcase both the strengths and challenges of the current ODK Scan software and process.

2.1 Supplemental Register at Private Clinic

Organization(s): Merck for Mothers (MfM) and Jhpiego

Country of focus: India

Project Description: Merck for Mothers and Jhpiego work with a network of 250+ private obstetric (OB) clinics in India to monitor and provide tools for systematically improving quality of care. In 2014, MfM and Jhpiego implemented the first standardized patient register (see Appendix B Figure B.1) across the OB network to record and report on quality of care data. This data includes information such as infant status at birth and what family planning information the mother received post-partum.

The challenges with the current process are:

- Data is not digitized, aggregated or analyzed at all of the clinics, with different practices in place for different sites
- MfM and Jhpiego do not have a way to access the data on the forms completed at clinics

Role of ODK Scan: As shown in the process flow below, workers at the private OB clinic will record patient information on a newly designed ODK Scan-compatible paper register. The redesigned register will maintain the basic flow and structure of the original form, but will be enhanced with bubble and number data fields, which improve data digitization accuracy. Certain sensitive data fields (such as patient name) would be omitted from ODK Scan processing entirely. The anonymized data can then be used for general reporting and tracking of quality of care improvements, but will not be linked to private patient information.

On a schedule that aligns with the clinic's work processes and protocols, clinic workers will use mobile devices to scan the labor room register using ODK Scan. This information will be validated on the mobile device, then synced with a local or clinic-specific cloud server to ensure the security of each clinic's data. Once validated, data from all the clinic's devices will be synchronized so that each device can view summary reports for the whole facility using ODK Tables. Health workers and supervisors can view filterable, custom clinic dashboard reports on their devices, while Jhpiego and Merck for Mothers can monitor the processed data in ODK Aggregate.

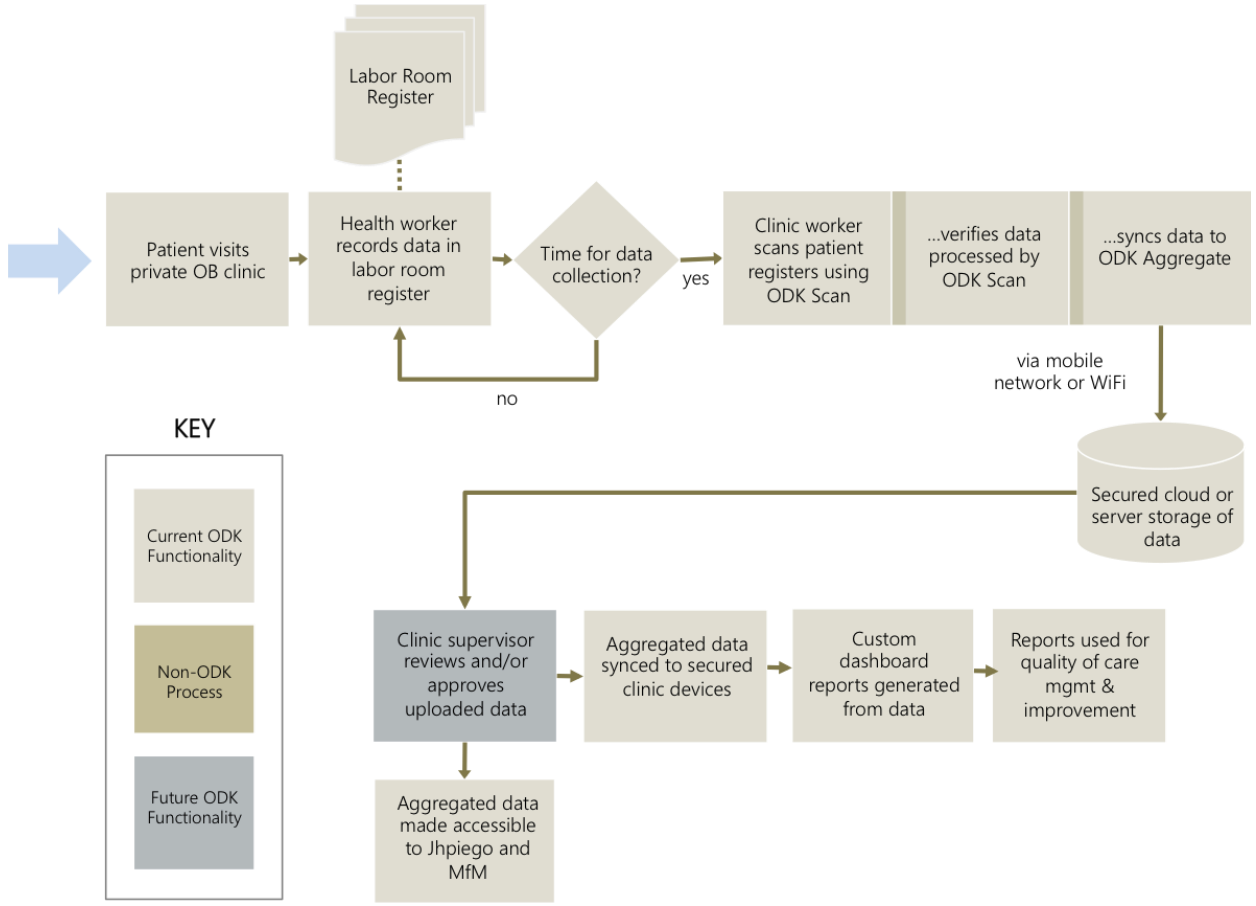


Figure 1: Labor Room Register process with ODK Scan

A potential barrier to adoption of the technology is the private clinics' reluctance to share their data with external entities, NGO or otherwise. Security and privacy of the data collected and transmitted by ODK Scan is very important to clinic's willingness to adopt the technology. In addition, providing customized, key performance indicator (KPI) dashboards to the clinics is a value-add that may overcome this resistance to information sharing.

ODK Scan Feature Analysis: Most, but not all, of the features necessary to support the MfM/Jhpiego project are currently available in ODK Scan. Reliability and security are two areas that would need improvements in order for MfM/Jhpiego to be confident releasing the product to private clinics.

Category	Feature	Available in ODK Scan
Digitization	Bubble/checkbox OMR	✓
	Number ICR	✓
	Omit fields from ODK Scan processing	✓
Validation	Validate/edit data in app	✓
	Bulk data validation/editing on web/desktop	✗
Non-Functional	In-app data security features	✗
	Encryption of data in sync with server	✓
	Reliability	✓
Reports	Reports on mobile device include data from multiple devices	✓
	Web based custom dashboards	✗
	Mobile based custom dashboards	✓
	Mobile based KPI reports	✓

2.2 Supplemental Register for Community Health Workers

Organization: VillageReach

Country of Focus: Malawi

Project Description: In Malawi, community health workers (CHWs) perform a multitude of health services, including conducting home visits with expectant mothers. During these visits, information is recorded in a government-issued register book. In Kwitanda, a community within the Balaka district, VillageReach works with local CHWs to provide comprehensive prenatal services, including collecting comprehensive prenatal visit data on a on a supplemental register (see Appendix B Figure B.2 for an image of the VillageReach Supplemental MNH Register).

Currently, these supplemental MNH registers are collected monthly by VillageReach staff. Data are manually entered into a computer database and used to measure maternal and neonatal health status and trends.

The challenges with the current process are:

- Register books must be transported to the main office for data entry, then returned to the CHW one or two weeks later. Data must be tracked outside the register during this time.
- Data is not consistently used for supportive supervision of CHWs.

