IMPLEMENTATION REPORT

PHASE II OF THE VACCINATION APPOINTEMENTS REMINDERS BY MOBILE TELEPHONY IN THE HEALTH DISTRICT OF KORHOGO

November 2015

SUMMARY

ABREVIATIONS

BCG: Bacilli Calmette-Guerin

RHC: Rural Health Centre

UHC: Urban Health Centre

DCPEV: Coordination Directorate of the Expanded Program on Immunization

DMT: District Management Team

RHT: Regional Health Team

HKI: Helen Keller International

MSLS: Ministry of Health and Fight against AIDS

NICT: New information and communication Technologies

EPI: Expanded Program on Immunization

PDV: Lost from sight

MIP: Maternal and infant Protection

RR: Relative risk

AIDS: Acquired Immune Deficiency Syndrome

SMS: *Short Message System*

VAS: Vitamin A supplementation

MMR: Measles, mumps and rubella vaccine

YEL: Yellow fever vaccine

TABLE DES ILLUSTRATIONS

1. EXECUTIVE SUMMARY

The Ministry of Health and Fight against AIDS through the Coordination of the Directorate of the Expanded Program on Immunisation (DCPEV) and with financial support and technical support of Helen Keller International (HKI) NGO, has since August 2012 initiated the implementation of pilot project of vaccination appointment reminders by telephone messages (Either by voice or SMS messages). This operational research initiative had a clear goal of evaluating the impact of the vaccination appointment reminders via mobile telephone network on the demand and use of vaccination service including vitamin A supplementation. A preliminary phase of the Project (Phase I, August 2012 – June 2013) had prepared the putting in place of the actual phase of the research (Phase II June 2013 – June 2014). This second phase can be considered as a success and it clearly shows the impact of the vaccination appointment reminders on the following the vaccination calendar by the beneficiaries as well as dropout from the vaccination program and monitoring of children aged 0 to 11 months.

After having given their informed consent, the mother-child couples are recruited at the time of BCG vaccination of children that takes place immediately just after birth. The objective of the project is to send reminders to each mother in form of telephone message, Voice or SMS, just before the vaccination appointment scheduled in the national vaccination calendar, with an objective of increasing vaccination service attendance. As a whole, the couples registered for the study, a half of them is integrated in a control group that receives no message, while the other half in a group that receives reminder messages for each vaccination appointment between the time of registration and when the child is 9 months old (Date for the last vaccine required as per the routine EPI calendar).

After enrolment, each mother-child couple is systematically managed by an automatic data management system. This system consists of a mobile phone "A smartphone" for collection and transmission of information about the beneficiaries (a cross a recruitment mask) and different vaccines received by the children (Penta 1, Penta 2, Penta 3, Vitamin A, YEL, MMR) as well as a local web Platform (http://www.e-voir.org) for data management and automatic transmission of vaccination appointment reminders. Up to date, the project enables the monitoring of 1623 mother-child couples, of which 1596 have been randomised into two groups (Reminder and Control) during the recruitment period starting from June 2013 to May 2014 (See the different periods of execution of activities in Annexe 2).

It is apparent in this study that 90.4% of the mothers are less than 35 years of age and are distributed in an almost equal manner between the different types of structures. The average age of the mothers is 27 years old. 68.3% of the mothers are uneducated and in majority are housewives (69.7%). Concerning children, 50.4% of the children are of male sex while 49.6% are of female sex that which gives a sex ration of 1.02. The average age of the children is 17 months old. Concerning the message preferences, 85% of the mothers prefer voice messages in comparison to 15% who prefer text messages. Senoufo is the most widely spoken language. There are 58.3% of the people speaking Senoufo, 27.5% speaking Dioula, 7.6% speaking French and 6.5% speaking other languages.

Concerning vaccination coverage of the total 1596 mother-child couples recruited at the time of BCG+ Polio 0 vaccination, 81.3% of children (1298 children out of the total 1596) had been vaccinated for the Penta 1, (86.6% in the vaccination reminder group while 76.1% are in the control group).

