Study of the effectiveness of strategies and methods for providing immunization reminders to parents and guardians of children in Benin

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Executive Summary

Understanding the current vaccination appointment reminder system is an important first step in identifying strategies for sending appropriate reminders to mothers of children who have upcoming vaccination appointments. A total of 14 health agents, 14 relais and 180 guardians of children in the immunization system were recruited from 7 clinics in Ouaké to participate in an assessment. The purpose of the assessment was to (1) understand the current vaccine reminder system; (2) understand participant preferences about giving or receiving appointment reminders; and (3) understand if SMS is a feasible way to remind health workers, relais, and/or guardians about upcoming or missed appointments. Surveys were conducted with these three different groups between February and March of 2016.

The study team found that while all three groups would like appointment reminders, only a small percent of mothers reported that they have received reminders in the past. In addition, 4 out of 10 mothers interviewed reported that they, or someone they knew, had missed a vaccination appointment. The study team also found that relais play a key role in the vaccination system by building awareness about vaccines and finding mothers who are due for upcoming sessions. While mothers had low literacy rates and low access to mobile phones, all participating health agents and relais were literate in French, had access to their own mobile phones and felt relatively comfortable using SMS.

Based on the data from this study, we conclude that an automated SMS reminder system could be implemented between health agents and relais to help relais understand which mothers are due for upcoming appointments. However, in order to implement an effective reminder system, we needed more information from health agents and relais in order to design a system that meets their needs. Focus group discussions with relais and health agents were conducted to determine appropriate message content, the frequency of sending messages, and the message preferences for missed and upcoming appointments. Findings indicated that relais would like to receive reminders for both missed and upcoming appointments on a weekly basis at least 3 days before a child is due for their vaccination. A preferred reminder format was selected to include: the patient's name, guardian's name, village, date to return to the health center, and phone number of the patient. Since relais have different preferences for the day and time that they would like to receive messages, reminder times and days will be customized for each relais when they are registered by a health worker to receive reminders.

We have used this multi-stage approach to build a system that meets relais and health worker needs, as well as assessing the necessary technical and programmatic requirements to build and implement an SMS feature within the VaxTrac system. Ongoing coordination and leadership from the health zone will be required to ensure the feasibility and sustainability of an SMS appointment reminder system. Next steps are to pilot test the SMS feature in a small group of clinics to determine the effect of reminders on patient's timeliness of return and adherence to the vaccination schedule.

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Introduction

The objective of the study was to understand how vaccination reminders are currently used and how they may be used to remind guardians, health agents or relais of upcoming or missed vaccination sessions. Appointment reminders can be a simple and inexpensive way to provide information to parents that increases schedule adherence, immunization coverage, and the number of fully immunized children.

Phase 1 Methodology

The seven health centers in the town of Ouaké (Assodé, Awotobi, Badjoudé, Komdè, Ouaké, SEMERE and Tchalinga) were selected for the two phases of the project. Phase 1 consisted of collecting qualitative data through interviews with the parents and guardians who accompany their children in an immunization session, relais involved in these sessions and health workers in Ouaké health facilities. A sample of parents and guardians of children who received immunization services during the months of February and March were interviewed.

The main variables of interest in these interviews included: general demographic information, information on literacy and preferred spoken language, how guardians learned about vaccination sessions, and preferences for receiving reminders for immunization appointments, access to mobile phones and comfort and use of SMS.

The study seeks to identify appropriate methods of reminding mothers of upcoming or missed vaccination appointments. The main study objective is to evaluate reminder strategies for missed or future vaccination appointments. Specific objectives include: 1) identify strategies/methods used for the recall of missed and upcoming vaccination appointments to parents and guardians of children; 2) analyze the strategies/methods used to improve the return rates for upcoming and missed vaccination appointments; 3) propose appropriate strategies/methods and effective means to test compliance with the vaccination schedule.

Study framework

The immunization system in Benin reflects the World Health Organization (WHO)-recommended vaccine schedule for children and targets several vaccine-preventable diseases (WHO, 2015). While overall coverage rates for BCG are high (96% in 2014) (WHO, 2015), there is a persistent dropout rate in between DPT doses. For instance, in 2014 WHO reported that only 73% of districts have a DTP3 coverage greater than or equal to the target rate (80%) (WHO, 2015). Similarly, in 2014 only 38% of districts had a measles (MCV1) coverage greater than or equal to the target rate (95%), and in the same year, there were 786 reported cases of measles (WHO, 2015).

The Centers for Disease Control and Prevention (CDC) recommends using appointment reminders for upcoming and missed vaccination sessions to increase attendance at clinics and improve the vaccination coverage rates in a variety of settings (Hamborsky J, 2015). A number of studies support the CDC's recommendations, finding evidence that appointment reminders, in a variety

of forms, have been found to increase attendance at clinics (Free C, 2013) (Hamborsky J, 2015) (Gurol-Urganci I, 2013).

Research has also demonstrated the potential impact of using text messages to remind patients of appointments (Free C, 2013) (Lester, 2010) (Labrique, Vasudevan, Kochi, Fabricant, & Mehl, 2013). Given the high mobile penetration rate in Benin of 101.7 mobile-cellular subscriptions per 100 residents (International Telecommunication Union, 2014), this study was designed to understand the feasibility of initiating an SMS reminder system in Ouake, Benin.

While mobile phone penetration is high, adult literacy rates remain low, averaging at 28.7% across Benin (UNICEF, 2013). For this reason, the study has recruited participants from three key groups, identified by zone staff as being part of the immunization reminder system. The study asked health workers, relais and guardians about their access to mobile phones, comfort with opening and responding to text messages, literacy rates as well as past experiences and preferences around vaccination appointment reminders, in order to determine if one stakeholder group might be more receptive or appropriate to receive an SMS reminder system than other stakeholder groups.

The results from this Phase 1 study will be used to design and implement a customized reminder system using appropriate technology.

Sampling

Ouake was selected as the study site by DCO health officials and the VaxTrac team due to its relatively small size and number of clinics, active participation of zone officials in the data collection and management process and high performance of health workers on the VaxTrac vaccine registry system. Participants were recruited and interviews were conducted over a four-week period in each of the seven clinics in Ouake between February and March 2016.

Three stakeholder groups were recruited to participate in this study. Stakeholder groups included: (1) health workers, (2) relais, and (3) mothers/guardians of children in the immunization system. The justification of recruiting participants from each of these three groups is because each group has been identified by stakeholders as active participants in the community- and clinic-level childhood vaccination system. Two health workers per clinic were recruited to participate in the study in order to understand an aide soignant's and infirmiere's/chef post's experience with appointment reminders (n=14). Similarly, two relais who specifically volunteered in the area of childhood immunizations per clinic in Ouake (n=14) were also recruited to participate in the study. Using the Schwartz method to calculate a representative sample of parents and guardians of children in Ouaké, the national immunization coverage statistic was used to estimate the appropriate number of parents to interview. The following parameters were used to arrive at the estimate 179.10 or 180 parent interviews:

$$N = e \times \frac{Za^2 \times P \times Q}{i^2}$$

P=37% (ECV national)
IC=95% et Z=1,96
i=10%

To recruit mothers and guardians of children in the immunization system, study staff collected the immunization schedules of each of the seven clinics in Ouake, and enumerators visited each of clinic over a four-week period between February and March 2016 during the immunization sessions. Mothers and guardians were recruited to the study while they were waiting for the immunization sessions.

Techniques and tools of the collection of data

A survey with a detailed guide was developed for each of the three stakeholder groups (health workers, relais and guardians) based on the key findings of interest for the phase 1 needs assessment: (1) understand the current vaccine reminder system(s) in place; (2) understand participant preferences about giving or receiving appointment reminders; and (3) understand if SMS is a feasible way to remind health workers, relais, and/or guardians about upcoming or missed appointments.

Enumerators were recruited, hired and trained to carry out the surveys orally with health workers, relais and guardians. Surveys were carried out orally due to varying literacy rates and comfort with responding in French or local languages. Enumerators and VaxTrac staff validated the survey instruments by 1) reviewing the instruments with the medical director and staff to ensure clarity, order, and comprehensiveness of questions and 2) recruiting a small sample of health workers (n=2), relais (n=2) and guardians (n=6) in Djougou for survey piloting and validation and to ensure clarity of the questions and response options.

Each participant gave informed consent after being read a description of the study, their rights as study participants and how data would be collected and stored. The consent form was developed according to the requirements of the ethics protocol of the National Committee for Ethics in Health Research that was adopted in April 2013.

Organization of data collection

Data were collected during a four-week period between February and March 2016. Since a convenience sample was used, we reviewed monthly clinic targets provided by the DCO statistician as well as designated clinic vaccination days to create a data collection schedule to best meet the study's needs. Data collection for guardians took place at the clinics during immunization session days, which were confirmed using historical VaxTrac data and with VaxTrac DCO staff. Since health workers and relais typically work during the immunization sessions,

surveys were conducted with these stakeholder groups when immunization sessions were not taking place.

