

# **EVERY CHILD COUNTS – THE USE OF SMS IN KENYA TO SUPPORT THE COMMUNITY BASED MANAGEMENT OF ACUTE MALNUTRITION AND MALARIA IN CHILDREN UNDER FIVE**

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Lastly, all results presented below are largely a result of the vision of Dr. James Wariero and the MVP Sauri health team and the diligence of the Kenyan community health care workers for whom this system was built.

## **BACKGROUND**

Baseline under five child mortality in Sauri, Kenya in 2005 was estimated at about 148 deaths per 1000 live births. By 2008, child mortality in this Millennium Villages Project (MVP) site had dropped to about 81 deaths per 1000 live births due to MVP interventions. A review child deaths from verbal autopsies showed that children died from malaria (28%), acute febrile illnesses (14%), diarrheal illnesses (18%) and HIV (14%). Underlying malnutrition is known to contribute to more than 50% of all child deaths and could be confirmed in 36% of the 58 reviewed cases in Sauri.

To mitigate this situation, specific, proven child survival interventions have been introduced. These community health care workers (CHW) led interventions include:

- Community-based management of acute malnutrition (CMAM), which involves identifying children at risk of acute malnutrition and in need of therapeutic nutritional interventions through home-based nutritional screening of children between the ages of 6 months to 5 years of age every 3 months. To do this, CHWs measure a child's Mid-Upper Arm Circumference (MUAC);
- Home-based testing for malaria using Rapid Diagnostic Test (RDT) kits and immediate dispersal of treatments of Artemisinin-based Combination Therapies (ACTs) by CHWs to children who test positive;
- Home-based treatment of children with diarrheal illness by CHWs using Oral Rehydration Salts (ORS) and Zinc supplements.

According to a 2007 census, the MVP Sauri Cluster constitutes a community of an estimated 65,000 people, of which 14% are children from 0 to 5. Taking into account an annual growth rate of 2.5%, the number of children in 2009 under five years of age is estimated at 9,561. This is the age group most at risk of death.

To help support the interventions being introduced, MVP decided to pilot a platform where CHWs equipped with mobile phones to use SMS text messages to register patients and send in their data with the ultimate goal of improving child health and empowering community health workers.

This report seeks to detail the methods used, illustrate early results and initial findings of the ChildCount mHealth platform that CHWs have now been using since early July of 2009.

## METHODOLOGY

### System Design and Development

The original purpose of this project was to develop an approach to use mobile phones to support the delivery of CMAM programs, which MVP was in the process of introducing to Sauri. To develop the required solution, the project decided to use RapidSMS [1], a free and open-source application development framework for developing SMS based applications. RapidSMS is based on the concept of using specially formatted text messages that are interpreted to represent specific actions to a back end web-application in a way similar to standard HTTP Post and Get methods [2]. Actions could include adding or modifying information in a database and triggering a response back to the user based on specific workflow logic defined by the system. The following is an example of a formatted SMS message that is used to register a child into the system.

*NEW LAST FIRST GENDER(M/F) Date Of Birth(DDMMYY) Parent*

**new diallo fatimata f 080408 Amie**

Once this message has been received, RapidSMS checks to see if this child exists in the system. If the child is not in the system, a new patient record linked to a CHW is created and a message is sent back to the CHW. For example:

**PATIENT REGISTERED> +28 DIALLO, Fatimata. F/13M.  
Mother: Amie, Kangaba Village.**

Over the span of about a month, MVP developed the initial prototype of the system with a set of functionalities for RapidSMS required to support the delivery of CMAM and packaged it into an mHealth platform called ChildCount. The functionalities of the initial system included:

- Ability for CHWs to register themselves by SMS and link themselves to the system through their phone number;
- Ability for CHWs to register children via SMS and in the process, generate an ID number that could be used to track a specific child;
- Ability to report, via SMS, anthropometric measurements of a child taken during a nutritional screening including MUAC, weight, oedema status and presence of malnutrition risk symptoms. These reports are automatically analyzed in the system using a CMAM workflow to return a proper diagnosis of malnutrition status immediately back to the CHW;
- Automated alert and notification system aimed at reducing communication gaps that affect proper treatment of children. This includes automated referrals and follow-up alerts to remind CHWs to check the status of children in treatment.

- A basic web interface for the health team to analyze aggregate nutritional status data and monitor individual children with malnutrition.

After an evaluation of SMS platforms, RapidSMS was chosen for its ability to support the complex workflow required for this project. Support for a web interface was required since the system would need to be accessed by multiple remote users simultaneously. RapidSMS was appealing since it was built with Django, a python web-framework, developed by the newspaper industry specifically to scale. Additionally, Django is very well documented, easy to develop with and provides good structure in which for new programmers to learn.

Once a functional prototype was built, the MVP technical team consisting of its ICT coordinator and a programmer provided by UNICEF traveled to Sauri with MVP's nutrition team to launch the pilot. Over a span of two weeks, the technical team worked with the Sauri health team to finalize the design of the system, while the nutrition team introduced the Sauri Cluster CHWs and clinic staff on the fundamentals of CMAM while integrating the use of SMS for reporting.