Role of ODK Scan: As shown in the figure below, CHWs will record information on a newly designed ODK Scan-compatible register (see Appendix B Figure B.3). Once a month the VillageReach

Monitoring and Evaluation officer will visit the CHW and scan each form. After validating that the data scanned accurately, the officer will pull up a performance report for the CHW in ODK Tables, highlighting any patients who have not received the full suite of antenatal care services for follow-up. When the program manager reaches a location with mobile Internet, s/he will synchronize the data to ODK Aggregate.

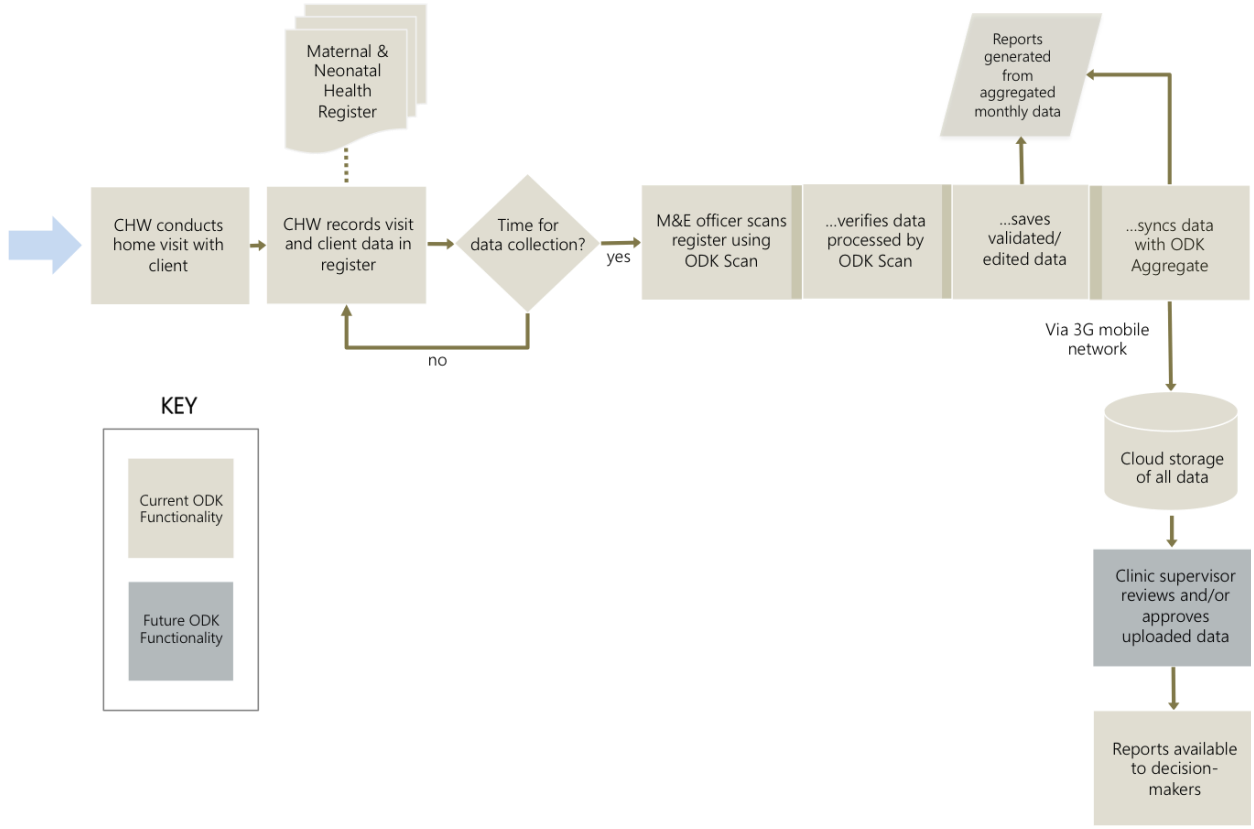


Figure 2: MNH Register process with ODK Scan

Use Case Feature Analysis: Most of the features needed to support this scenario are available. Improved number recognition will be important to this use case, as is development of a tool for bulk data validation.

Category	Feature	Available in ODK Scan
Digitization	Bubble/checkbox OMR	✓
	Number ICR	✓
	Process updates to forms	✗
Validation	Validation of data in app	✓
Reports	Customized reports	✓
	Bulk data validation/editing on web/desktop	✗
	Export raw data	✗

2.3 Child Immunization Data at National Scale

Organization: PATH

Country of focus: Zambia

Project Description: Part of the Better Immunization Data (BID) Initiative, this project tracks vaccinations through digitization of forms pre-populated with patient data (see Appendix B.4 and B.5 for images of this form). Each month, health-center specific forms are printed with information on each child that needs to receive a vaccine. The forms are delivered to the health centers and completed by health workers at the time of vaccination. Health workers locate the patient entry on the form via the pre-printed name and ID number and then fill in the corresponding bubble fields to indicate what immunizations the child has received and when. After completion, the health worker separates the data capture section of the form from the defaulter sheet section, keeping the defaulter sheet at the facility for patient follow-up. The data capture section, which contains the completed information on type, number, and date of vaccines given, is sent back to the district office for scanning on a desktop scanner. The district vaccine manager scans the form and validates the scanned data. Once scanned, the data is sent to the immunization registry.

Role of ODK Scan: Process requirements for the BID project were predetermined over a year's worth of process study in-country, and thus are very specific. The to-be process utilizes batch scanning of the immunization forms via a desktop sheet-feed scanner at a centralized location. Because ODK Scan does not currently have a desktop version, or the ability to push content into forms ("mail merge" feature), significant additions to the ODK Suite would be needed to support this to-be process.

As shown in Figure 3 below, a potential to-be process would begin with an API pulling patient data from the immunization registry for patients that have immunizations due in the next month. This data would feed into the Form Designer to pre-populate patient data fields on an ODK Scan-compatible register. The forms would be printed and sent to the health center where they are completed by health workers. After completion, the health worker separates the two sections of the form and sends the data capture sheet to the district office for mass-scanning into a desktop version of ODK Scan. Data is automatically processed via an ODK Scan desktop version and then validated by the user. Finalized data is synced with ODK Aggregate, then pushed to the immunization registry.