On a par with Penta 2, the proportion of children vaccinated was 74.1% that is to say that 1183 of the total 1596 children were vaccinated (81.0% in the vaccination reminder group against 67.3% in the control group).

As for Penta 3, the proportion of children vaccinated was 66.2% making 1057 of the total 1596 children to be vaccinated, 74.2% in the vaccination reminder group in comparison to 58.3% in the Control group.

As for Vitamin A supplementation at 6 months, the proportion of children given Vitamin A supplements was 52.7% ; 841 of the total 1596 children (64.7% of the children were in the vaccination reminder group while 40.7% of children in the control group).

Concerning the vaccination of children against measles and yellow fever, 49.7% of the children had been vaccinated; 786 of the total 1596 (60.7% in the Vaccination reminder group while 37.8% in the control group).

Qualitatively, most of the vaccinating agents (83.3%) interviewed think that the project had a widely positive effect on the use of vaccination service by simply having a telephone reminder for the vaccination appointments. In addition, the implementation of the project enabled them to save time and be much more efficient in carrying out vaccination sessions especially during the Penta 1 to 3 appointments. As for the mothers interviewed, 83% of them attended their vaccination appointments after having received the SMS reminder. However, 52% of the mothers affirm that they would not have been able to come for the appointment if they had not received the SMS reminder. Various reasons make the mothers not to be able to attend their appointments. Furthermore, 8.3 % don't attend due to for lack of information, 5.2% for continuous shortage of the vaccine and 8.4% for other reasons (Forgetfulness, health problems and the long journey) Furthermore, most of the mothers (99%) would like to receive the SMS reminders for the PNC appointments. All in all, for the mothers interviewed, receiving messages coming from the Ministry of health is a sign of consideration and interest shown in them.

The stistical analysis of the data clearly demonstrates that there is also a statistically positive significance on the use of accountable vaccination services to make appointment reminders. This statistical difference between the " Vaccination Reminder" and the "Control" group was 17.4% for all the flustered antigens including VAS and 10.5% for Penta 1; 13.7% for Penta 2; 15.9% for Penta 3; 23.9% for VAS and a difference of 22.8% for YEL/MMR.

2. CONTEXTE AND JUSTIFICATION

The Expanded Program on Immunisation (EPI) was launched in Ivory Coast by the World Health Organisation in 1974. Its principal mission is to reduce morbidity and mortality linked to priority childhood diseases that are evitable by vaccination, while assuring vaccination against nine targeted[1] diseases and all other illnesses as per the need of the feasibility. (*See annexe 1*). Traditionally, EPI targets children aged 0 to 11 months old and women who have reached procreation age. Certain interventions like Vitamin A supplementation, fumigation and distribution of mosquito nets that are impergnated with insecticides for a long term action were added to EPI vaccines within the EPI+ framework, this offers an integrated approach that is more cost effective.

However, the 2010 EPI external review revealed that the proportion of children having access to EPI was 87%, while 64% had received the Penta[2] 3.57% YEL, 36% MMR and 36% were completely vaccinated. As regards to knowledge of, attitudes and practices of the parents on vaccination, only 4% could name 5 targeted EPI diseases with 6% in the urban areas and 2% in the rural areas. About 12% of the parents knew that a child must attend 5 times vaccination sessions to be completely vaccinated. Only a quarter (24%) of the parents know the age for administration of the last dose of vaccine to the child. Among the reasons of non-vaccination of children, lack of motivation and lack of information were the most frequently mentioned reasons.

These results indeed show the need for reinforcing among others the interventions of EPI routine communication in order to address and support the need for vaccination services for the benefit of the target groups. To this end, the Ministry of Health and Fight against Aids through the management of EPI coordination (DC-PEV) initiated in 2012 in collaboration with Helen Keller International (HKI) NGO a project called « **SMS Reminder ».** This initiative through appointment reminders by SMS aimed at reinforcing adherence by the population at the implementation of the program notably the following of the current vaccination calendar for children aged 0 to 11 months old with an objective of reducing in a durable manner the dropout from the vaccination cycle and reinforcing active research on lost from sight. In addition, based on its experience in data collection via smartphone acquired in Ivory Coast since 2011, with use of software applications such as EpiSurveyor/MAGPI, Form Hub or ONA, HKI aims to make available to the health agents a basic health data collection and management tool to evaluate utility and acceptability.