Once having fully understood the system, the Sauri health team quickly identified several new important uses to extend the functionality of the system.

First, instead of just acting as a monitoring system for malnourished children, the Sauri health team made the bold decision to use the system to register all children under 5. They hoped that the system could, not only be used to monitor malnutrition but, serve as a “living” registry that would enable them to account for every child in the community. It was planned for the registration of every child under 5 to be done in conjunction with the initial mass screening required for the launch of the ChildCount supported CMAM program.

Second, with the peak malaria season imminent, MVP was preparing to introduce home-based testing for malaria using rapid diagnostic tests (RDTs)—an important new diagnostic tool for properly diagnosing malaria. Prior to RDTs, accurate malaria diagnosis required lab-based microscopy. As a result, malaria has historically been over diagnosed resulting in the over prescription of antimalarials, which has contributed to increased resistance of the parasite to traditional antimalarials. Use of RDTs also represents a real cost savings as a RDT costs significantly less than a full treatment of ACTs.

Per the request of the Sauri team, ChildCount was extended to allow the CHW to report the RDT result for any tested febrile child under five. Besides reporting the malaria status of the child, the RDT report sent in by the CHW would also include whether or not a bed net was present at the child's home. For RDT positive tests, the CHW would be provided with immediate instructions on dispensing appropriate dosages of ACTs based on the child's age. When negative, the CHW is instructed to refer the child immediately to a clinic to properly identify the source of the fever. In addition to tracking RDT use, since the child's age is known at the time of the diagnosis, it is possible to estimate quantities of ACTs prescribed in aggregate and

by each CHW. This would help the health team monitor the usage of ACT by CHWs by comparing the actual amount of ACT drugs for children consumed vs. prescribed by the system. This could help cut down over diagnosis and misuse.

### **Pilot Launch and Training**

Sauri's community health program is based around 108 CHWs supporting 8 clinics and one sub-district hospital. Health care workers are assigned to a particular community or sub-community with a specific number of households assigned to them. On average, a CHW is responsible for about 100 children under 5 at any time. All CHWs are literate with most having achieved some level of secondary school education. CHWs are provided with a small monthly stipend for their work and are expected to work on a part-time basis.

In addition to the CMAM training, SMS trainings were organized in groups of about 20 and usually lasted 2 to 3 hours each. Much of the initial training consisted of teaching the CHWs how to use their new phones and how to send a text message. While all CHWs knew about SMS, it is unknown how many had sent a text message prior to the training. This is a question that was unfortunately omitted and should be included in future deployments. In general, most of the CHWs quickly picked up on the concept of the system and became proficient users within a few weeks. A portion of the CHWs, however, struggled initially with the system and required additional individual training. It was also found that training was required whenever new features were added to the system. There were also instances of downtime in number of texts received during the launch of the system due to technical glitches in the system that have since been debugged.



*Training of CHWs*

CHWs were also provided with a ChildCount cheat sheet that was glued into their CHW diaries. The diaries are used to write down information related to their households, including visits and treatments.

The CHWs completed their initial round of training in late June and the system went live in early July.

## **PARTNERSHIPS**

This project has benefited from a number of important partnerships led by Ericsson. Each CHW was provided with a phone from SonyEricsson. Zain, a local GSM operator provided the project with a toll-free SMS number that allows CHWs to message the system for free. The UNICEF Innovation Group also contributed by supporting some of the initial programming costs of this system.

While these partnerships, help defray some of the costs of getting started; they are not a precondition for replicating this approach. ChildCount is an open source application that is free for any organization to use. While some custom programming work may be required to adapt it to a specific implementation's need, being able to leverage the existing code base would help reduce this cost. ChildCount also only requires a basic handset capable of sending an SMS. This greatly reduces the cost of provisioning phones and makes it possible to use the CHWs own phones if they have them.

Establishing a toll-free number so that the end-user is not charged is very important. It is also one of the greatest challenges in establishing such a program since it requires negotiating with operators. It is possible to use ChildCount to automatically distribute credit and track usage but this requires work to support.

## **SUPPORT**

During the initial phase of training, a full time person was needed to monitor the system, lead training sessions, provide individual phone based support to CHWs and work to encourage initial usage. This person stayed on the project for the initial 2 months of the pilot. A local Kenyan programmer has since been brought in to replace this person and is currently working with the local health team to continue to improve the system.