Data Processing

After each week of data collection was completed, paper surveys were sent to two statisticians, who were each tasked with entering the completed data into a database designed for each of the three surveys. The database had data quality checks to ensure that the correct type of data for each question was entered into the database. The data from each survey were entered twice, once by each statistician, and the databases were compared to assess discrepancies using Excel. Any discrepancies between the databases were resolved by the statisticians by cross-referencing the database with the paper surveys. This process ensured that the data was validated before it was analyzed. Only validated data files were used in the analysis.

Data Analysis Plan

A data analysis plan was developed based on the purpose of the research study. Survey questions were grouped by theme and the purpose of each question was outlined. Next, the VaxTrac team outlined the types of analyses to run on the dataset. For the purposes of the study, mostly descriptive statistics such as frequency analyses, were used to assess overall trends in the data. All quantitative data were analyzed using SPSS. Open-ended responses on the survey were analyzed as qualitative data using Excel. Responses were translated, coded and grouped by theme. The number of times a theme appeared as a response is noted in the results section.

Ethical considerations

We have reviewed and are in compliance with the ethical considerations of the national ethics committee. Consent forms were reviewed aloud with participants to ensure that informed consent was reached. Risks and benefits were described within the consent forms and measures of privacy were described. We have no conflicts of interest to disclose.

Limitations of the study

A key limitation of this study was that it focused on one commune, Ouake, for data collection. While that may limit the generalizability of the study to other communities, the study helped us to identify key enabling factors for a text message reminder system that should be considered before beginning an SMS message reminder project in Ouake, as well as other communes across Benin. These critical enabling factors include: (1) Literacy levels of audience; (2) access to mobile phones; (3) comfort with technology; (4) mobile phone providers; (5) frequency of use of SMS; (6) cost of sending/receiving SMS; (7) logistics and appropriate planning; (8) types of information to send in an SMS reminder and character length; and (9) involvement of government organizations (Rajan R, 2013) (Perosky, et al., 2015) (Ashraf, et al., 2015).

Results

Study Sample

Participants in this study represent guardians, health workers and relais from seven clinics in Ouake. Table 1 (below) describes the study's sample by stakeholder group and clinic. 100% of guardians interviewed were mothers. In the results section, we use the term "mother" to reflect the sample of guardians that participated in this study.

Table 1. Sample sizes by stakeholder group and clinic.

Health Center	Mothers/ Guardians	Health Workers		Relais
		Aide Soignant	Infirmiere chef poste / responsible du CS	
Assodè	5	1	1	2
Awotobi	30	1	1	2
Badjoudé	30	1	1	2
Komdè	15	1	1	2
Ouaké	40	1	1	2
Sèmèrè	45	1	1	2
Tchalinga	15	1	1	2
Total	**180**	**7**	**7**	**14**

There were differences in language used by stakeholder group (see Table 2). Of the 135 mothers interviewed, only 16% were interviewed in French, whereas 84% were interviewed in a local language. The most commonly used local language was Lokpa (78%). Most relais and health workers were interviewed in French.

Similar to national literacy levels, only 25% of mothers reported being able to read either French or Lokpa, whereas all 14 relais reported that they could read French and that they feel very comfortable with receiving written reminders.

When mothers were asked if they had someone at home who can read for them, 84% confirmed that they did. When asked who helps them read, mothers reported that they receive help from their husband (22%), brother (19%), children (19%) or other family member or neighbor (7%).

Table 2 describes the language spoken during the interview as well as literacy by stakeholder group.

Study Sample

180 mothers

14 relais

14 health agents

9 in 10 mothers had children > 1 month old

Language and Literacy

4 in 5 mothers were interviewed in a local language.

1 in 5 mothers read French

5 in 5 relais read French

Table 2. Language and literacy by stakeholder group

Language spoken during interview by stakeholder group					
Stakeholder group	**French # (%)**	**Local Language**			
		Lokpa # (%)	**Dendi # (%)**	**Yom # (%)**	**Fodo # (%)**
Mothers	29 (16%)	**141 (78%)**	7 (4%)	1 (1%)	1 (1%)
Relais	**13 (93%)**	1 (7%)	0 (0%)	0 (0%)	0 (0%)
Health Workers	**14 (100%)**	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Number of participants by group that said yes to: Can you read?					
		Local Language			
Stakeholder group	**French # (%)**	**Lokpa # (%)**	**Dendi # (%)**	**Yom # (%)**	**Fodo # (%)**
Mothers	38 (21%)	2 (1%)	0 (0%)	0 (0%)	2 (1%)
Relais	**14 (100%)**	0 (0%)	0 (0%)	0 (0%)	0 (0%)

For a text message reminder system to be effective, it is crucial to consider both the language and literacy levels of the target populations (Rajan R, 2013). For example, in Ouake, the majority of mothers interviewed primarily speak Lokpa (78%) and only 21% reported being able to read French. As a result, sending text message reminders in French to mothers may not be effective. However, 100% of relais reported being able to read French, indicating that that this group may be more responsive to a text message reminder system than mothers.

Only 21% of mothers reported being able to read French.

Role of Relais in the Childhood Vaccination System

In order to understand how relais fit within the vaccination system in Ouake, relais were asked to describe their role. Table 3 (below) shows that 100% of relais interviewed said that their primary role included reminding mothers of vaccination sessions and helping health workers search for mothers who have either missed an appointment or have an upcoming vaccination session. Since relais are already involved in locating mothers in their communities, text message reminders containing information on which children are due for upcoming appointments might help support relais in the work that they already do in Ouake.

Table 3. Role of Relais

Role	# (%)	Examples
Mobilization	14 (100%)	Remind mothers of vaccination sessions and gather them in the village for vaccination campaigns
Searching	14 (100%)	Find mothers whose children are due for vaccination sessions
Advanced Strategy	10 (71%)	Help prepare place of vaccination
Sensitization	9 (64%)	Provide education about vaccines and the vaccine schedule
Other	2 (14%)	Serve as an interpreter; Monitor children for adverse effects

Current Reminders for Upcoming Vaccination Sessions

We asked health agents and relais if and how they have historically given appointment reminders to mothers with children in the vaccination system. We also asked mothers and relais if and how they have received appointment reminders from health workers for upcoming vaccination sessions. The purpose of these questions was to understand the current appointment reminder system in Ouake.

Table 4 (below) describes the number of health agents and relais who have reported that they have reminded mothers of upcoming appointments, as well as how that reminder was communicated. The table also describes how many relais and mothers have reported that they have received appointment reminders, as well as how and when the reminder was communicated.

Health agents and relais report reminding mothers of their child's upcoming vaccination appointments, however, few mothers reported receiving a reminder.

Interestingly, while the majority of health agents and relais reported reminding mothers of upcoming vaccination sessions, only 24 mothers (13%) reported ever receiving a reminder for an upcoming session. Of those that reported either giving or receiving reminders, the majority reported that reminders were communicated in person, either at the health center or at the mother's home either the day before the session or a few days before the session.

Only 24 mothers (13%) reported ever receiving a reminder for an upcoming session

Another point to note is that about half of the relais interviewed (n=6) reported that they were reminded of a mother's upcoming appointment via telephone by a health agent. Slightly fewer, (n=4) relais reported using a telephone to remind mothers of upcoming appointments.

When mothers were asked how they know when to bring their child to the clinic to get vaccinated, the most common responses were as follows:

- Referred to the vaccination card (n=111)
- Counted days/ weeks since last appointment (n=39)
- Remembered the date given to them at last appointment (n=31)

Table 4. Reported historical vaccination reminders by stakeholder group for upcoming appointments

Stakeholder		How was reminder communicated? #	When was the reminder?
	Have you given reminders? # (%)		
Health Agents	14 (100%)	At the clinic: (n=11) Relais (n=6)	Other interval: (n=5) Day of: (n=3) A few days before: (n=2) Week before: (n=2)
Relais	12 (86%)	At mothers' homes (n=8) In community (n=6) Telephone (n=4)	Other interval: (n=5) Once a month: (n=4) Once a week: (n=3)
	Have you received reminders? # (%)		
Relais	7 (50%)	Telephone (n=6) In person (n=4)	A few days before (n=6) Day before (n=1)
Mothers	24 (13%)	At the clinic (n=11) At mothers' homes (n=11) In person, unspecified (n=4)	Day before (n=10) A few days before (n=9) Previous session (n=3)

Note. Participants were allowed to provide up to 4 response options for how reminders were communicated, thus aggregated counts by stakeholder group may be higher than the number of participants for a given group.