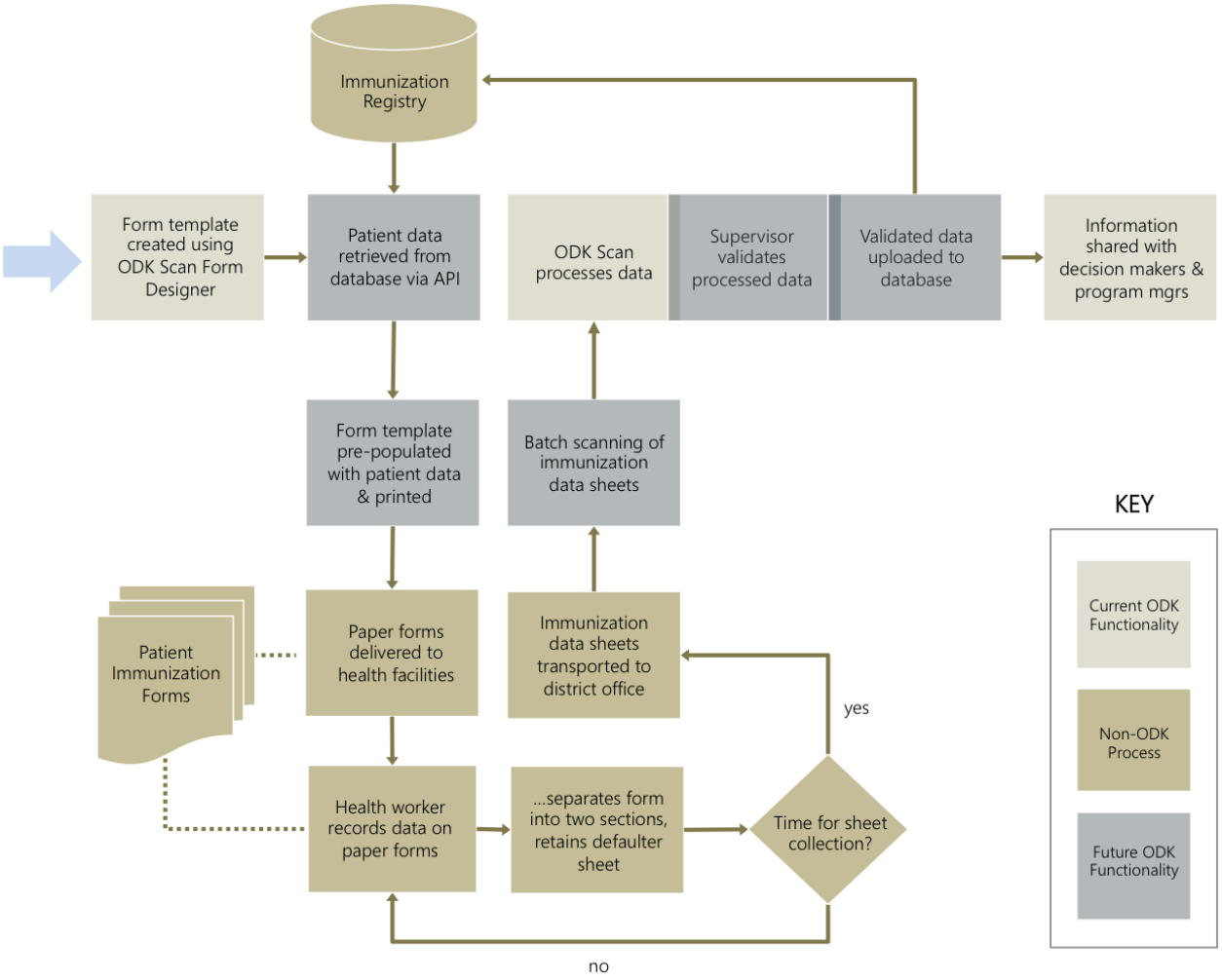


Figure 3: Immunization Registry process with ODK Scan

ODK Scan Feature Analysis: This use case is not well-supported by ODK Scan. ODK Scan is designed to operate on mobile devices in the field, not via batch scanning on a desktop, and thus most of the features needed for this scenario are not currently available. In addition, with the intent to deploy the solution nationally, improvements to reliability are needed.

Category	Feature	Available in ODK Scan
Form Generation	Pre-population of patient data	✗
Digitization	Bubble/checkbox OMR	✓
	Barcode/QR code recognition	✓
	Scanning of custom-sized form	✓
	Desktop scanning option	✗
Validation	Flag potential errors / centralized data editing	✗
Non-Functional	Reliability	✗

2.4 Digitizing Health Registers and Supplemental Forms

Organization: eHealth Nigeria

Country of Focus: Nigeria

Project Description: Kano State, in Northern Nigeria, has the highest population of all states in the country. Despite the main urban center, it is populated with many rural areas and nomadic tribes, making it difficult to properly plan health services. The Kano Connect program supports health workers by providing an Android smartphone to every health facility in Kano State. The distribution and use of the phones is purposefully open ended, as a major goal of the Kano Connect project is to determine how facility and health workers employ a mobile resource without structured training. Unlike the previous examples, this use case explores what could be possible based on in-hand technology and the types of forms filled at the health center level, rather than beginning with a specific form process. Additional collaboration with eHealth would be needed to further define the use case and implement in-country.

Role of ODK Scan: Facility-based health workers record and transport a significant amount of health data. As with most low-resource settings, this data is recorded on paper forms and delivery of the data to the district level is complicated by poor transportation infrastructure. As shown in Figure 5 below, health workers could use the phones already deployed to health centers to scan forms using ODK Scan and sync the processed data to a centralized database over the 3G network. Existing health data collection forms would need to be revised to be ODK Scan compatible. In this scenario, a health worker would use the app to scan a collection of ODK Scan compatible forms once a month and send the collected data to the district level, instead of delivering reams of paper forms. The data would be available instantly at the local government area (LGA) and state level, aggregated as appropriate, eliminating time consuming and error prone manual summary steps.

Figure 4: Nurse Using Immunization Tally Book at Kano State Health Facility

Implementing ODK Scan would immediately transform the process of tallying vaccines. One form process currently in place at Kano State health facilities is the recording and aggregating of immunization data from large-scale tally sheets (see Figure 4). Health workers at facilities record daily vaccine usage in large registers using tally bubbles, where one bubble represents one vaccine. ODK Scan has been specifically designed with data fields like this in mind and could be implemented to automatically calculate total data amounts, improving data accuracy and increasing task efficiency for health workers. Because of the high accuracy rates for bubbles using ODK Scan, manual validation of the scanned data would not be required.