The preliminary phase carried out in the health region of Poro-Tchologo-Bagoué, precisely in the health district of Korhogo for a period of seven (7) months (August **2012** to February 2013), tested sending out of SMS texts in French to mother-child couples in order to remind

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[1]Tuberculosis, diphtheria, tetanus, whooping cough, poliomyelitis, measles, yellow fever, hepatitis B and Haemophilic influenza. Apart from these vaccines, other vaccines like the ones against rotavirus and pneumonia will be added in 2015, this will integrate the vaccination cycle of the said " Pentavalent" (against diphtheria, tetanus, whooping cough, hepatitis B et Haemophilic influenza) as well as the vaccines against poliomyelitis given at 6, 10 and 14 weeks.

[2] Penta : identifying vaccines against diphtheria, tetanus, whooping cough, hepatitis B et Haemophilic influenza

[2] MMR = Anti measles vaccine; YEL = Anti yellow fever vaccine (against yellow fever).

them of vaccination appointments of children and among the establishment of a mixed web mobile platform for collecting and monitoring vaccination data. This preliminary phase had been a success in various aspects (For the health sector stakeholders and the aforementioned district) It enables putting in evidence between other than the integration of the mobile technology in the monitoring proved to be advantageous in the rapid collection, transmission and analysis of data with the same quality in information just as with the traditional method.

However, there would be need for putting in place a validation system of data to the fact that the system handles crude data from the field during the study. Furthermore, concerning telephone interviews carried out from the women, according to them, it appears that the sensitization messages and the SMS that they receive contributes to the improvement of their state of health and that of their children. In addition, they believe that by receiving SMS from the Ministry of health is a sign of consideration and the interest shown in their wellbeing.

Likewise, the project enables having a repertoire of recruited mothers and facilitates the identification and catching up of those lost from sight, however, this preliminary phase experienced various execution imperfections as expected of which includes knowhow of operating the smartphone by vaccination agents, difficulties of transmission of vaccination reminder data to the site www.e-voir.org , insufficiencies realised at the recruitment level of the mother-child couples, shortcomings in supervision and monitoring technique and as well as occasional running out of stock of inputs. Aspects relative to illiteracy of the targeted women (With a big proportion that can neither read nor understand the SMS) also made the partners of the projects to relook the messaging options. Based on the lessons learnt during this preliminary phase, solutions were brought in order to orientate Phase II of the project in a much better way. This second phase of the project concerning telephone reminders kicked off of on the 17th June 2013 with a major innovation of voice messages (in local languages – in Senoufo, Dioula and in French) as a reminder option to be chosen by the beneficiaries of the project.

By this report, HKI in collaboration with DCPEV, the technical support of Ivocarte-Abyshop and the officials form the Health district of Korhogo present the final results of Phase II of the operational research project after a year of activities.

3. RESEARCH QUETIONNAIRE

Does the introduction of mobile technology in the management of EPI routine activities integrating Vitamin A supplementation for children aged 0 to 11 increase the use of health services by populations in the health district of Korhogo?

GOALS AND OBJECTIFS OF THE PROJECT

4.1. Goal of the project

The goal of the project is to contribute to the growth of the use of the health services by the population in the health district if Korhogo by integrating mobile technology in management of routine EPI activities while integrating Vitamin A Supplementation.

4.2. Overall Objective

The objective of the project is to evaluate the effects of automatic vaccination appointment reminders by mobile telephone on following the vaccination calendar (Routine EPI integrating Vitamin A supplementation) by the mothers or guardians of children aged 0 to 11 months old in the health district of Korhogo.

4.3. Specific Objectives

In a much specific manner, it's about:
- Determining the effect of vaccination appointment reminders by mobile telephony on the use of vaccination services (five fundamental appointments notably the pentavalent vaccine cycle, those against measles and yellow fever)
- Determine the causes of not following the vaccination calendar by mothers or by guardians of children aged 0 to 11 months.
- Make recommendations with an aim of improving the use of mobile technology during the routine EPI activities while integrating Vitamin A supplementation.