Also of note, all 14 relais interviewed reported that they would like to receive a reminder for future vaccination appointments in their community. When relais were asked when they would like to receive the reminder, the majority (n=12) said that they would like to receive a reminder a few days before the vaccination session, preferably in the morning (n=7) or in the evening (n=4).

All relais interviewed reported that they would like to receive a reminder for future vaccination appointments in their community.

Reminders for Missed Vaccination Sessions

A health agent consults with a mother and register's the child's doses into VaxTrac

The World Health Organization and the Benin Ministry of Health have created a vaccine schedule for newborns that outlines when children 0-11 months should receive each of their vaccine doses. Generally, children are supposed to receive their first dose before two weeks of age, and then are scheduled to receive additional doses at six weeks, ten weeks, fourteen weeks, six months and nine months. A missed vaccination session occurs when a child does not receive a dose on schedule.

Health workers and relais were asked if and how they have historically reminded mothers of vaccination sessions that they have missed. Mothers and relais were also asked if and how they have received reminders about missed vaccination sessions. The purpose of this section was to understand the current appointment reminder system for missed sessions.

Health agents and relais reported notifying mothers of missed appointments, however, the majority of mothers reported that they did not receive reminders for missed appointments.

The majority of health agents (n=13) and about half of relais (n=8) reported that they have informed mothers of a missed vaccination session (see Table 5).

Table 5. Reported historical reminders of missed vaccination sessions by stakeholder group

Stakeholder	Have you informed a mother about a missed session? #(%)	How was reminder communicated? #	When was the reminder? #
Health Agents	13 (93%)	Relais (n=10) Telephone (n=7) At mother's home (n=5)	Day after (n=5) Day of session (n=5) Day before next (n=2) Week before next (n=2)
Relais	8 (57%)	In person (n=8) Telephone (n=2)	Day after (n=5) Day before next (n=2) Week before next (n=1)

Four out of ten mothers reported that they or someone they know has missed a vaccination session and would like to be reminded in the future.

Almost half (40%) of mothers interviewed reported that they or someone they know has missed a vaccination session. Of those who reported missing a session, only 16% reported that they were informed of the missed session.

While the vast majority of mothers interviewed reported that they have not received reminders for missed sessions, 96% said that they would like to receive a reminder if they miss a session, by phone (51%), by a relais (29%), at their house (16%) or at the health center (11%) either the day before the appointment (51%), a few days before the appointment (31%) or a week before the appointment (9%) so that they do not forget the appointment and have enough time to prepare.

REASONS MOTHERS MISSED VACCINATION SESSIONS:

- Lack of awareness or negligence (n=21)
- Busy (n=20)
- Forgot (n=19)
- Did not have or could not read vaccine card (n=13)

An appointment reminder system could help mothers overcome barriers to attending appointments on schedule. For example, one of the most common reasons mothers reported for missing a vaccination session was that they forgot. In this case, a reminder could serve as a necessary cue to action. Another common reason mothers reported for missing appointments was because they were busy, which included traveling outside of the community or tending to other tasks at home. A system that reminds mothers of upcoming appointments a few days ahead of the appointment could be a promising way to plan for the vaccination session in advance, so it does not conflict with her other responsibilities.

All participating relais reported that they would like to be informed of children in their community who missed a vaccination session.

Relais would like to be informed of a child who has missed a vaccination session the day after the missed appointment (n=8), the day of the missed appointment (n=3) the week before the next appointment (n=3) or the day before the next vaccination session (n=1) either by phone (n=13), specifically SMS (n=11) or in person (n=3).

Mobile Phone Access

The majority of participants in each stakeholder group has access to a mobile phone.

In order to assess the feasibility of a text message reminder system, we asked each stakeholder group about their access to mobile phones, their comfort with using mobile phones as well their mobile phone providers. The majority of participants in each stakeholder group has access to a mobile phone. All health agents and relais interviewed reported that they have their own mobile phones that are able to send and receive text messages. While 91% of mothers reported having access to a mobile phone, only 52% reported having their own phone. Mothers reported that they have access to the mobile phone of their spouse (32%) or another family member (6%). Table 6 describes phone access across stakeholder groups.

While 91% of mothers reported having access to a mobile phone, only 52% reporting having their own phone.

Table 6. Access to mobile phones

	Mother/Guardian # (%)	Health Agents # (%)	Relais # (%)
Access to Phone	N=164 (91%)	N=14 (100%)	N=14 (100%)
Has own phone	**N=94 (52%)**	N=14 (100%)	N=14 (100%)
Able to send texts	N=165 (92%)	N=14 (100%)	N=14 (100%)
Able to receive texts	N=162 (91%)	N=14 (100%)	N=14 (100%)

MTN and Moov were the most common mobile phone providers reported.

Of the stakeholders interviewed, 79% of mothers and 100% of health agents and relais reported having an MTN phone. Many of the stakeholders interviewed reported having more than one mobile phone provider. Approximately two thirds of health agents and one third of relais also reported having a Moov phone. Similarly, 20% of mothers interviewed also reported having access to a Moov phone. Table 7 describes the breakdown of mobile phone service provider among stakeholder group.

Table 7. Mobile phone service provider

Provider	Mother/Guardian	Health Agents	Relais
MTN	**N=142 (79%)**	**N=14 (100%)**	**N=14 (100%)**
Moov	**N=36 (20%)**	**N=10 (71 %)**	**N=4 (29%)**
Togocel	N=3 (2%)	N=0 (0%)	N=0 (0%)
Glo	N=1 (1%)	N=0 (0%)	N=0 (0%)
More than 1 provider	N=18 (10%)	N=10 (71%)	N=4 (29%)

These findings suggest that a text message reminder system between health agents and relais using MTN would be feasible based on accessibility to their own mobile phone. The fact that about half of mothers interviewed reported that they do not have access to their own phone indicates that a text message reminder system directed towards mothers may not be as effective. However, an SMS system that notifies relais which children are due for upcoming or missed appointments would allow relais to remind mothers either through a phone call or home visit. However, given that a large number of mothers do not have access to their own phones, reminders through phone calls might not be feasible.

Current Accessibility and Use of Mobile Phones and Text Messages

Mothers tend to have less access to mobile phones all of the time compared to health agents and relais.

While looking at mobile phone access is important, it is equally crucial to assess each stakeholder group's use of mobile phones and comfort with texting. When we asked each stakeholder group about how often they have access to mobile phones, 100% of health agents and relais interviewed reported that they have access to their mobile phones "all of the time." As a group, mothers tend to have access to mobile phones

less often than health agents and relais. Only 54% of mothers reported having access to their phone all the time, possibly related to the fact that many mothers share mobile phones with their spouse or other family member. Table 8 describes the frequency of mobile phone access by stakeholder group.

Table 8. Frequency of phone access

	Mother/Guardian # (%)	**Health Agents # (%)**	**Relais # (%)**
Less than once per week	N=11 (6%)	N= 0 (0%)	N= 0 (0%)
Once a week	N=19 (11%)	N= 0 (0%)	N= 0 (0%)
Once a day	N=35 (20%)	N= 0 (0%)	N= 0 (0%)
All the time	**N=98 (54%)**	**N= 14 (100%)**	**N= 14 (100%)**

Similar to assessing frequency of mobile phone use, we also asked each stakeholder group to estimate the number of texts that they send and receive in a typical day. The purpose of these questions were to understand if and how often mothers, health agents and relais text. Table 9 describes the number of text messages sent and received in a day by stakeholder group.

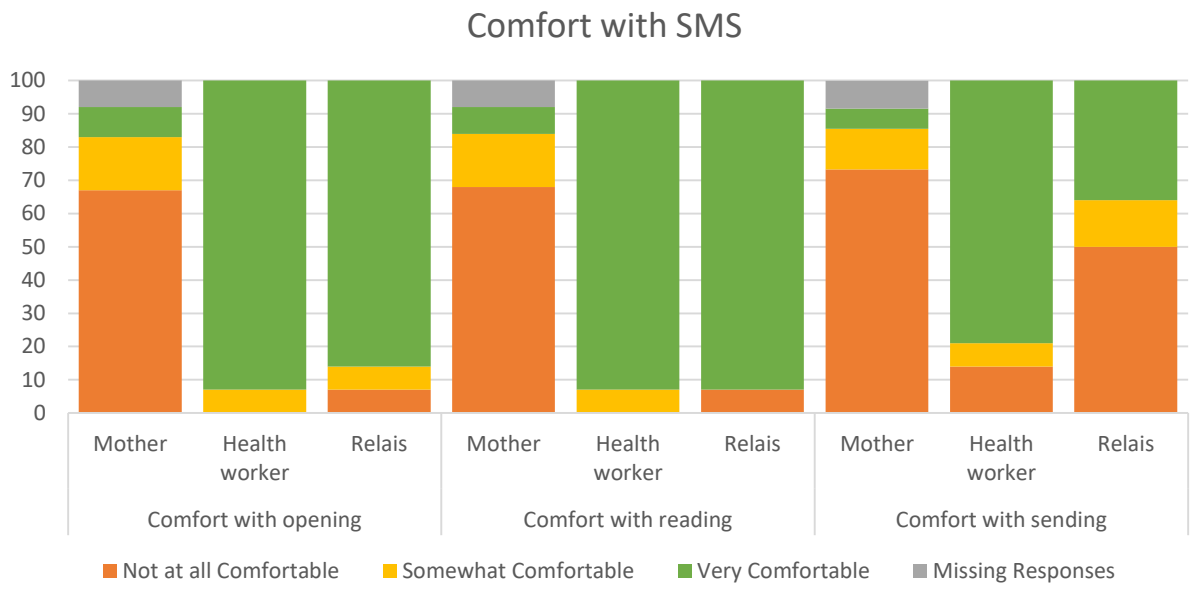
Table 9. # of SMS sent and received in a day