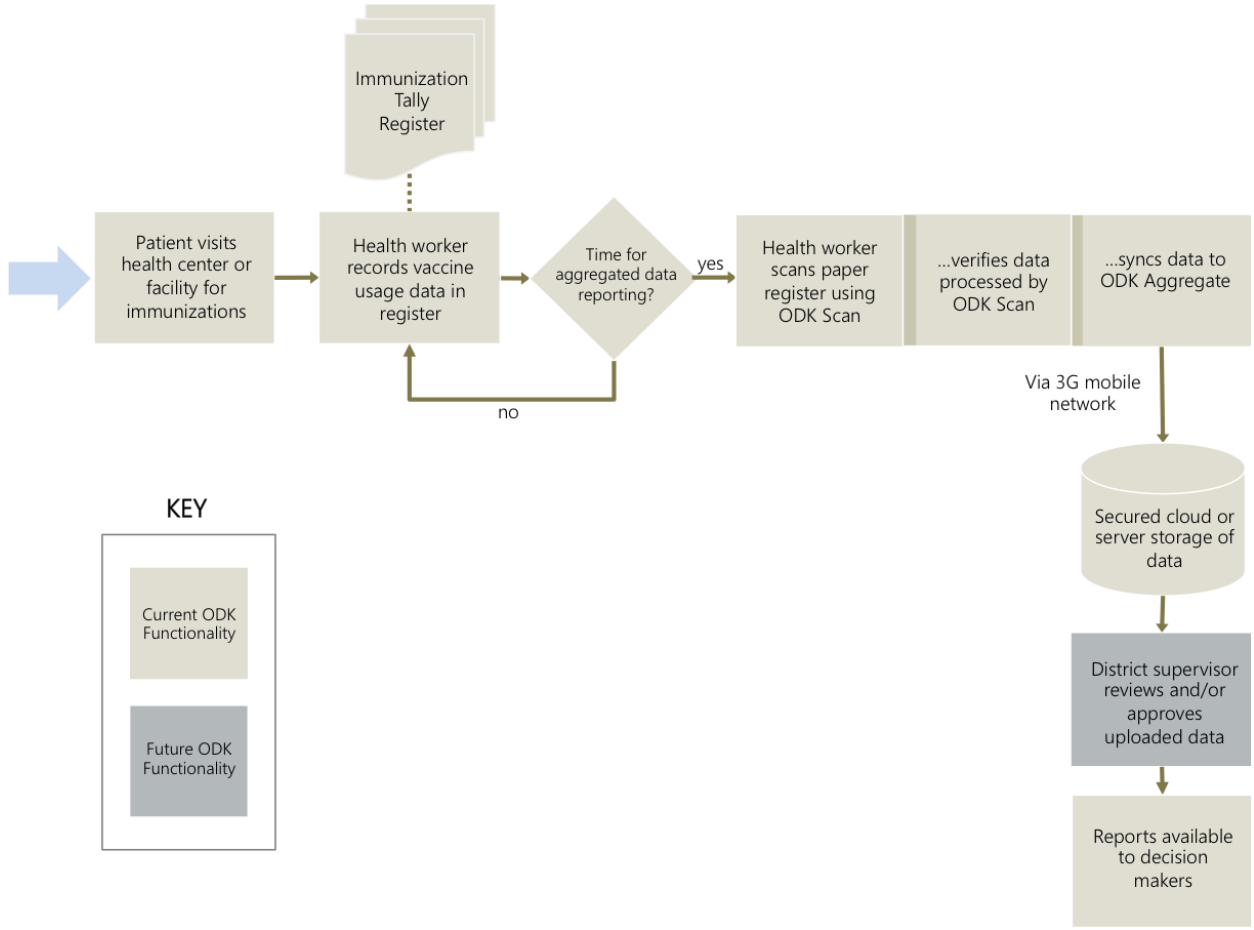


Figure 5: Immunization tally sheet process with ODK Scan

ODK Scan Feature Analysis: The biggest challenge for this use case would be redesigning the existing health register forms for ODK Scan compatibility. Current forms use large-format register books that span horizontally across two pages. ODK Scan may be able to be enhanced to support some increase in page size (current supported size is up to A4), however some modification to the current form factor is likely necessary for ODK Scan compatibility. For more discussion of how we plan to engage Ministries of Health regarding ODK Scan introduction and form redesign, see Appendix C.

Category	Feature	Available in ODK Scan
Digitization	Bubble/checkbox OMR	✓
	Number ICR	✓
	Scan rows that cross page binding	✗
	Scanning of large-format register books	✗
Validation	Flag potential errors / centralized data editing	✗
Reports	Web-based reports	✓
	KPI reports on phone	✓

3 ODK Scan Recommendations and Product Roadmap

3.1 Demand for ODK Scan

The user scenarios outlined in Section 2 provide a useful window into the real-world needs of NGOs striving to improve data collection and use. It is clear that the drive for data-based decision making has taken hold and that leading-edge NGOs and governments are eager for technologies to help achieve this goal. There is indeed a continued demand for analog data collection instruments, as well as for tools that translate paper-based data into digital content.

The Kano Connect project provides an intriguing example of the potential for ODK Scan if Android phones become standard equipment at health facilities (either government or health worker provided). With phones now falling below $50 USD and basic tablets already at an accessible price point, Android apps such as ODK Scan could become widespread. Although these phones could be used for direct to digital data entry, this approach would require a phone for each health worker, not one per facility. In addition, phone-based direct to digital solutions can be cumbersome for busy health workers to use during patient interactions, hindering adoption and data completeness. Use of paper forms in conjunction with ODK Scan is an intriguing possibility for improving data collection while minimizing changes to current health worker processes.

It is also clear that in addition to the vast amount of data collected by governments, there are also many, many NGO-driven projects where health data is collected on paper. In both the Merck for Mothers/Jhpiego and VillageReach scenarios, supplemental health information is being collected by an NGO. These supplemental registers provide an opportunity for initial validation of ODK Scan at scale, prior to full adoption by a ministry of health for governmental registers. Interviews with other NGOs not featured in this paper have confirmed that creation of paper-based data collection tools are common, and are plagued with the familiar challenges of poor data entry accuracy and lack of data use. NGOs are interested in solutions that would lead to quicker and easier data collection.

Lastly, conversations with organizations revealed a strong preference for open source tools over commercial products. A major motivation is price, but in addition organizations are seeking out solutions that are tailored to the needs of low-resource environments.

All said, we are confident based on this analysis that there is market demand for ODK Scan.

3.2 ODK Scan Desktop?

The most-requested feature across all conversations with potential ODK Scan users is an ODK Scan Desktop version. In this scenario data would be collected on paper, returned to a central location, processed by a sheet-feed scanner, validated, and then exported to a database. Although this scenario is markedly different from the initial vision for the ODK Scan tool, the interest in centralized, bulk data collection led us to investigate whether ODK Scan should build a desktop-based product.

In order to answer this question, we assessed existing desktop scanning products. These products were selected based on their ability to process custom forms, optical mark recognition (OMR) functionality, option for data validation, and availability to consumers. In addition, we purposefully

included products that are either currently in place or being assessed for use by the global health organizations. A table summarizing the products reviewed is shown on the following page.

Desktop Scanning Software Product Comparison

Software	Type	Recognition		Cost	Compatible with desktop scanner
ABBYY	Software	Bubbles/checkboxes Barcodes	Handwritten numbers Handwritten letters	$7,200[2]/one concurrent license[3]	Yes
Creative ICR	Software	Bubbles/checkboxes QR/Barcodes	Handwritten numbers Handwritten letters	$350/seat	Yes
Remark Office OMR	Software	Bubbles/checkboxes	QR/Barcodes	$995/seat	Yes
Accusoft	Software	Bubbles/checkboxes QR/Barcodes	Handwritten numbers Handwritten letters	$4,200/seat	Yes
Captricity	Cloud-based	Bubbles/checkboxes QR/Barcodes	Handwritten numbers Handwritten letters	$825/month[4]	Yes
Teleform from HP	Software	Bubbles/checkboxes QR/Barcodes	Handwritten numbers Handwritten letters	$30,000/package [5]	Yes
FormScanner	Software	Bubbles/checkboxes		Open source (free)	Yes
queXF	Web-based	Handwritten numbers	Handwritten letters	Open source (free)	Yes
SQS	Software	Bubbles/checkboxes		Open source (free)	Yes
ODK Scan	Software	Bubbles/checkboxes QR/Barcodes	Handwritten numbers	Open source (free)	No

[2] Cost is for maximum of 120,000 pages scanned per year. Higher cost for higher yearly page max. $1,200 for each additional concurrent license.
[3] Concurrent license means multiple stations can access the same licensed software, just not at the same time.
[4] Cost is for maximum of 30,000 fields per month. Annual plans are also available starting at $1,031/month for 360,000 fields/year maximum.
[5] Includes 1 scanning and 3 data reviewer licenses.

As is clear from the table above, there are a large number of paper-to-digital desktop-based software products. Even in the digital age, a huge number of companies, organizations, and governments rely on paper systems for their daily work, and there is high demand for products that meet this need.

Printed Text Recognition (OCR) Software

Low cost or free software that comes bundled with scanners typically features Optical Character Recognition (OCR). OCR deals with the automatic detection and digitization of printed text fields. This functionality is widely available for purchase and for free use across desktop, mobile, and web-based systems. This technology is largely used for digitization of printed materials such as book pages, contracts, meeting documents, and business cards. In low-resourced global health fields, however, the most important information in the paper system is the data that is recorded by hand. Digitization of this information requires Intelligent Character Recognition (ICR) and Optical Mark Recognition (OMR), which provide automatic digitization of handwritten text and fill-in bubbles/checkboxes, respectively.

Proprietary ICR/OMR Software

Recognition of handwritten fields presents a greater challenge than recognition of printed text. ICR solutions are sophisticated, and typically include additional features necessary for large-scale digitization such as form designer and data validator interfaces. These products are targeted at medium and large businesses, and are generally priced at several thousand dollars per seat. That said, the quality of these products seems impressive and may well be appropriate for bulk digitization at scale.