## RESULTS

### CHILD REGISTRATIONS

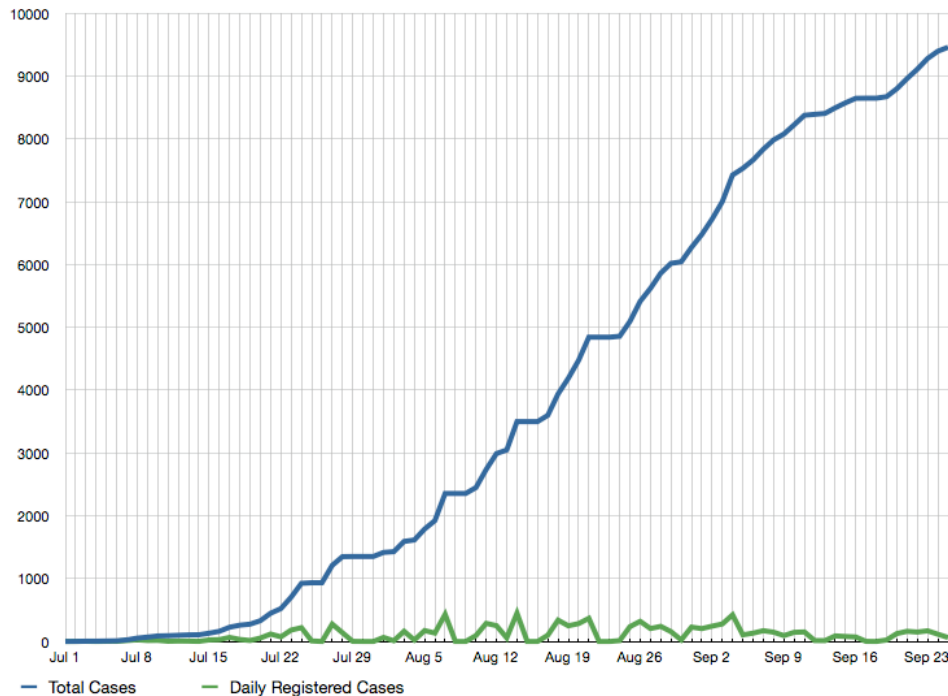
The initial use of the system focused primarily on the registration of children under five. Since populating the system represented a much higher volume than average daily usage, it provided a good means of quickly reinforcing use of the system. Since many CHWs had already recorded the names of some of the children in their diaries, registrations proceeded quickly with over 400 children being registered some days.

As of September 28th 2009, approximately three months after the initial child registration, there were 9,501 children in the system. Of these, 9,107 children are between 0 to 60 months and represent **95%** of the estimated 9,561 children under five in the cluster<sup>1</sup>. Since the system does not currently restrict child registrations based on age, approximately 400 of the total 9,501

There are also approximately 400 children in the system that are five or over.

Children registered per CHW range typically from 70 to 150 with an average of 85 children registered per CHW.

**Figure 1. New Child Registrations**

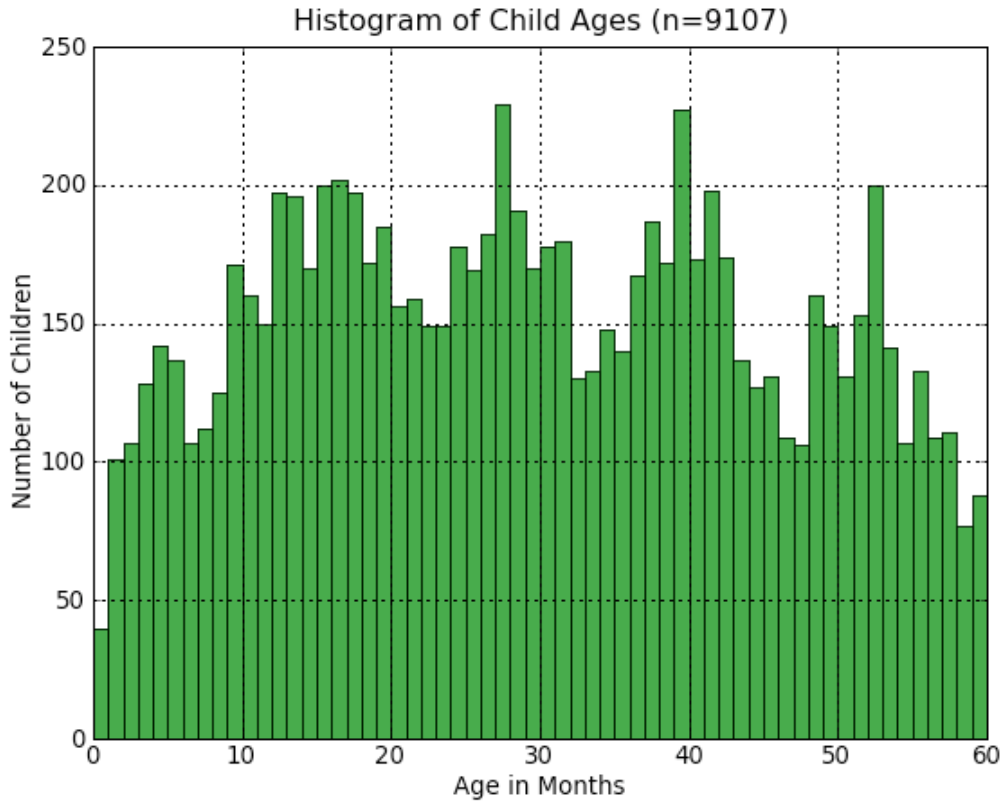


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<sup>1</sup> Since the system currently does not restrict child registrations based on age, approximately 400 of the total 9,501 children in the system are five or older. The decision has yet to be made on how to handle these children.