	Mother/Guardian # (%)		**Health Agents # (%)**		**Relais # (%)**	
	SMS received	**SMS sent**	**SMS received**	**SMS sent**	**SMS received**	**SMS sent**
No SMS	1 (1%)	**134 (74%)**	0 (0%)	3 (21%)	0 (0%)	**8 (57%)**
1 to 10 SMS	**164 (91%)**	30 (17%)	**14 (100%)**	**11 (79%)**	**14 (100%)**	6 (43%)
11 to 20 SMS	0 (0%)	1 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Overall, text message use is relatively low across stakeholder groups. Interestingly, while 91% of mothers reported receiving between 1 and 10 text messages per day, 74% of mothers reported that they do not send any text messages in a typical day. Similarly, while all 14 relais reported receiving between 1 and 10 text messages per day, 8 relais reported that they do not send any text messages.

Each stakeholder group was asked about their comfort level with opening, reading and sending text messages. Relais and mothers reported that they did not feel comfortable sending text messages. Figure 1 describes the comfort level of each stakeholder group with opening, reading and sending text messages.

Figure 1. Comfort with opening, reading, and sending text messages



The figure above illustrates that the majority of mothers reported they are not very comfortable opening, reading or sending text messages. While the majority of health agents and relais reported that they are very comfortable with opening and reading text messages, half of the relais reported that they are not comfortable sending text messages. This indicates that relais could be receptive to receiving text message reminders from health agents, but might require additional training if they will be required to text any messages back to health agents. These findings also show that mothers, as a group, would not be the best candidates for a text message reminder system.

> The majority of mothers reported that they are not very comfortable opening, reading or sending text messages.

Text Message Reminder Preferences among Health Agents

The study team described a potential text message reminder system to health agents in order to elicit feedback. Health agents were asked about their preferences for a potential text message reminder system. The most common responses are highlighted below.

What time of day should text message reminders be sent?

Morning, n=7

Afternoon, n=2

Evening, n=2

Half of the health workers interviewed said that reminders should be sent in the morning, because that is when mothers will most likely be in their homes.

Who should receive a text message reminders?

Relais who search for children for vaccination sessions, n=11

Mothers or guardians of children who miss a vaccination session, n=10

Mothers or guardians of children who are due for a vaccination session (on the callback list), n=9

Most health agents identified both relais and mothers as stakeholder groups who could receive a text message reminder for either upcoming or missed vaccination sessions. While mothers are the group that ultimately needs to receive a reminder, our research indicates that they would not be responsive to a reminder in the form of an SMS. Relais, however, would be an appropriate group to receive a text message reminder about the mothers in their communities who have children that are due for a vaccination session.

When should reminders be sent for vaccination sessions?

There was no consensus among health agents regarding when SMS reminders should be sent for upcoming or missed sessions. For upcoming vaccination sessions, health agent responses were split between the day of the vaccination session, the week before the vaccination session and the day of the vaccination session. Similarly, for missed sessions, health agent responses were split between the day after the missed session, the day before the next session, and the day of the missed appointment. More research needs to be done to understand when a text message reminder should be sent.

Conclusion

In Ouake, health agents, relais and mothers of children all play key roles in the childhood vaccination system. The majority of all three groups would like to inform or be informed of upcoming and missed vaccination appointments in order to comply with immunization recommendations and attend to their children's needs. However, findings demonstrate that there is a disconnect in the reminder system for missed and upcoming vaccination appointments. While most health agents reported that they remind mothers of upcoming vaccination sessions, only a small percent of mothers reported receiving reminders. When health agents remind mothers of their next session, it is often communicated in person at the clinic, several weeks before the next session. The information provided at the clinic about upcoming appointments may vary and mothers may forget over the course of a few weeks. Our results indicate that 4 of 10 mothers interviewed reported that they, or someone they knew, had missed a vaccination appointment in the past. Both mothers and relais reported that they would like to receive reminders either in the morning or in the evening, a few days to a week before the upcoming session. It is important to remind them about the vaccination session with enough notice so they can adjust their schedule accordingly in order to attend the session.

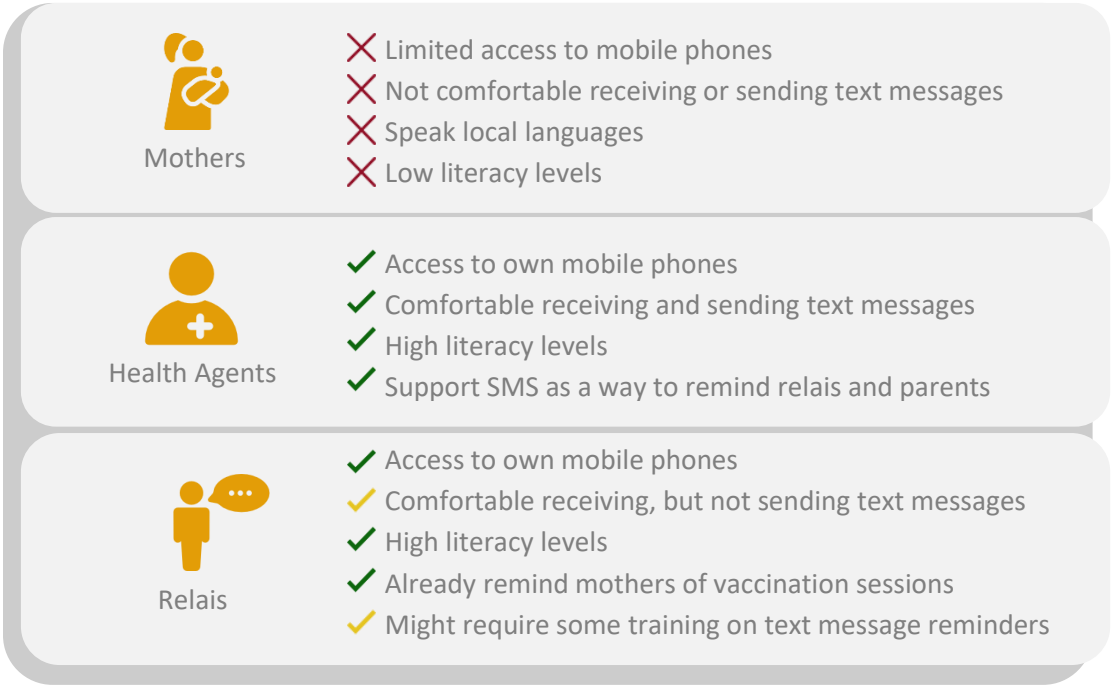
Relais play a pivotal role in the vaccination system. They build awareness about vaccines in their communities, find mothers who are due for upcoming vaccination sessions, and encourage them to go to the clinic. However, only seven of the relais interviewed reported that they had received reminders about the women in their communities from health agents. Their work could be facilitated by receiving reminders of upcoming sessions for the women in their communities. In fact, the majority of relais interviewed said that they preferred reminders over the phone, specifically over SMS.

In fact, mobile phone access and literacy is extremely high among health agents and relais in Ouake. All health agents and relais interviewed have their own mobile phones, can read French and most use MTN and Moov telecom networks. While relais feel comfortable opening and reading text messages, they feel less comfortable sending text messages. Health workers feel comfortable opening, reading and sending text messages. Mothers, however, have less access to their own mobile phones and do not feel comfortable opening, reading or sending text messages. Figure 2 outlines the feasibility of a text message reminder system by stakeholder group, based on the critical enabling factors identified in the literature. The critical enabling factors are highlighted in box 1.

Box 1. Critical enabling factors for implementing an SMS reminder system (Rajan R, 2013) (Perosky, et al., 2015) (Ashraf, et al., 2015).