4.4. Attained results

In the end, the project targets to:
- To enable the health agents of the targeted structures to have a good command of how to use the mobile technology in data collection and transmission.
- To obtain an improved version of the mobile and web platform for the management of Phase II of the project.
- To have an electronic registry of the mother-child couples in the project framework.
- To improve the use vaccination services through vaccination appointment reminders via mobile telephony.

5. METHODOLOGY

5.1. Type of study

It's a randomised test study, controlled by a qualitative component in order to identify the causes of not following the vaccination calendar by the mothers or guardians of children aged 0 -11 months. After the verification of eligibility to take part in the study and recruitment after giving consent, the mother-child couples are randomly distributed (randomisation in blocks of 2,4 and 6 per health centre) into two groups ; one group that receives vaccination reminders by telephone (via SMS or voice message), and the other group that does not receive reminders. The objective of randomisation is to limit bias selection and therefore enable a homogenous distribution between the two groups, known and unknown prognostic factors, as well as an initial comparability (see Algorithm in *Annexe1)*. Thereafter, when the reminder cycle begins, the mother-child couples and the health agents do not know which couple belongs to which group. This allows the only variable that is different between the groups either reminder with an objective of maintain comparability between the two groups.

5.2. Zone of study

The project was implemented in 29 health centres (19 of the 21 health centres of the first phase and 10 new in the health region of Poro-Tchologo-Bagoue, precisely in the health district of Korhogo. These health centres constitute 7 health centres in the city of Korhogo, 12 other centres are in urban areas and 10 in the rural zones. They were chosen principally on the basis of GSM network existence (Orange which was preferred) and the targeted population density (0 to 11 months)

Table 1: Targeted health centres

TYPE OF STRUCTURE	DETAILS FONCTION/ STRUCTURE
Health centres and vaccination posts in Korhogo City (7)	PMI, Kokoton, Petit Paris, Kassirimé, Centre Social I, Centre Social II, Brigida Postorino.
Urban Health centres (UHC) (12)	Dikodougou, Guiembé, Karakoro, Komborodougou, MBengué, Napié, Sinématiali, Sirasso, Tioro, Kanoroba, Kassirime, Torgokaha
Rural Health Centres (RHC) (10)	Kafiokaha, Lataha, Séguétiélé*, Binguébougou, Ballèkaha, Bahouakaha, Katiali, Ouragnene, N'Guanon, Nanguasseregue.

The health centre of Seguetiele was pulled out of the project in the fact that the only person who was recruited after the implementation year of the project was not corresponding to inclusion criteria (intermittent network coverage, lack of motivation of the health agent, almost non-existent attendance)

5.3. Population of Study

The targeted population consists of mothers and guardians of children who are 0 to 11 months old living in the Health District of Korhogo. These mother-child couples had been recruited at the time of BCG + Polio vaccination period of the child.

5.3.1. Inclusion criteria

To be eligible, the criteria of inclusion for the mother-child couple were that:
- The mother or the guardian should be a resident of the Health district of Korhogo ;
- The child be recruited at the time of BCG vaccination (0 to 45 days old children);
- The mother or the guardian possesses a mobile telephone;
- The mother or the guardian gives her clear consent to participate in the project and signs the consent form (**Figure 1**) ;
- The mother or the guardian be able to respond to questions.

5.3.2. Criteria of non-inclusion

A mother or a guardian who is:
- a non-resident in the Health district of Korhogo, or ;
- does not possess a mobile telephone or ;
- is unable to respond to questions or ;
- did not give her consent.

5.3.3. Sampling

The calculation of the samples is based on the results obtained from the first phase of the project. In fact it is due to the proportions of the mothers or guardians who used health services in in the two different groups (receiving or not receiving reminders) that the calculation of the samples was done. More precisely, the proportions obtained for Penta.