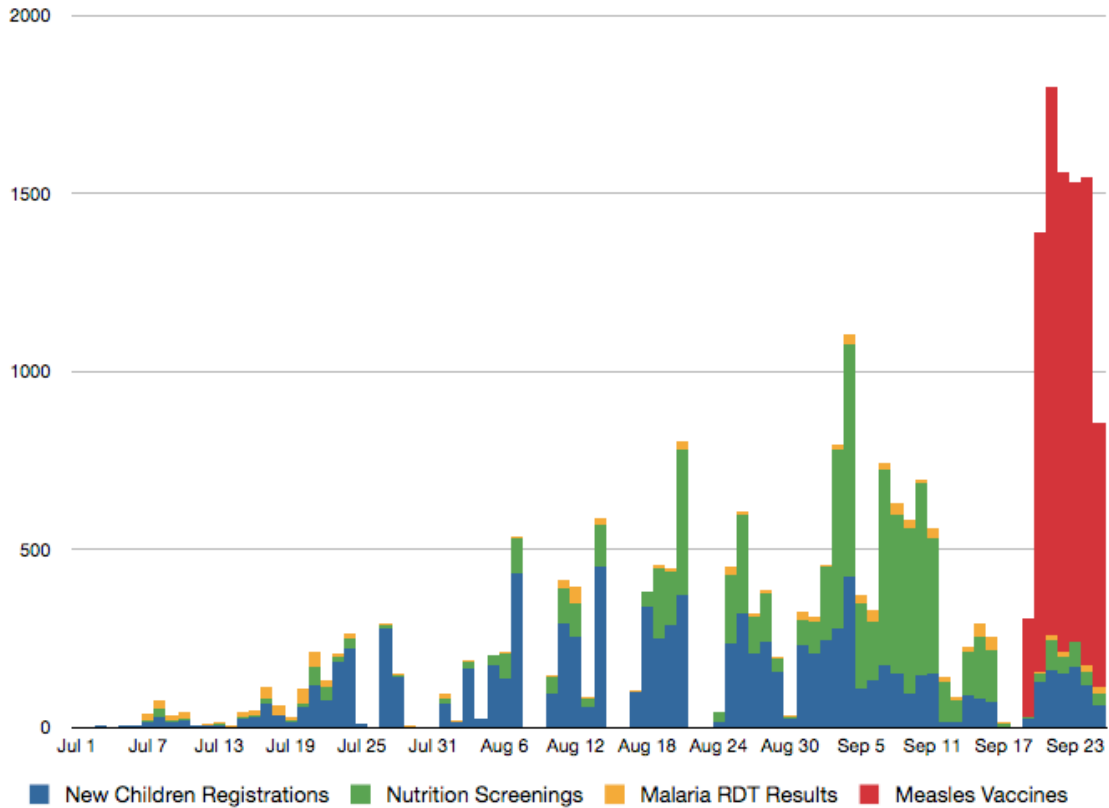
**Figure 2. Distribution of Children by Age Group**



**SMS REPORT VOLUME**

CHWs using the system have sent in over 20,000 SMS based health reports and registrations consisting of 9,501 new children registrations, 7,646 nutrition screening reports, 839 RDT results and registration of 7,803 measles vaccinations. Total incoming SMS volume that includes rejected messages and user messaging was approximately 25,000 messages. Not taking the measles campaign into account, this averages out to about 330 reports per weekday (volume drops on weekends) and 165 reports per CHW for an average of 3 SMS reports per day per CHW.

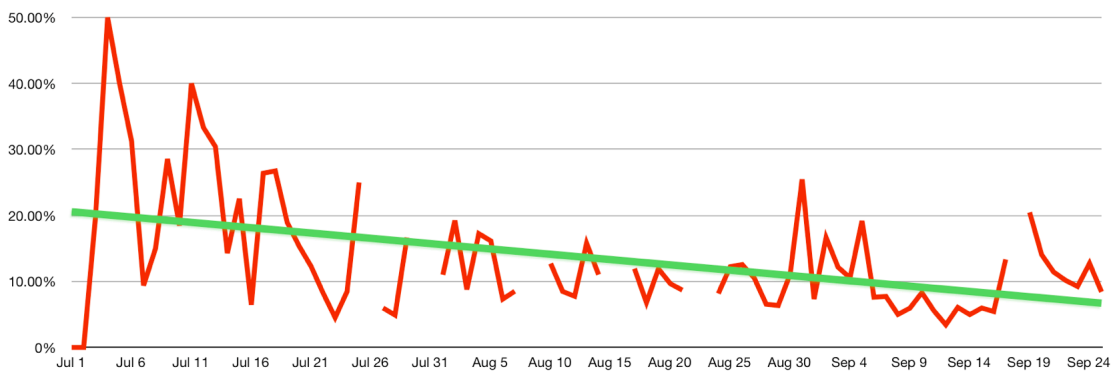
**Figure 3. Daily SMS Based Health Reports and Registrations**



### SMS DATA ENTRY ERRORS

About 10% of all incoming messages sent to the system were rejected due to improper formatting. Typically there are spikes in errors when new users are added into the system or a new functionality is introduced. The increase in error messages on September 19<sup>th</sup>, for example, reflects the launch of the measles campaign. These rates quickly normalized as depicted in the chart below.