- ✓ Literacy levels of audience
- ✓ Access to mobile phones
- ✓ Comfort with technology
- ✓ Network coverage
- ✓ Frequency of using text messages
- ✓ Cost of sending/receiving text messages
- ✓ Logistics and appropriate planning
- ✓ Involvement of government organizations

Figure 2. Feasibility of a text message reminder system by stakeholder group based on critical enabling factors



The data from this study provide support for a text message reminder system between health agents and relais in order to help mothers overcome barriers to following the vaccine schedule outlined by the World Health Organization and the Benin Ministry of Health. In this system, health agents or the VaxTrac system could text relais a list of mothers and their children who have an upcoming or missed vaccination, and relais could use the list to facilitate the work that they already do: informing mothers of their upcoming session and encouraging them to go to the clinic on vaccination day. Automated reminders sent through the VaxTrac system could increase the consistency of sending reminders to relais and increase vaccine schedule adherence and catch up children who may have missed a vaccination.

Recommendations

Based on the data from this study, we conclude that an SMS reminder system could be an appropriate reminder strategy between health agents and relais to help relais understand which mothers are due for upcoming appointments. Such a system could increase consistency of reminders to mothers and guardians and strengthen the bridge between the formal and non-formal health system. However, in order to implement an effective reminder system, more information is needed from health agents and relais in order to design a system that meets their needs.

We recommend a focus group discussion with relais and health agents to understand 1) how a text message reminder system could fit within their existing workflow; 2) what information they would need from the text message system to carry out their work more effectively; and 3) how, when and at what frequency they would like text messages to be delivered. The focus group should also aim to confirm our findings about preferred mobile phone network providers to ensure that all relais would be able to send and receive texts. We also recommend meeting with health zone staff to discuss the long-term sustainability of a reminder initiative as well as the types of health outcome information that they would like to impact.

In addition to an automated SMS reminder system, there could also be appropriate, complementary non-technical solutions, such as informing mothers on market day of the upcoming vaccination session or public awareness campaigns. Working with the health zone, health agents and relais to understand what strategies and methods are feasible will increase long-term sustainability of these reminder initiatives.

Follow-up Phase Methodology

VaxTrac worked closely with the DCO health zone to conduct focus group discussions with relais and health agents to understand interest, feasibility and potential design of a text message reminder system. Three focus groups were conducted with a total of 28 health agents and relais to identify information to include in a text message reminder, conduct requirements gathering to build a text message feature within VaxTrac, and plan for implementation of the SMS feature.

Focus group discussions with relais and health agents were conducted to determine appropriate message content, the frequency of sending messages, and the message preferences for missed and upcoming appointments. Findings indicated that relais would like to receive reminders for both missed and upcoming appointments on a weekly basis at least 3 days before a child is due for their vaccination. A preferred reminder format was selected to include: the patient's name, guardian's name, village, date to return to the health center, and phone number of the patient. Since relais have different preferences for the day and time that they would like to receive messages, reminder times and days will be customized for each relais when they are registered by a health worker to receive reminders. An SMS feature was developed based on the focus group findings to accommodate for relais preferences (see Technical Overview in Appendix for additional details).

Additional considerations for the health zone include that relais would like some sort of financial or non-financial motivation for participating in the SMS reminder intervention. These incentives included financial compensation, compensation for fuel, a quality telephone, and a notebook to document the patients that they could not find.

Next Steps

The next steps included below reflect actions needed to prepare and implement Phase 2 of this reminder study. VaxTrac will work closely with the DCO health zone to plan and implement the following activities.

- Plan and implement the SMS intervention Phase 2 by randomly selecting clinics in Ouake to receive SMS reminders; and
- Conduct research on timeliness of return and additional qualitative analysis in Phase 2 to understand relais experience with the SMS reminder system;
- Present Phase 2 findings and submit final report to health zone.

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Appendix

SMS REMINDERS FOR VACCINATION APPOINTMENTS

TECHNICAL OVERVIEW

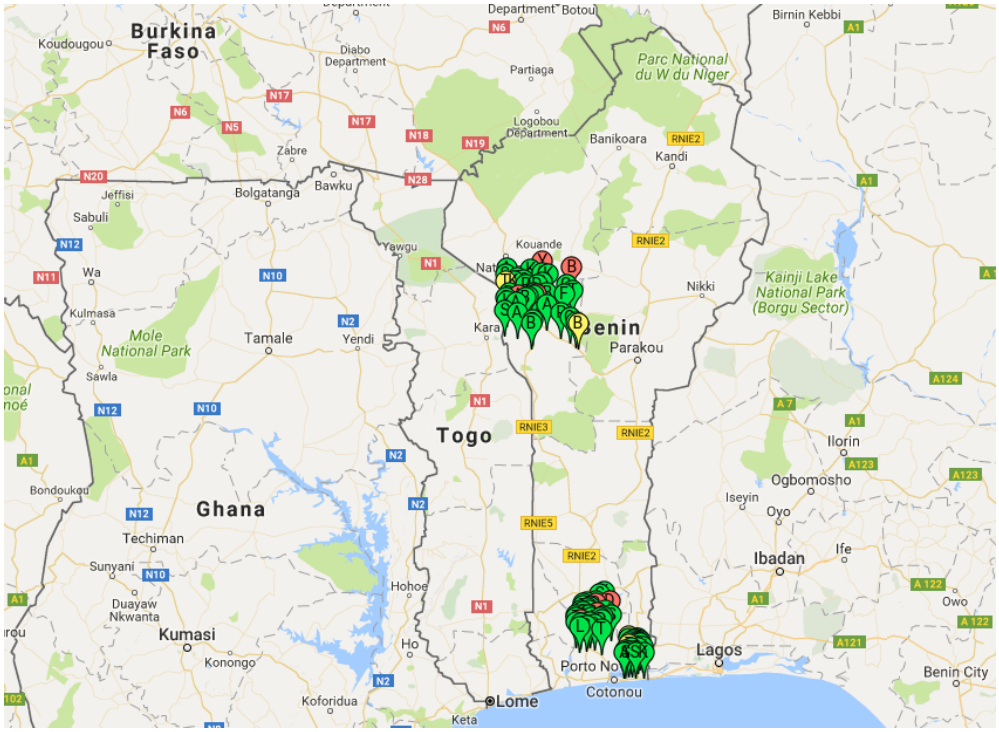
1. Context and goal of the project

VaxTrac is a set of applications designed to strengthen immunization systems by providing identification of patients, supporting immunization workers in vaccine provision and follow-up, and providing EPI managers above the clinic level with detailed vaccine dispersal information.

Each partnering clinic has a mobile device running the VaxTrac system. Patient level data such as demographic information, contact information, and received vaccines is recorded in the system by health workers during vaccination sessions in the clinics.

VaxTrac system in use during a vaccination session in Benin

VaxTrac has worked in partnership with the Health Zone of Djougou-Copargo-Ouaké in Benin to assess the need for SMS reminders for vaccination appointments. It was concluded from the study that most patients' guardians did not have mobile phones, did not read French, or did not feel comfortable opening or receiving SMS reminders. Therefore, it was decided to target health relais since they showed a greater ability and comfort with reading and receiving SMS reminders. Such relais work alongside health clinics and go directly into communities to reach out to patients.



Map view of clinics using the VaxTrac system in Benin

The SMS reminder plug-in adds a set of features to VaxTrac aimed at helping community relais identify children who have missed or are expecting a vaccine more easily. The goal of the project is to improve patients' return rate and timeliness of return for vaccination sessions, and reduce the workload for relais and health workers.

Relais currently receive a list of patients to look for from health clinics. However, the process is not automatized yet and relais have to go to the clinics in person to retrieve the vaccination cards of patients with a pending vaccination appointment. Those cards are manually sorted by health workers to identify patients who need to be sought after. By subscribing to SMS reminders

through VaxTrac, relais will automatically receive the list of children due to receive vaccines directly on their mobile phones. VaxTrac already collects the patient level data necessary to generate the list of patients needing a reminder.

The effectiveness of the system will be evaluated by measuring the period of time between the callback date of a patient and the day the patient returns to the clinic, by counting the total number of missed appointments by patient and clinic, and by asking the guardians of the patients if they received a reminder to come to the clinic, and if so, who reminded them. These indicators will be compared between a test group and a control group of 3-4 clinics respectively in Ouaké.