P1 being the proportion of mother or guardians of children of the reminder group; P2 being the proportion of mothers or guardians of children in the Control group. The following formula is used to determine the size of the sample:

$$n = \frac{[(a+b)^2(p_1q_1 + p_2q_2)]}{x^2}$$

n = size of the sample
a = alpha error
b = beta error
p_1 = proportion of responses from the Reminder group ($q_1 = 1 - p_1$);
p_2 = proportion of responses from the Control group($q_2 = 1 - p_2$);

In calculating the size of the sample, we used:

p_1 = 0.5; q_1 = 0.5
p_2 = 0.4; q_2 = 0.6
x = 0.1
a = 1.96
b = 1.64
$\alpha = 0.05 \,; \beta = 0.95$

In order to detect a difference between p_1 and p_2 or an improvement of 10% in the participation of the mother-child couples in the Reminder group during the vaccination sessions and while estimating that 15% was lost from sight, we calculated a sample of **n = 1462** mother-child couples randomised between the two groups.

However, in order to be certain that the samples are of the mother-child couples recruited by zone of study (City, urban area, rural area), we had to take into account the proportion of the population in each zone and also the uncertainty linked to good working state of the technological tools (potential breakdown of the smartphones, potential loss of data due to software bugs or poor handling) The objective was therefore to attain **1765** mother-child couples. In the end, **1596** mother-child couples were effectively randomised into two groups and this made the subject of this study. In fact, even though 1462 correspond to the required minimal size, HKI preferred to spread out the recruitment groups due to the following reasons : to allow replacing of the mother-child couples in case of missing variables during analysis ; allow pulling out of the couples if the recruitment criteria were not followed.

In addition, for reasons of randomisation at the health centre level and as well as slowness of recruitment process in certain structures (It was necessary to wait until when there were 2 or 4 couples recruited so that the randomisation is not carried out in an unpredictable manner to classify the mother-child couples either in the Reminder group or in the Control group) as well as the lateness in the data synchronisation by the software, HKI could confirm

having joined the appropriate size of the samples only after the recruitment of 1765 couples, of which 1596 were effectively eligible and were therefore randomised (cf Annexe 2)

5.4.   Variables of the study
The variables retained for data analysis are those that allow measuring of socio-demographic characteristics of the mother and the child, variables linked to the type of vaccine, variables linked to preference of type/message language, the language normally used and finally variables relative to the type of group.
In terms of socio-demographic characteristics we have:
- Sex of the child
- Age of the child (months)
- Age of the mother (years)
- Level of education of the mother
- Profession/occupation of the mother
- First language (French, Senoufo, Dioula, Others)

At the level of the type of appointment is named as follows:
- Penta[3] 1
- Penta 2
- Penta 3
- Vitamin A supplementation (VAS)
- YEL/MMR[4]

At the level of preference of type and language of the message.
- Voice message or text message(SMS)
- Message language (French, Senoufo, Dioula)

Type of group
- Vaccination reminder group
- Control group

In addition to these variables on which data analysis covered, other variables that were collected were:
- Code of the mother
- Surname and name of the mother
- Residency of the mother
- Surname and name of the child
- Date of recruitment
- Telephone number of the mother

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[3] Penta: identifying the pentavalent vaccine against diphtheria, tetanus, whooping cough, hepatitis B and Haemophilic influenza.
[4] MMR = MMR = Anti-Measles Vaccine; YEL = Anti-Yellow Fever Vaccine (against yellow fever).

6. IMPLEMENTATION OF THE PROJECT

6.1. Conceptual Framework

6.1.1. Conception of the web and mobile interface of the project

On the basis of the blueprint of data management of the project (*figure 1*), the mobile and Web interface of the project named *e-voir* (http://www.e-voir.org) was adapted for Phase II by Ivocarte Abyshop, a local structure was recruited specifically for this purpose. The mobile application includes a panel for capturing information from a mobile telephone (smartphone) and enables the collection and transmission of information via mobile internet network.