**Figure 4. Percentage of SMS messages rejected by system due to improper formatting**

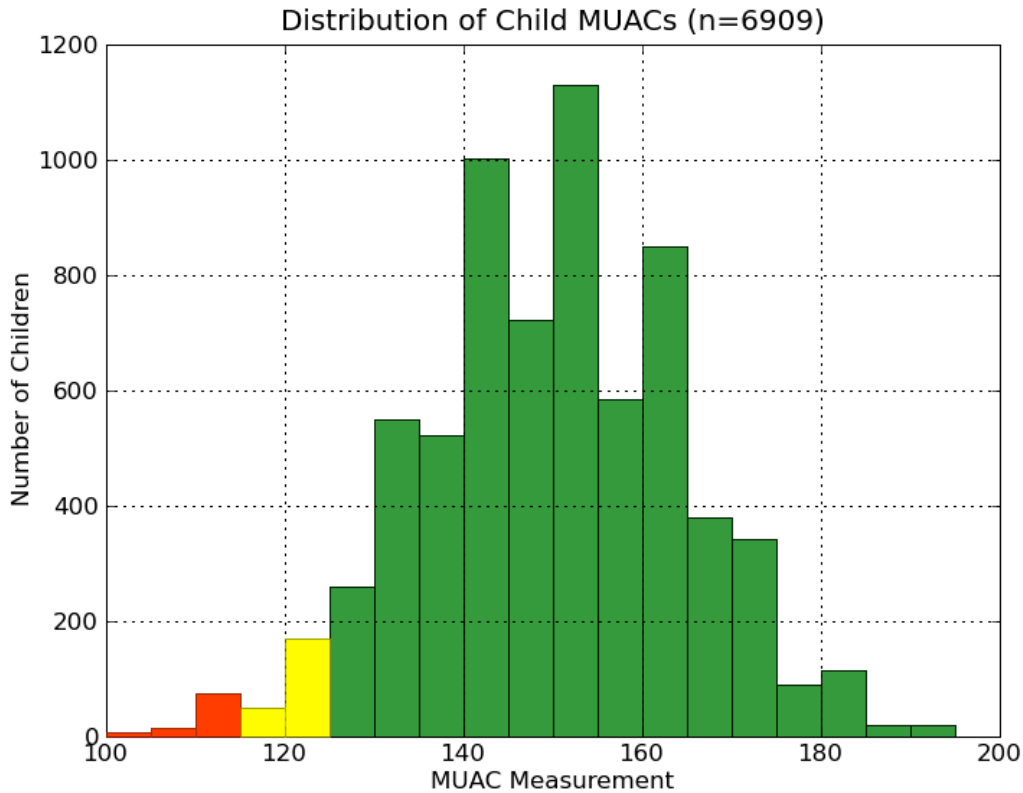


Overall, this indicates that CHWs are able to use SMS to effectively submit reports to the system. From the standpoint of data quality, further analysis, is required to provide comment.

### NUTRITION SCREENING

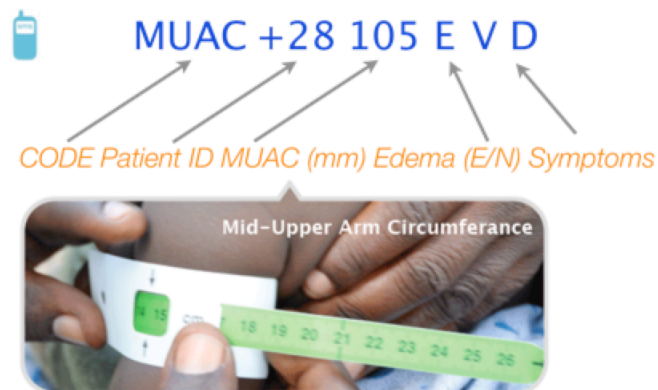
There have been 7,646 individual nutrition screening reports providing the MUAC status on 6,909 children—73% of registered children in the system. Of these, about 93% had a single MUAC update and about 6% had multiple updates (2-4). Of these, 258 (3.7%) children have moderate acute malnutrition (MAM), 50 (0.7%) have severe acute malnutrition (SAM) and 66 (0.96%) children with SAM exhibiting risk symptoms (SAM+). 6,958 children are not exhibiting signs of acute malnutrition. The global acute malnutrition rate (GAM) is about 5.3% with a global SAM rate of 1.5%.

**Figure 5. Distribution of Child MUACs**



*Note: Red indicates severe acute malnutrition (SAM) and yellow moderate acute malnutrition (MAM).*

Nutrition reports were sent in with an SMS with the following format:



Symptom codes are shared across the different health reports. In this case, the child is **V**omiting and has **D**iarrhea.