2. System overview

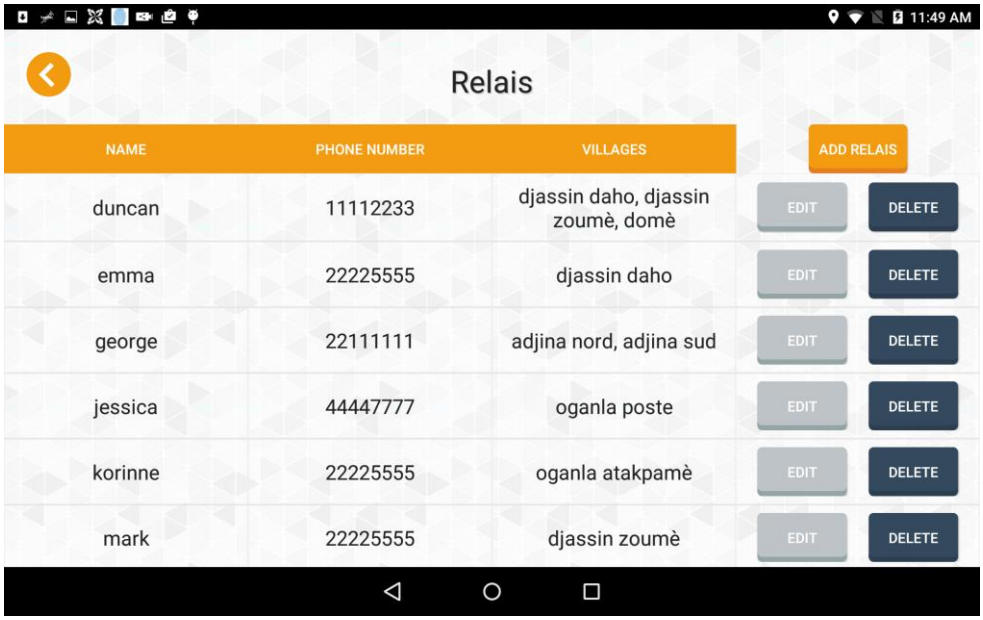
a. Features

The SMS reminder plug-in offers the following features:

- Register, update and delete relais who subscribed to the service.
- Send a confirmation SMS upon registration, contact update or unsubscription.
- Send SMS reminders to relais for children who missed a vaccination session or have an upcoming appointment.
- Send status updates to relais letting them know how many patients they reminded went to the clinic
- Measure timeliness of return and number of missed appointments per patient, and record receipt of a reminder as stated by the patient's guardian.

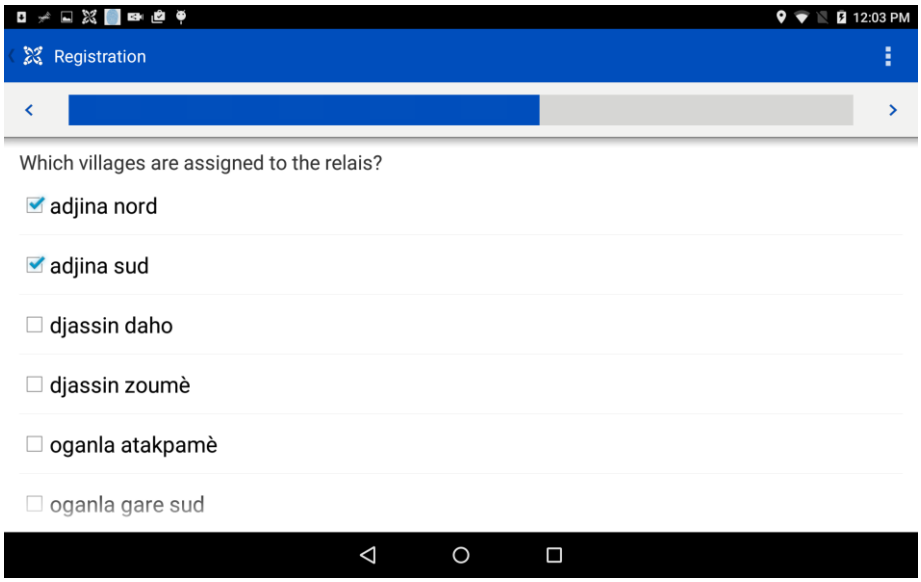
b. Workflow

Health relais who wish to receive SMS reminders can go to the health clinic they are affiliated with to subscribe to the reminder service. There, health workers trained to use the VaxTrac system can help them register on the clinic's device, update their information or unsubscribe.

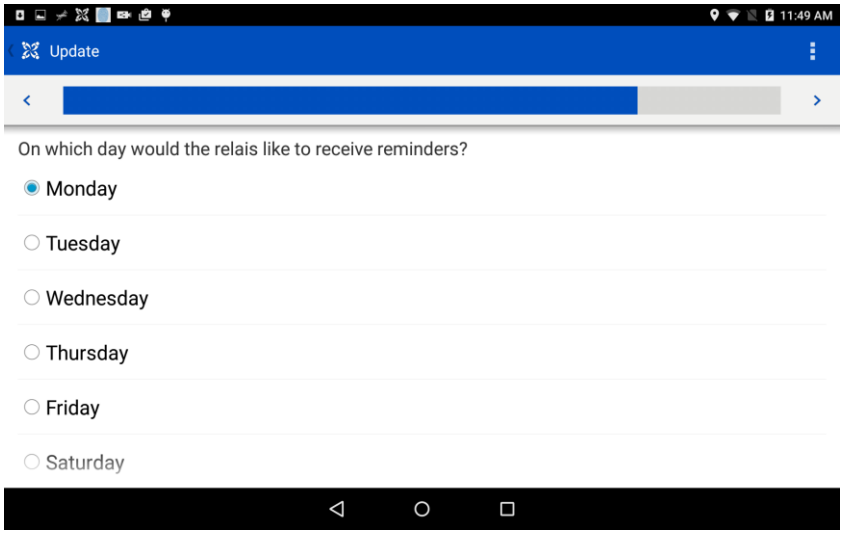


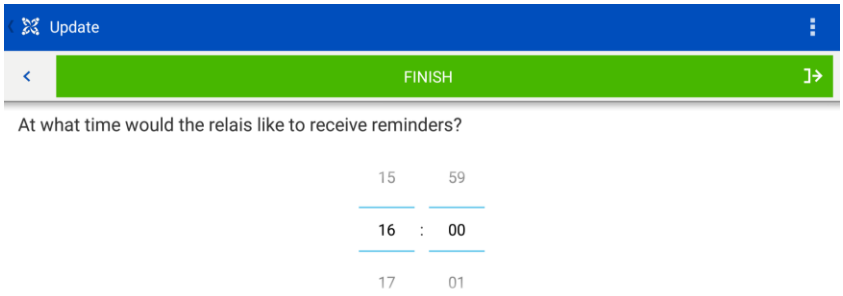
Relais management screen in the VaxTrac app

The process is fairly simple and only requires relais to provide their names, phone numbers, assigned villages and choose a day a time on which weekly SMS reminders will be sent.

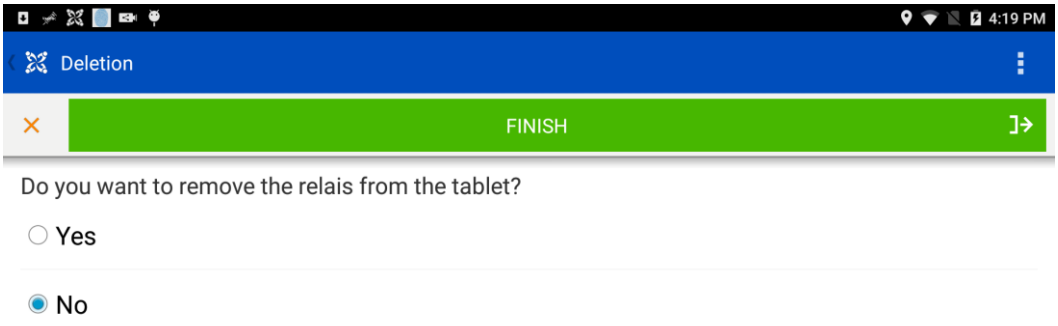


Relais are given a list of villages to choose from





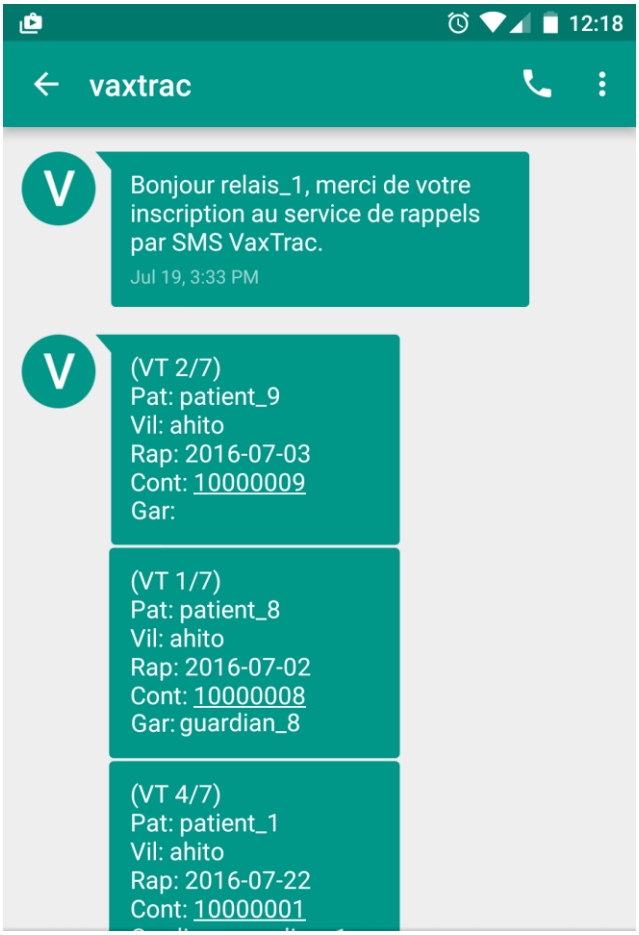
They can also choose when they want to receive the reminders



If a relais does not want to receive SMS reminders anymore,
they can unsubscribe from the service.