The web interface (*figure 2*) arbitrates the data base and equally enables the automatic sending of activation SMS as well as automatic sending of vaccination appointments reminders. In addition, this platform automatically generates statistics enabling the online monitoring of this project on a daily basis.
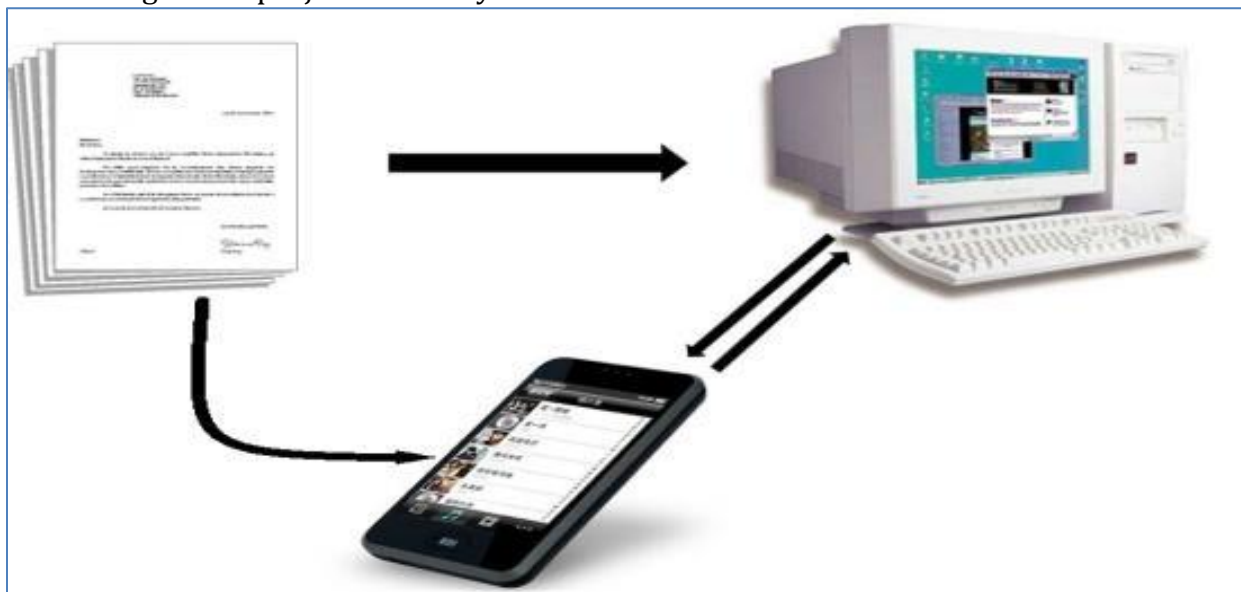
Figure 1 : Data management blueprint of the project.

Figure 2 : e-voir Web interface

6.1.2. Procedures of mother-child couples recruitment

The mother-child couples are recruited at the time BCG vaccination (By the Vaccinating agent) if the mother corresponds to inclusion criteria of the project, and after having given her clear consent (*figure 3*).

Figure 3 : Consent form of the mother

As soon as the mother gives her consent, the health officer fills in the "Recruitment" part of the recruitment form and monitors appointments (*Annexe3*) with the following basic information:

1. Code of the mother.
2. Surname and name of the mother.
3. Age of the mother.
4. Residency of the mother.
5. Education level of the mother.
6. Profession/occupation of the mother.
7. The most spoken language by the mother.
8. Surname and name of the child.
9. Date of birth of the child.
10. Sex of the child.
11. Date of recruitment.
12. Mobile Telephone number of the mother or the guardian.
13. Preference of the type of message (SMS or voice message).
14. Language preference for the message (French, Senoufo or Dioula).

The code is attributed to the mother or guardian of the child on the consent form is entered in the recruitment form of appointments, and in the mother-child individual booklet, and as well as in the routine EPI registry of the health centre. At the end of the recruitment session and after filling in the form, the health officer captures the data in the mobile interface, verifies the data and records it in the register before transferring them. From there the mother receives an activation SMS message (this notifies her of her enrolment in the project)

6.1.3. Randomization
As soon as the mother-child couples are recruited, they are classified randomly (randomization in block of 2, 4 and 6 according to the health centre) either in the Reminder group or in the Control group. The ones in blocks 2 are used for the rural health centres, while blocks 4 and of 6 for city and urban health centres. The randomization is carried out in an automatic manner by a software program. The objective of randomization is to limit biasness in the selection process and so as to allow a homogenous distribution of known and unknown prognostic factors between the groups. It also allows for an initial comparability.