### **MALARIA RAPID DIAGNOSTIC TEST RESULTS**

There are 839 reports on RDT usage. 69% of the RDT tests results were positive and 31% negative. Since the system has only been in use for 3 months and usage rates are still somewhat variable there is insufficient data to indicate seasonable variability in malaria rates.

### **INITIAL FINDINGS**

While this pilot is still in its initial stages, there are several key observational findings that can be made based on the experience thus far.

### **INFORMATION MUST BE A TWO WAY FLOW**

After the initial trainings, as Figure 3 indicates, usage of the system was characterized primarily with new user registrations and relatively consistent reporting of RDT use. Usage of nutritional status reports was generally limited to reporting on children that presented signs of acute malnutrition. The system was being used primarily to report on sick children but there was no systematic recording of MUACs for all children under five as is required for proper malnutrition monitoring under CMAM.

**Figure 6. CHW Case Report**

*Anyiko: Carolyn Ateka*

#	PID#	NAME	SEX	AGE	MRDT	BEDNET	CMAM	SYMPTOMS	LAST UPDATE
1	6056	[REDACTED]	F	15.10.07 - 23m			MAM (115mm) 62		21.07.09
2	32346	[REDACTED]	F	30.11.07 - 21m			Healthy (158mm) 10		11.08.09
3	76911	[REDACTED]	F	06.04.05 - 53m			Healthy (160mm) 15		04.09.09
4	84899	[REDACTED]	F	06.08.09 - 1m					08.09.09
5	19345	[REDACTED]	F	18.06.08 - 15m			Healthy (140mm) 10		02.08.09
6	3578	[REDACTED]	F	11.01.04 - 68m (2X)			Healthy (155mm) 14		17.07.09
7	78099	[REDACTED]	F	11.07.07 - 26m			Healthy (145mm) 14		04.09.09
8	32297	[REDACTED]	F	07.02.08 - 19m			Healthy (137mm) 10		11.08.09
9	86157	[REDACTED]	F	15.01.06 - 44m			Healthy (167mm) 11		10.09.09
10	92015	[REDACTED]	F	01.10.04 - 59m					19.09.09
11	22994	[REDACTED]	F	30.07.08 - 13m			Healthy (150mm) 14		05.08.09
12	73787	[REDACTED]	F	26.05.06 - 39m			Healthy (140mm) 15		03.09.09
13	77968	[REDACTED]	F	14.06.07 - 27m			Healthy (135mm) 11		04.09.09
14	78491	[REDACTED]	F	03.09.04 - 60m			Healthy (170mm) 16		04.09.09
15	92023	[REDACTED]	F	19.04.08 - 17m					19.09.09

As the project team looked into the absence of MUAC measurements, the team quickly realized that they lacked the required information to address the problem. The aggregated data displayed in the web interface did not make it possible to see who the data was coming from. Moreover, once a report is sent, a CHW did not know where the data went nor could they easily manage the list of registered patients on their own. As a result, the project team quickly realized the need for reports that could be distributed to each CHW on a frequent, initially a weekly, basis. This *CHW Case Report* (Figure 6) provided to each CHW consists of a list of children s/he is responsible for and information on each child, such as id, age in months (auto-calculated based on DOB), RDT result history, last recorded nutritional status of the child, and number of dates since the last screening. Since August 5<sup>th</sup> these reports were initially introduced on (See Figure 3), there was an immediate and sustained uptake in recordings of MUAC measurements. This can be attributed to the CHWs being able to monitor their own progress each time they get a new report and the improved ability by the project team to monitor MUAC reporting on a per CHW basis.

**IMPROVED MONITORING = BETTER PERFORMANCE**

According to the Sauri health team, one of the unintended benefits of the system was the ability for the health team to provide improved feedback to CHWs who may not be working optimally. Prior to ChildCount, it was difficult for the health team to reliably monitor individual activity levels. While this system does not take in account all CHW activities, usage of the system provides a proxy of their activity levels including a basis of comparison between CHWs

Another paper report developed for use by the Health team was the *CHW 30 Day Performance Report* (Figure 7) that provides a breakdown of the recent activities of

all CHWs organized in groups by their clinic. This report includes: the total number of children registered by the CHW, the number of children registered in the last 30 days, total of RDT cases reported by the CHW in the last month, the number of MUAC reports, and percentage of children with an up to date nutritional status. It also includes an SMS accuracy rate, which is based on the percentage of messages, sent and accepted by the system over the past 30 days. This SMS accuracy rate has been useful in identifying CHWs who may have been struggling with the system. Lastly, a “last activity” column indicates the number of days since the CHW last used the system making it easy for the health team to flag CHWs not actively using the system in their work.