Once they are registered and their data is sent to our server, they will receive a subscription confirmation and weekly SMS reminders containing the information (name, contact,

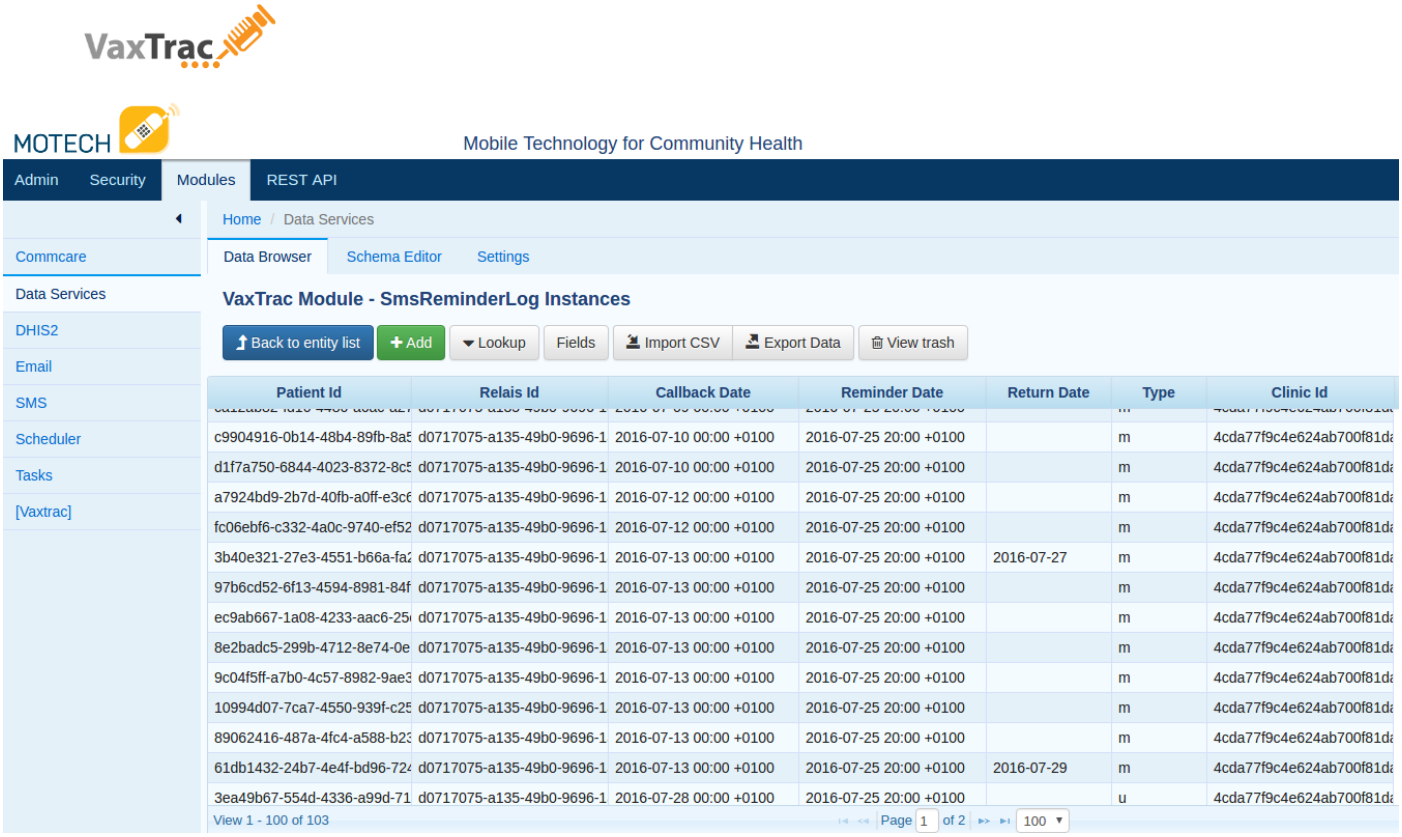
appointment) needed to find patients that have missed an appointment or have an upcoming appointment.



Subscription confirmation and reminders received on a phone

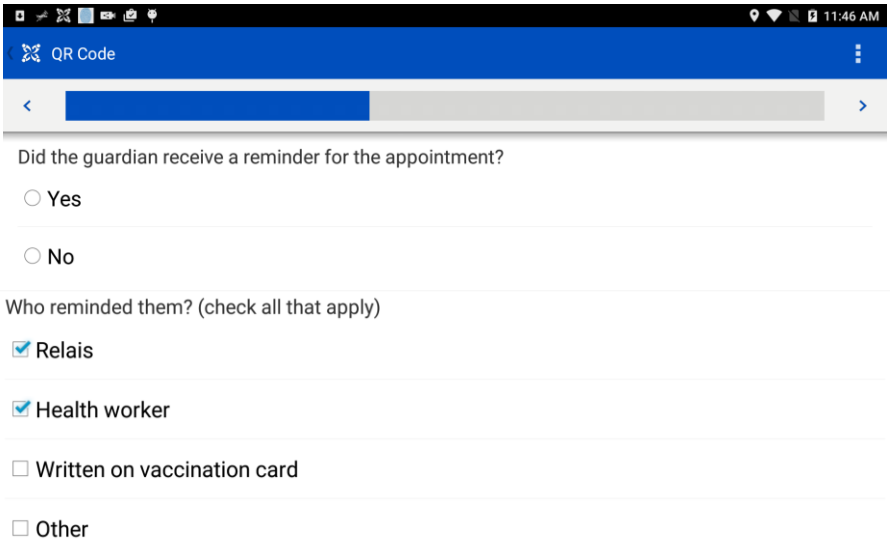
(Pat = patient, Vil = village, Rap = callback date, Cont = contact, Gar = guardian)

To measure the timeliness of return, patients' return dates are logged in our server.



Log of sent reminders in our MOTECH server

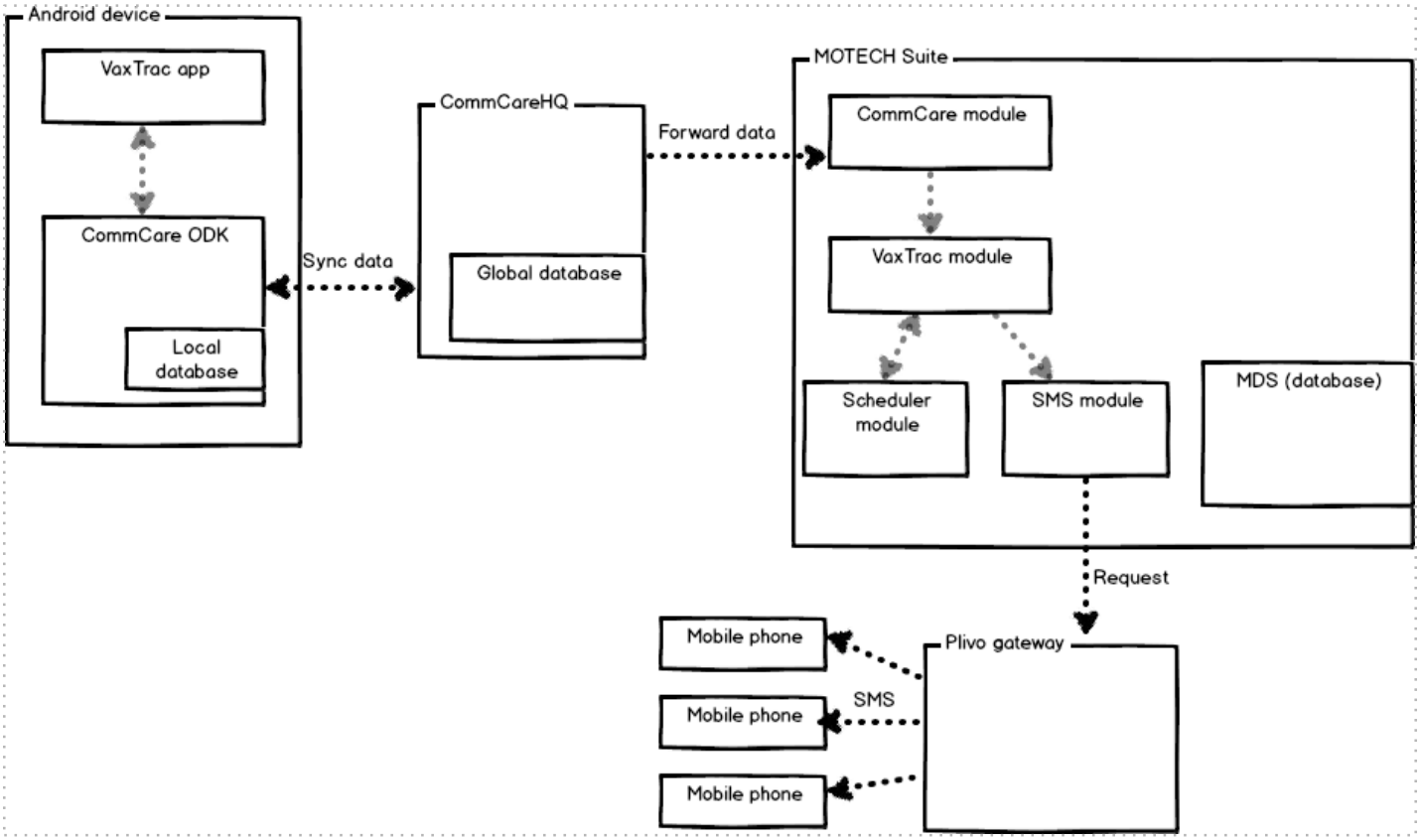
Moreover, when patients return to the clinic, health workers will ask their guardians if and by whom they were reminded of their appointments, and record the answers in the VaxTrac system.