We did identify one small US-based company, Creative ICR, with a $325/seat price point. This package includes form designer software, a scanning interface, and basic (non-customizable) data reporting. The relatively low cost provides a more economical option for resource-constrained organizations, but the company noted that it does not have experience working in low-resource environments in Africa. Another product, RemarkOMR, also offers a reasonably low price point ($995/seat), but their software works only for bubbles and bar codes and does not include handwritten data processing, such as numbers.

Captricity offers the bulk data digitization model that is most applicable to NGOs. Forms are scanned and placed in a Dropbox file for synchronization with the Captricity service in the cloud, enabling syncing when connectivity is available. Form images are converted to text via crowdsourcing. The data is then provided back to the client in excel format a few days after it was submitted. Captricity uses a per-field billing model, with a quarterly scholarship-based option for non-profits where forms are processed pro bono (see captricity.org). Unlike other scanning software, Captricity does not require creation of a specialized form template compatible with proprietary software and can be used with any existing form. This simple form setup, as well as utilization of the widely-used Dropbox system, enables a deployment timeline of just a few days.

Open Source ICR/OMR Software

In addition to commercial offerings, there are a limited number of Open Source products focusing on ICR and OMR. One of the more successful and widely-implemented OS systems is FormScanner. Created originally as a free and open alternative to Scantron, FormScanner specializes in recognition

of bubble fields (OMR) for forms scanned to a desktop/laptop computer. While this solution has an active community of users, it does not have the ability to recognize hand-written numbers or printed barcodes. QueXF, another OS solution, does include ICR, but it relies on a web-based system to run powerful recognition engines.

Summary of Desktop Scanning Products

Much of the quality commercial desktop OMR/ICR software is beyond the price point of many NGOs, and there are currently no compelling open source equivalents. Beyond this preliminary product survey, more in-depth testing of available systems is required to determine the usability of low-priced commercial systems in low-resource environments. Current understanding of the commercial software suggests that there would be significant interest in an open source desktop scanning software, particularly one that is purpose-built for use in LMIC and developed with the specific needs of NGOs in mind.

Although it is in high demand, developing a desktop version would be a significant undertaking requiring significant investment. A more complete cost benefit analysis will be needed to determine whether a desktop version should be built. Before embarking on a potential ODK Scan Desktop version, our recommendation is to focus current efforts on a releasing a quality ODK Scan mobile version. Further consideration of potential development of ODK Scan desktop will be prepared as we near the conclusion of the current grant period.

3.3 ODK Scan Roadmap

The purpose of the ODK Scan product roadmap is to identify the features most important to potential implementing organizations and to prioritize these features in an ODK Scan development plan. By assessing user needs across multiple organizations, we are able to determine what new features will make ODK Scan the most useful for real-world use cases in the global health sphere. This section captures our baseline product roadmap for the next two years. This plan will be revised based on the findings from upcoming ODK Scan field trials.

A summary of the key roadmap features for 2015 and 2016 is shown in the diagram below.

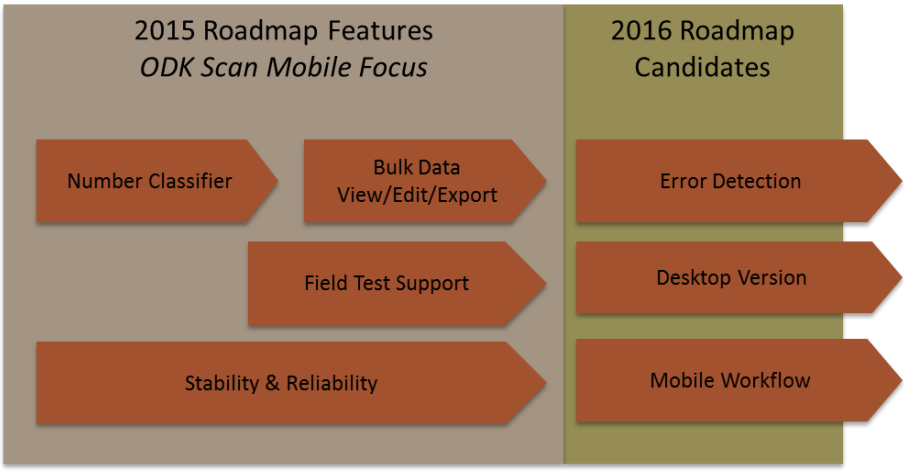


Figure 6: 2015-2016 Roadmap Features

Stability & Reliability

A core issue that arose when working with potential ODK Scan users is the overall lack of maturity in the application. Users would often start out excited about ODK Scan but, upon running into technical glitches, would lose interest. This is to be somewhat expected in an open source beta project, however to be useful to organizations with limited technical capacity the product has to work well. Continuing to identify and correct bugs, build integrated tests, and improve the reliability of the application will remain a key focus for 2015.

Number Classifier (Improved Number Recognition)

Feature work to add a high-quality number recognition classifier to ODK Scan is currently in progress. Recognition rates are now greater than 95% and additional work is in progress to further improve classification rates. User analysis confirmed that number recognition is necessary for most use cases, and that accuracy rates are essential to product adoption. Continued improvement of the number classifier will remain a focus in 2015.

Bulk Data View/Edit/Export Tool

The feature that is most needed to support deployments is a web-based tool for centralized validation and editing of data collected via ODK Scan. As shown in Figure 7 below, use of ODK Scan generally follows a workflow of generating a form, scanning the form, validating the data, and viewing reports. While significant functionality exists for generating, scanning and viewing, there is only a very limited interface for validating and editing data on the mobile phone, and no mechanism for centralized validation, editing, and data export. In addition, validating data on the phone is time consuming. Moving data validation from a process that is done on the mobile device to one that is done centrally is a critical factor for enabling efficient scanning on the mobile device.

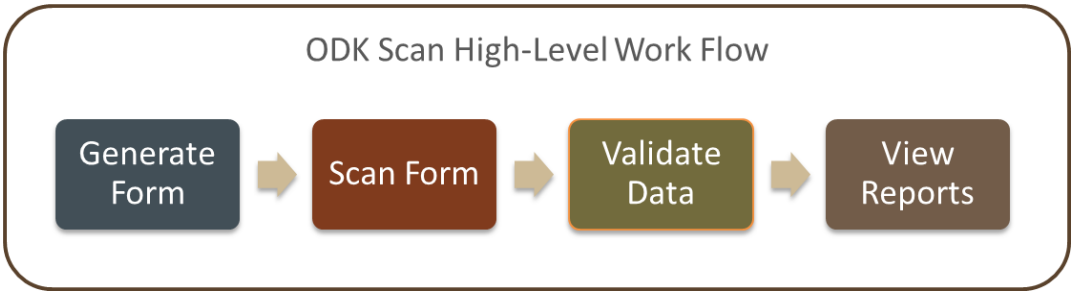


Figure 7: ODK Scan High-Level Work Flow

Error Detection

To use ODK Scan at scale, it is not feasible to manually validate each scanned field. We are interested in identifying approaches to reducing that amount of data that needs to be checked, while maintaining overall accuracy rates. This approach may include enhancements on the mobile application, such as raising an alert to re-scan the page if the number of detected fields does not match the form definition (due to a fuzzy image, for example). Within the bulk validation tool, we will

investigate approaches to streamlining data validation, such as flagging numbers that are out of range. The concepts for error detection will be further defined during the ODK Scan field trials.

Mobile Workflow

The ODK Scan mobile workflow is not currently optimized for ease of use. There is a need to create a more intuitive user interface and reduce the number of clicks required for key operations. Upcoming field trials will provide key input to inform the to-be mobile workflow.