According to the Sauri health coordinator, James Wariero:

*“Most CHWs seem to appreciate the system since it simplifies what they are already trying to do well... the lazier ones find that basically it forces them to pull up their socks.”*

**Figure 7. CHW 30 Day Performance Report**

*Nyawara Clinic*

#	PROVIDER	TOTAL CASES	# NEW CASES	MRDT	MUAC	RATE	LAST ACTIVITY
1	Solomon Wasambo	116	17	10	112 97% (112/116)	92% (129/140)	1 days ago
2	Emily Aoko	81	3	3	76 94% (76/81)	100% (49/49)	1 days ago
3	Josephine Otieno	87	8	0	83 95% (83/87)	86% (53/61)	2 days ago
4	Jacob Ochieng	73	5	1	66 90% (66/73)	100% (35/35)	1 days ago
5	Lawrence Ogogo	55	11	4	3 5% (3/55)	80% (37/46)	1 days ago
6	Salome Abonyo	71	2	1	30 42% (30/71)	94% (16/17)	2 days ago
7	Wycliffe Okol	116	2	6	118 102% (118/116)	100% (59/59)	1 days ago
8	Peter Onyango	99	3	0	86 87% (86/99)	93% (44/47)	1 days ago
9	Godfrey Nyateng	73	4	1	71 97% (71/73)	89% (68/76)	1 days ago
10	Frederick Odhiambo	109	52	0	81 74% (81/109)	100% (166/166)	1 days ago
11	Josephine Mutiba	55	39	3	30 55% (30/55)	89% (114/127)	1 days ago
12	Lilian Okello	65	1	3	68 105% (68/65)	94% (52/55)	2 days ago
13	Maurine Akinyi	107	11	0	88 82% (88/107)	84% (38/45)	1 days ago
Summary		1107		32	82 % (912/1107)	93% (860/923)	

**A COMPREHENSIVE CHILD REGISTRY ENABLES SPECIFIC TARGETING OF INTERVENTIONS**

Much of the initial value of the system can be derived from having been able to rapidly create an accurate and updated registry of the majority of children under five in the cluster. Registering by SMS allows this to be done in a very distributed way empowering the CHWs to be responsible for their own registry. Furthermore, compared to a paper based approach, having the information in a relational database makes it easier to intelligently identify children for specific interventions. A simple query, for example, can create a list of all children 6 months old requiring a Vitamin A pill.

In a specific example, the Sauri health team adapted ChildCount to help manage a large measles drive. Using the registry, the team generated a list of eligible children for vaccination by each of the CHWs. CHWs were also provided with instructions on how to pass the IDs of the children who had been vaccinated back to the system via SMS, averaging 3.5 children at a time. For example:

**MEASLES +452 +5652 +324 +8425 +4224**

Using this approach, the health team was able to accurately record a vaccination in 94% of eligible children in a seven-day campaign.

**Figure 8. ChildCount Supported Measles Campaign Summary**

Facility	Vaccinated	Eligible	%
Ramula Clinic	1525	1653	92%
Lihanda Clinic	708	738	96%
Gongo Clinic	499	544	92%
Marenyo Clinic	1000	1027	97%
Yala Sub-District Hospital	1473	1547	95%
Nyawara Clinic	871	930	94%
Masogo Clinic	342	371	92%
Sauri Clinic	540	627	86%
Mindhine Dispensary Clinic	617	646	96%
<b>Total:</b>	<b>7575</b>	<b>8083</b>	<b>94%</b>

An additional outcome of the drive was an increase in child registrations during this period. With ChildCount in place, each campaign in effect becomes a chance to audit the registry.

One of the features noticeably missing from the system has been the ability to record deaths. This is an important feature that is being added and in hindsight should have been included from the beginning. Furthermore, this feature will provide an improved ability to track child mortality and hopefully show, over time, that careful monitoring with SMS will lead to better capture of information, better responses and behavior change that will drive down child mortality rates.

## **IMPROVED LONGITUDINAL MONITORING COULD HELP BETTER IDENTIFY CHILDREN AT RISK**

It is hoped that the routine use of a system like ChildCount will improve the frequency in which sick children are properly diagnosed and treated. In the process, the system could be used to start building a row-level longitudinal medical history for each child in the community. By monitoring for risk factors like recurrent malaria, malnutrition and diarrhea, the health team will be able to use the system to identify and profile children (and their siblings) who are most at risk so the local health team can take proper action.

Currently, the part of ChildCount that identifies and profile most at risk children is still limited and requires further development. An updated malnutrition report consisting of all the children with acute malnutrition along with a report of children recently diagnosed with malaria is reported to the health team on a semi-weekly basis. While the malaria reports indicate whether a child has been diagnosed with malaria before, the malnutrition report currently does not show how the child's status is progressing. Optimizing this report to help the nutrition team and CHWs better manage treatment of children with acute malnutrition will be a major focus in future releases of the system. Ultimately, the goal is to create a *Child @Risk Report* that will take in account the malarial, nutritional, diarrheal, advanced respiratory illness status and history of a child to identify those most at risk.

## **CHALLENGES**

Several of the challenges encountered thus far include:

- Some users struggled initially and required additional training before they could effectively use the system.
- Several of the phones provided by the project have malfunctioned and needed to be replaced. In addition, several phones have gone missing and require the project to acquire additional phones for the CHWs to continue to use the system. In the future, providing CHWs with cheaper, basic entry-level phones could potentially mitigate this problem.
- The system currently lacks the ability to accurately record deaths or to capture when children receiving inpatient care default, recover or do not recover.
- There was an initial challenge with duplicate child registrations. Changes made to the registration algorithm have helped reduce this occurrence.
- The existence of a functional health care system and motivated CHWs are probably required for this approach to be successful. A system like this is only worth putting in place when there are resources and infrastructure to implement interventions.