3. System design

This section gives an overview of the components used in the VaxTrac system, explains how the data flows from a one component to the next, and describes how reminders are computed in more details.

a. General architecture



General system architecture

CommCare ODK (CCODK) is the core platform on which all Android-based interactions are built. It gathers data in simple forms, takes data from the VaxTrac Android Application and creates cases based on its output, handles user log in, data storage and encryption, and manages the synchronization with CommCareHQ.

The **VaxTrac Android Application** controls and executes all functions specific to vaccination. This includes vaccine scheduling, callback generation, and patient identification generation and control. This module also handles complex communication with CCODK.

CommCareHQ (CCHQ) is a set of server-side applications. CCHQ handles all first-level data operations including storage, database partitioning based on user, and synchronization. It allows administrative control over end user devices including user management and setting predefined site specific values. It also provides granular program health information including date of last synchronization, number of cases per user, views of individual cases and more.

The **MOTECH Platform** is a software package that connects popular mHealth technologies. It is a event-based platform that provides a scheduling system, and acts as an interoperability layer to other systems such as SMS gateways like Plivo.

Plivo is a Cloud API Platform and a Global Carrier Services Provider for Voice Calls and SMS. It is used in VaxTrac's reminder system to send SMS.

b. Data flow

Patient-level data and relais information is collected on an Android device through the VaxTrac app which communicates with the CommCare ODK app. CommCare ODK synchronizes its data with the CommCareHQ server by submitting local data and retrieving server-side data. Then, CommCareHQ forwards the data it received to a server running the MOTECH suite. The data is finally processed inside MOTECH, which schedules and formats SMS messages before requesting Plivo to send them out.

c. Reminders computation

When CommCare patient, guardian or relais cases are forwarded to MOTECH, the data is extracted by the CommCare Motech module and passed on to the VaxTrac module. The VaxTrac module logs new cases and updates existing ones in the local MOTECH database.

When a relais case is received, the VaxTrac module schedules a recurring weekly job to send reminders to that relais through the Scheduler module. It can also reschedule or unschedule an existing job related to that relais.

When the weekly job is triggered, it emits an event which notifies the VaxTrac module to generate and send SMS messages to that particular relais. It generates messages by looking at the information logged for patients living in the relais' assigned villages. On reminder day, patients who had an appointment within a certain date range that did not show up within a set number of days after the appointment date will be put in a "missed" list while patients who have an upcoming appointment within a certain date range will be put in an "upcoming" list.

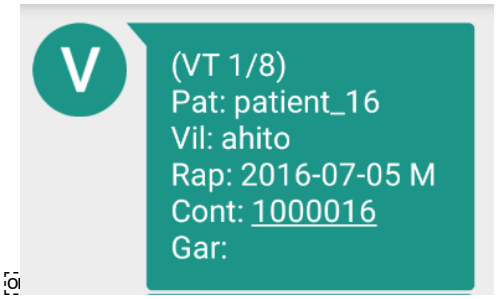
Regarding upcoming appointments, relais need enough time to find patients before their appointment dates. In our case relais asked for about three days of leeway. Knowing that relais will only receive reminders once a week, the callback dates of the selected patients need to cover a week. As a result, for that week's reminders, patients who live in one of the relais' villages and have a callback date due between 3 to 10 days after the messages are sent are selected.

Regarding missed appointments, health workers need to be given enough time to synchronize the data on the tablet with CommCareHQ. In average, they manage to do so within less than a week after recording new data on the tablet. To be safe, we give them 10 days to sync. If patients do not return within 10 days after their due callback date, they are considered to have missed their appointment. Since relais will only receive reminders once a week, return dates for patients who had callback dates between 10 to 17 days before the day the reminders are sent are checked. Patients are known to have returned when a new vaccine dose is recorded in the system.

Reminder timeline

These date ranges can be modified to adapt to local conditions such as distances relais have to cover to get to patients or network coverage. The reminders' language can be adapted as well.

The date of that update is logged, so it is possible to know when a patient returned. Missed appointments are marked with a "M" in the reminder.



Reminder for a patient who missed an appointment

All selected patients' information is formatted and sent to relais as individual SMS messages through a request to the SMS gateway by MOTECH's SMS module. Patients are sorted by ascending callback dates. SMS are labeled "VT" so relais know they come from VaxTrac, and numbered so they know how many messages to expect and in which order they were sent. The order in which the SMS are received indeed depends on the network. A given patient is only sent to a given relais once for a given upcoming appointment and once when that appointment is missed.

4. Tests

a. Network coverage

Network coverage was tested in the commune of Ouaké (Benin) by sending SMS from MOTECH to the local carriers (MTN, Moov and Glo) through Plivo. Each of them sends a status update when the SMS is correctly received by the recipient. Roaming and carriers from bordering countries such as Togo were not tested.

b. Software

Unit tests were performed on all implemented features in VaxTrac, CommCareHQ, MOTECH and Plivo.

Integration tests were run to test the complete process from relais registration in the VaxTrac app to reminder reception on a mobile number. Update and deletion of relais were tested in the same manner. To do so, US mobile numbers were set on Plivo to receive SMS messages and redirect them to MOTECH for logging purposes. Real patient data from CommCareHQ from January to July 2016 was pulled and forwarded to MOTECH as test data. That sample consists of several hundreds of patients and guardians. In addition, live data forwarding from CommCare to MOTECH was enabled. In less than a week, dozens of reminders were sent and received. No issues were encountered so far for the most frequented clinic of the commune nor for clinics that have no access to power or connectivity.

5. Challenges

Here are some challenges that have been encountered or may be encountered in the future:

- Receiving reminders might be delayed if the recipient is roaming (near the border), using a foreign carrier, or of the network is faulty.
- SMS can only contain up to 160 characters, so the information for only one patient can be sent per SMS. As a result, relais might receive many SMS in one day, and not tread through them all. According to our estimates, this should not be too much of a problem during testing in Benin.
- It is necessary to find a SMS gateway that can send SMS to local carriers. Moreover, sending messages to local numbers must be tested ahead of time in order to have enough time to work with the gateway provider to fix potential problems. Besides, some providers do not send status updates when a SMS is delivered, which makes knowing if messages were received correctly difficult. An option would be to ask recipients to write back when they receive reminders, which may be time-consuming. It also requires finding a gateway that supports two-way SMS with the destination country.

- The tablets need to sync regularly for us to get the patient and relais data in a timely manner, which may be challenging when the clinics do not have access to power or connectivity.
- Not all patients are registered in the VaxTrac system, and health workers can count missed or upcoming appointments differently, so our reminder lists may differ from those handed out by clinics. For example, in the VaxTrac system, callback dates are computed relatively to a global vaccination schedule. The dates on which each clinic actually holds vaccination sessions are not recorded. As a result, VaxTrac might consider a patient has missed an appointment when there were actually no vaccination session held in clinics for several days.
- It is unsure how the system (in particular data forwarding by CommCareHQ and processing in MOTECH) would behave on a larger scale (i.e more than a dozen clinics).