Desktop Version

As discussed in section 3.2, an ODK Scan desktop version will be evaluated for inclusion in the 2016 product roadmap.

Not in Roadmap

Also of interest is items that are not on the roadmap. There are many features that have been discussed by the ODK Scan team, such as text recognition, that were not mentioned by any users as priorities. Specific features that have been under consideration that we not prioritized for inclusion in the roadmap are:

- Enhanced security of ODK Scan application
- Pre-population of data on forms (mail merge feature)
- Scan page across a binding
- Text recognition
- Decreasing bandwidth of ODK Scan transmission
- Detect updates to form that has already been scanned once

These items have been added to the product backlog, but are not prioritized at this time. These decisions will be re-evaluated at the end of 2015.

4 Conclusion

An increasing focus on data for decision-making is accelerating the need for data from the "last mile" of health systems. At the last mile, health clinics and community health workers are providing direct service to patients in resource-constrained environments. It is no longer acceptable for essential data to take 30-60 days (or more) to travel from the most resource-constrained areas to a decision maker at the national level. Direct to digital solutions are one way to approach the data collection challenge, but deploying direct to digital solutions to all health workers is costly, and adoption by health workers can be challenging. Leveraging familiar paper-based data collection, followed by analog to digital conversion, is a promising approach to bridging the data divide.

NGOs working with Ministries of Health and within private health networks have shown a strong interest in easy-to-use, low-cost solutions for converting paper-based data to digital format. The decreasing cost of phones and tablets puts the possibility of placing a device in the hand of every data collection supervisor (or even every health facility) within reach. Unlike sending forms to a central location for scanning and processing, ODK Scan enables immediate data feedback to health workers at the time of data collection via interactive reports.

ODK Scan shows great promise for transforming health data collection at the last mile. To rise to this challenge, ODK Scan needs to build a more robust mobile platform for analog to digital data conversion. Key near-term enhancements include increased accuracy rates, improved product reliability, and the addition of a web-based bulk data validation tool. With these improvements, ODK Scan will be ready to meet the data collection needs of organizations striving to improve health outcomes in low and medium income countries.

Appendix

Appendix A – Organization Contact List

Amref
Big Water Consulting
eHealth Nigeria
IntraHealth
Jhpiego
Merck for Mothers
Mercy Corps Somalia
Mercy Corps Afghanistan
PATH Tanzania
PATH Zambia
Peace Winds America
University of Washington Department of Global Health
VillageReach

Appendix B – Health Register Images

FIGURE B.1: Current Standardized Labor Room Register (Developed by Jhpiego, Merck for Mothers, and government partners)

Client Detail	Age and Obstetric History	Admission Details	Date and Time of Delivery	Type of delivery and indication	Sex and Weight of baby	Condition of the mother and child at discharge		Complications		Postpartum Family planning	Treatment and Remarks
								Mother	Baby		
Name _____ Husband's Name _____ Address _____ _____ _____ Mobile No. _____ Religion _____ Education _____	Age (in Years) _____ Gravida _____ Parity _____ Abortion _____ Living children _____ Previous complications:	Date _____ Time_____ Booked ☐ Unbooked ☐ **Term** Full term ☐ Pre-term ☐ Post-dated ☐ BP_____ Temp_____ FHS_____ Proteinuria _____ Hb gms% _____ Pulse Rate ----------_____ Blood Group____ HIV _____	Date _____ Time_____ **AMSTL** Yes ☐ No ☐ **Oxytocin IM** ☐ **Others** ☐ If others, then specify: _____ _____ _____ _____ Blood transfusion ☐ Antibiotics ☐	**Type:** Normal ☐ Normal with episiotomy ☐ Instrumental ☐ Caesarean ☐ **If caesarean, Indication:**	**Sex:** Male ☐ Female ☐ Other ☐ **Weight (Kgs):** _____ Dried immediately after birth Yes ☐ No ☐ Breast feed within 1 hour Yes ☐ No ☐	**Child** Alive ☐ Still birth ☐ IUD ☐ New born death ☐ **Mother** Alive ☐ Maternal Death ☐	Date and time of Discharge _____ _____ _____ BP _____ Temp _____ Bleeding PV_____ **Child** Temp_____ Feeding_____ Respiratory rate_____	APH ☐ PPH ☐ Pre-eclampsia ☐ Eclampsia ☐ Sepsis ☐ Obs. Labour ☐ Prolonged labour ☐ Others (specify): _____ _____ _____ Referred Yes ☐ No ☐	Sepsis ☐ Asphyxia ☐ LBW ☐ Pre Maturity ☐ Others ☐ (specify): _____ _____ _____ Referred out Yes ☐ No ☐	Counselling Yes ☐ No ☐ **Method chosen:** LAM ☐ OCP ☐ Condoms ☐ Injectables ☐ PPIUCD ☐ IUCD ☐ Male Sterilization ☐ PPS ☐ Others ☐	
Name _____ Husband's Name _____ Address _____ _____ _____ Mobile No. _____ Religion _____ Education _____	Age (in Years) _____ Gravida _____ Parity _____ Abortion _____ Living children _____ Previous complications:	Date _____ Time_____ Booked ☐ Unbooked ☐ **Term** Full term ☐ Pre-term ☐ Post-dated ☐ BP_____ Temp_____ FHS_____ Proteinuria _____ Hb gms% _____ Pulse Rate ---------- Blood Group____ HIV ____	Date _____ Time_____ **AMSTL** Yes ☐ No ☐ **Oxytocin IM** ☐ **Others** ☐ If others, then specify: _____ _____ _____ _____ Blood transfusion ☐ Antibiotics ☐	**Type:** Normal ☐ Normal with episiotomy ☐ Instrumental ☐ Caesarean ☐ **If caesarean, Indication:**	**Sex:** Male ☐ Female ☐ Other ☐ **Weight (Kgs):** _____ Dried immediately after birth Yes ☐ No ☐ Breast feed within 1 hour Yes ☐ No ☐	**Child** Alive ☐ Still birth ☐ IUD ☐ New born death ☐ **Mother** Alive ☐ Maternal Death ☐	Date and time of Discharge _____ _____ _____ BP _____ Temp _____ Bleeding PV_____ **Child** Temp_____ Feeding_____ Respiratory rate_____	APH ☐ PPH ☐ Pre-eclampsia ☐ Eclampsia ☐ Sepsis ☐ Obs. Labour ☐ Prolonged labour ☐ Others (specify): _____ _____ _____ Referred Yes ☐ No ☐	Sepsis ☐ Asphyxia ☐ LBW ☐ Pre Maturity ☐ Others ☐ (specify): _____ _____ _____ Referred out Yes ☐ No ☐	Counselling Yes ☐ No ☐ **Method chosen:** LAM ☐ OCP ☐ Condoms ☐ Injectables ☐ PPIUCD ☐ IUCD ☐ Male Sterilization ☐ PPS ☐ Others ☐	

FIGURE B.2: VillageReach Supplemental MNH Register

VillageReach Maternal and Newborn Health Supplemental Register for HSA:_____

Name: _____
(last name, first name)
ID #: _____
Age: _____ _____
Village: _____ _____

Maternal History
EDD: _____
Total # of pregnancies: _____
Total # of live births: _____

CCPF
Registered for CCPF Yes No
If no, registration form completed?
Yes No

Official Use Only:
Registration Complete:
Discharge Complete:

ANTENATAL CARE

ANC Location: _____
Month (#) of pregnancy when ANC started:_____

Dates of ANC Visits	Tetanus Toxoid Vaccine
#1	#1
#2	#2
#3	#3
#4	#4
#5	#5

Malaria Prophylaxis
#1
#2

Iron Given (tick if yes): [ ]

Albendazole
#1
#2

ITN Given (tick if yes): [ ]

POSTNATAL

Date of Delivery: _____
Location of Delivery: _____
Complications/Notes:

Infant Status
Live Birth ____ Stillbirth____ Neonatal Death ____
Complications/Notes:

Maternal Health Conditions (tick if yes)
Hypertension/Pre-eclampsia [ ]
Diabetes [ ]
Under the age of 20 [ ]
Underweight [ ]
Carrying twins or triplets [ ]
History of preterm delivery [ ]
History of stillbirth or neonatal death [ ]
Other: _____
Other: _____

Postnatal Checkup (tick if yes): [ ]
Date Attended: _____
Location: _____

Vitamin A given: [ ]
Breastfeeding: [ ]

HIV Testing (tick if yes)
Tested this pregnancy: [ ]

Birth Plan
Location: _____
Transport: _____

Danger Signs (tick if yes):
Excessive vaginal bleeding [ ]
Fever [ ]
Foul vaginal discharge [ ]
Convulsions [ ]
Severe Headache [ ]

ADDITIONAL NOTES (include information about miscarriages, abnormal findings, or any other relevant details.)

Home Visits and Education *(Place a check mark next to each topic)*

Visit #	Date	Pregnancy Danger Signs	Malaria Prophylaxis	HIV/TB Counseling	Activity Level	Tetanus	Nutrition	Birth Plan	Breastfeeding	Family Planning	Postnatal Danger Signs	Neonatal Care/ Danger Signs
1												
2												
3												
4												
5												

FIGURE B.3: VillageReach Supplemental MNH Register Redesigned for ODK Scan

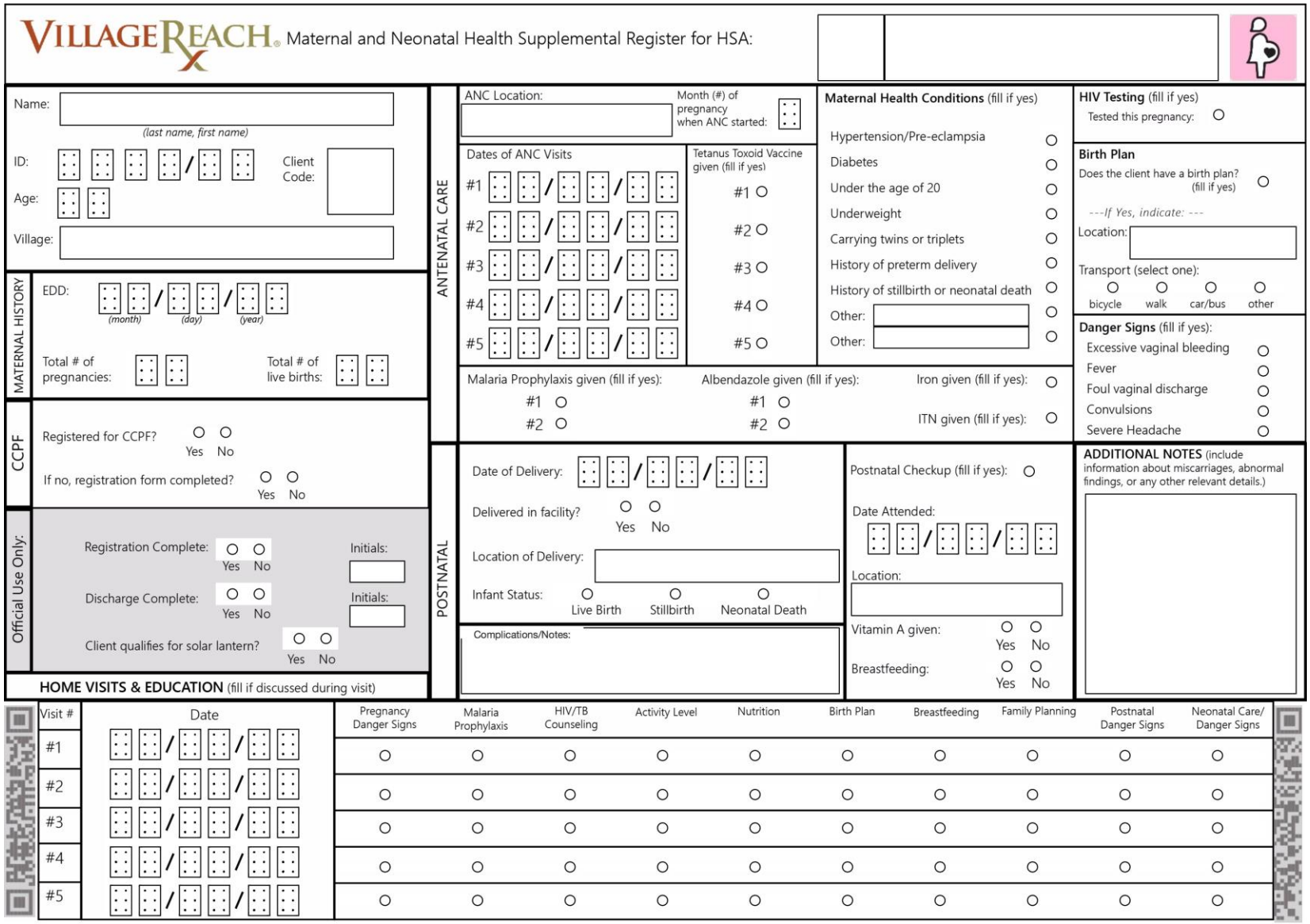
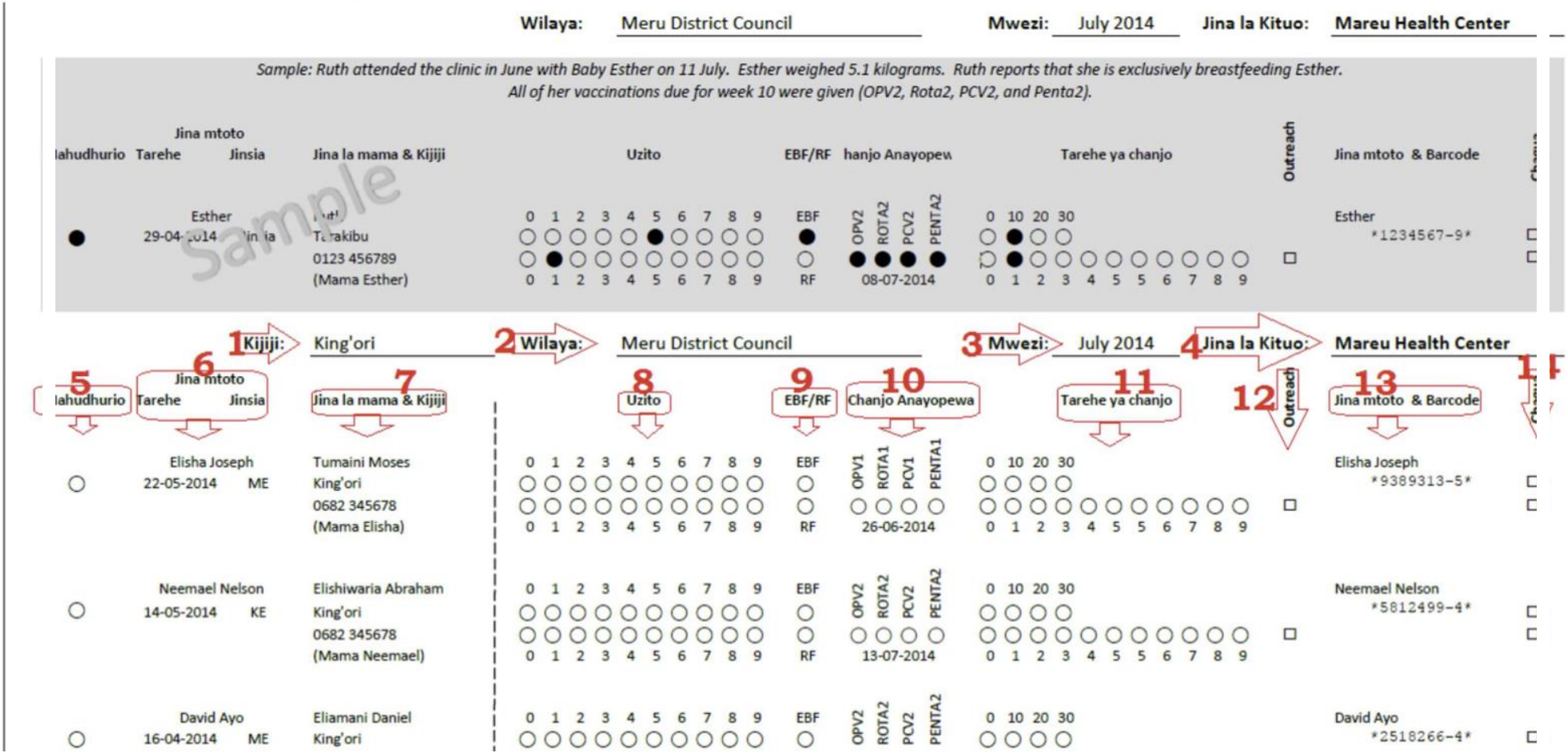
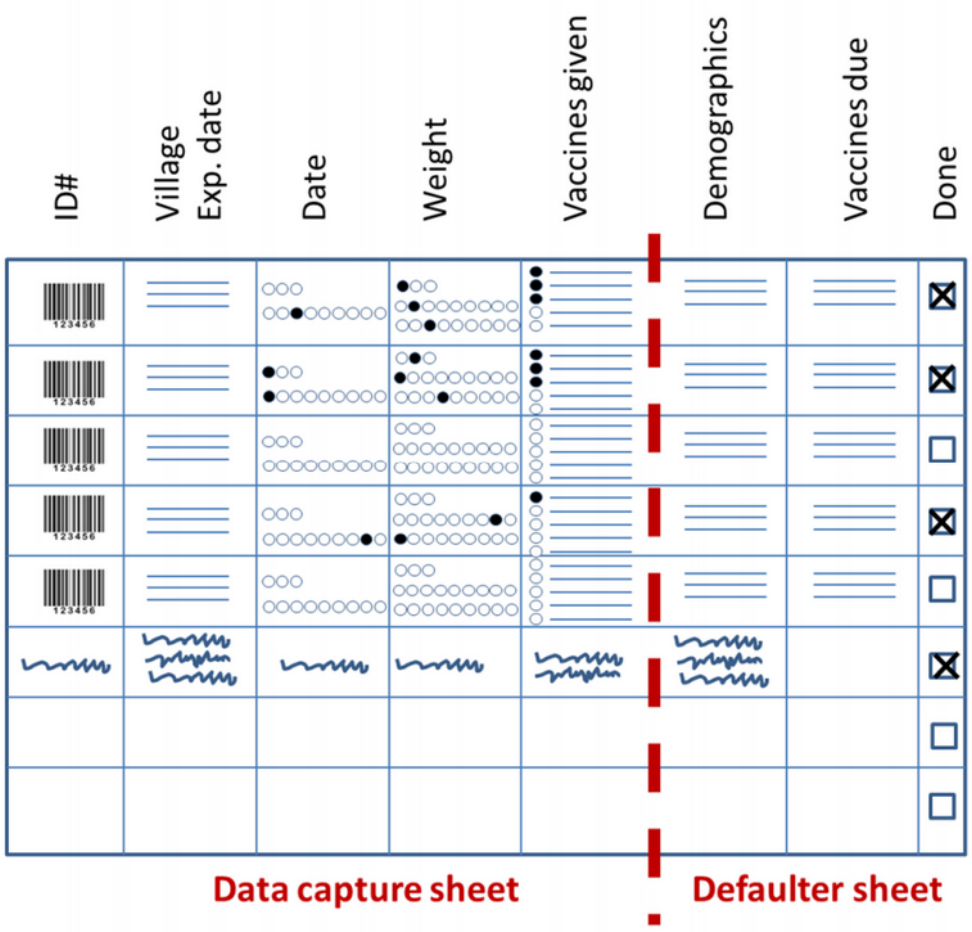