- Assuming an average cost of \$0.05 USD an SMS, it would cost about \$2,500 (\$833/month) in credit to pay for the estimated 50,000 text messages used in the pilot thus far. While this could be considered potentially cost effective, it may be outside the means of some health care systems under current pricing practices. A drop in SMS rates to \$0.01 USD [3] could have a tremendous impact in sparking demand and driving innovation for services like this. Support from operators would also make it possible to scale these programs further.

## **MOVING FORWARD**

As the pilot continues to progress, there are a number of functionalities planned to extend the system and to address some of the challenges identified thus far.

### **VITAL EVENTS**

Besides providing immediate support for recording child deaths in the system, the project team plans to extend the system to capture other vital events in the community including births and pregnancies. Using the system to register and monitor for healthy pregnancies is a logical extension for this application. It could also help improve reporting on pregnancies that do not come to term and mothers or children that die during childbirth at home which tend to be very difficult to accurately record.

### **OTHER CHILDHOOD ILLNESSES AND FULL IMMUNIZATION SUPPORT**

The system is currently being updated to support home-based treatment of children with diarrheal illness by using Oral Rehydration Salts (ORS) and Zinc supplements. In addition, a module aimed at addressing pneumonia is also being considered. As illustrated by the measles vaccination campaign in Sauri, one of the strengths of the system is the ability to track children by age groups, which makes it ideal for helping to manage a comprehensive child immunization program.

### **ALERT SYSTEM**

One of the initial core functions of ChildCount, which has not been fully implemented, is the alert system that would facilitate the sharing of children's status between the members of the health team and the follow up alert system that would be used to help prompt CHWs to check up on sick children. The important focus moving forward will be to introduce functionalities that help monitor and improve the treatment of care once a child has been diagnosed with an illness. The system will also be extended to allow the care giver to signal when there is a problem or check on a child's status.

## **DRUG DISTRIBUTION MANAGEMENT**

Proper management of drugs distributed to community health care workers is a common problem facing community health programs. As a first attempt to help address this, a basic working version of an inventory management system for ChildCount has been developed and will be piloted soon. Initially, this system will only attempt to manage the 5-10 core drugs distributed by CHWs.

For drug distribution, the system is based on three basic concepts.

First, any single user in the system is able to distribute drugs to any other user in the system. As a result, the system supports transfers from pharmacist to CHW, CHW to pharmacist and CHW to CHW. All transfers are tracked with an SMS exchange that the distributor must initiate and the recipient must confirm.

Second, any user is allowed to check the stock of drugs at a particular clinic, as well as, any other user (or their own).

Third, only the chief pharmacist is able to add new drugs into the supply.

An additional component of this system that will be tested is tracking the drugs dispensed to patients. For each dose of drug dispensed, the CHW would send in an SMS containing the drug and quantity dispensed and basic patient data including the name, age and gender of the patient or simply the patient ID if it exists. An SMS with a transaction number and prescription instructions is then returned. The CHW would then record the transaction number into an already existing paper form. Since the age and gender of the patient is known, each prescription can also be checked to ensure proper dosage guidelines were followed. One of the initial uses of the system will be to track Plumpynut, a ready to use therapeutic food (RUTF) that is used to treat children with acute malnutrition at home.

## **IMPROVED BACK END ANALYTICS**

Built in statistical analytic tools aimed at evaluating data quality and addressing sampling issues are important for improving the overall accuracy of the results produced by and measures derived from the system. This would include, for example, the ability to verify data based on Z scores and to check for bad measurement practices or falsified entries by analyzing the distribution of last digits used in the reports sent in.

## **CONCLUSION**

In summary, the pilot has begun to show that an SMS based approach, using a system like ChildCount, can lead to improved maintenance of child-specific anthropometric records which in effect is helping to monitor a community's health. ChildCount also makes it easier to develop and maintain a comprehensive child registry that facilitates the ability to implement targeted interventions. The system has also already shown that it can be used to increase the level of accountability of CHWs while enabling the health team to better manage community-based care.

James Wariero, the Health Coordinator for the Kenya team who leads the pilot locally, hopes that access to this level of data will help overcome a perceived "numbness to numbers" that he finds common in rural African health care. He hopes that when the medical history of each child is available, each preventable death becomes increasingly unacceptable.

Overall, this project intends to show that with a working community health care system, with CHWs assigned to specific homes, it is possible to begin to build a comprehensive child registry where every child is counted. This registry can then be used to help insure full immunization coverage and the close monitoring of major risk factors for child mortality (i.e. malnutrition, malaria, and diarrhea) thereby empowering the community with the knowledge to begin to attack child mortality head on.

**For more information on ChildCount please visit:**

**<http://www.childcount.org>**

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