Figure B.4: Sample of BID Immunization Child Register Version 1
[6]



[6] Taken from BID Tanzania use case documentation. BID Zambia use case was described as being functionally equivalent.

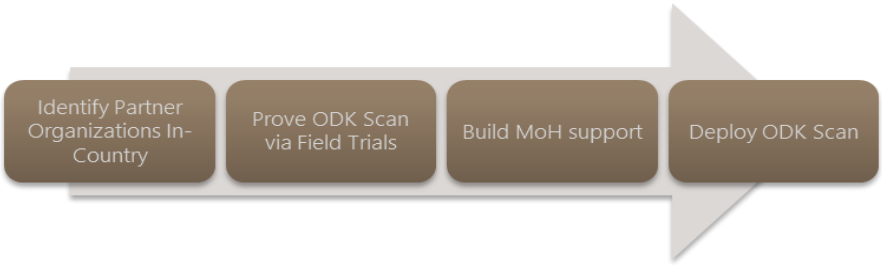
FIGURE B.5: Sample of BID Immunization Child Register Version 2
[7]



[7] Taken from BID Tanzania use case documentation. BID Zambia use case was described as being functionally equivalent.

Appendix C – Ministry of Health Engagement

The Enhancing ODK Scan grant includes engaging with ministries of health to lay the foundation for future larger-scale deployments of ODK Scan. Our strategy for engaging with ministries of health is to first identify a partner organization in a potential deployment country, then work with that partner to build support for ODK Scan. By working with the partner organization, we are able to evaluate the data collection needs in-country, assess willingness of ministry to try new data collection approaches, develop potential roll-out strategies, and identify decision makers within the ministry. We are currently working at this phase with partner organizations in Nigeria, Tanzania, Mozambique, and Malawi.



As shown in the diagram above, prior to approaching ministries of health (MoH), we will collate results from the 2015 field trials. Ideally, field trials will be done within the target country to overcome the potential concern that ODK Scan may not work within the specific country context.

The largest change management issue for ODK Scan introduction will be the need to redesign current forms to be compatible with ODK Scan. Multiple test scenarios have proven that it is possible to redesign even complex registers in a format that ODK Scan can use – the challenge is a willingness at the ministry of health to change to a new form. To address this challenge we will use the following strategies:

- Pair ODK Scan form introduction with an already in-progress form redesign project
- Identify forms that are currently non-standardized across the country (often this is the case for stock management and stock transfers at the district level), and introduce an new, standardized, ODK Scan compatible form
- Identify a single-page form that is not critical to current business processes (such as refrigerator temperature monitoring sheet), and replace existing form with ODK Scan compatible form
- Introduce ODK Scan initially with a NGO health form that is used at scale, building the case for change in MoH forms

Using these approaches, we are confident we can build support for ODK Scan within ministries of health.