I addition, the mother-child couples and the health agents do not control the randomization information, meaning that they don't know which couple belongs to which group. This in principle enables that the only different variable between the groups is the reminder.

6.1.4. Vaccination monitoring after enrolment
An appointment reminder message (SMS or voice as per the choice of the mother) is sent two (2) days before the vaccination appointment day of the child[5] in accordance to the vaccination day of each health centre. In the case where the mother does not come for the

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[5] This period was chosen following a prior qualitative survey that was done with the health agents and certain mothers of the children who are clients of the health centres in the health district of Korhogo.

appointment, a second reminder is sent to her three days after the sending of the first message, and a third reminder after two (2) days before the following vaccination day. In this manner, the mother/guardian has three chances (a maximum of three reminders) to come with the child to the health centre for each due date.

When the mother comes for the vaccination appointment, only the code of the mother and the name of the vaccine is captured, registered and transferred from the smartphone to the central server. The 5 appointments taken into account are the following:

- 6 weeks (Penta[6] 1)
- 10 weeks (Penta 2)
- 14 weeks (Penta 3)
- 6 months (VAS)
- 9 months (YEL/MMR)

The vaccination appointments are automatically fixed by a web interface from the date of birth of the child while also taking into account the specific vaccination days in the health centres, and equally taking into account the effects of public/national holidays and weekends (Saturdays and Sundays) in calculating the next appointment date.

6.2. Operational framework

The implementation of the project in the health district of Korhogo was undertaken from June 2013 to June 2014 (CF annexe 2). During this period of undertaking, various field activities were executed enabling the attainment of fixed objectives. As mentioned here bellow, on the blueprint basis of proposed data management as in *Figure 1* (page 12), the mixed Web/mobile interface (http://www.e-voir.org) was adapted for Phase II by Ivocarte Abyshop; a company specialised in IT solutions. The following actions were implemented.

For the implementation of the project, the following organisation made available the necessary human resources, namely:

- The Coordination Directorate of the Expanded Program on Immunisation of the Ministry of Health and Fight against AIDS (MSLS), to assure general coordination and quality control of the project.

- The Regional Health Management and Department in charge of Korhogo. To assure coordination in the implementation of the project in the centres and vaccination at the posts level. In terms of operational level, the human resource was essentially constituted of health agents from the district and from the targeted health centres of the project.

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[6] Penta: identifying the pentavalent vaccine against diphtheria, tetanus, whooping cough, hepatitis B and Haemophilic influenza.
[6] MMR = Anti-Measles Vaccine; YEL = Anti-Yellow Fever Vaccine (against yellow fever).

- The conception, planning and implementation of the project was undertaken in a consensual manner (HKI-DCPEV- Korhogo District -Ivocarte Abyshop), with HKI as the lead partner. The Program Assistant – Health, Technical Assistant – Nutrition and the country Director were staff members form HKI who were the most involved in the initiative, with the support of the headquarters and of local consultants to handle the more technical issues relating to statistical interpretation.

6.2.1. Basic evaluation and planning with the district

An awareness mission and a micro-planning session with the district was undertaken by DCPEV, HKI and Ivocarte-Abyshop from the 9th to 16th June 2013. It enabled a meeting of the key implementation partners from the pilot experience with an objective of explaining to them the reason of partaking in the activity and evaluating the prerequisite conditions for its renewal. For this purpose in collaboration with the district management team, twenty nine (29) centres and vaccination posts were identified on the basis of availability of network coverage, attendance levels and accessibility of the health centres and health posts. The operational action plan of the project was also revised and validated by region and by the health district of Korhogo.

The project action plan, mobile Web interface, as well as the training tools (project directive, data collection forms, interface user-guide) were revised then validated by the regional team and the district management team) Finally actions to be taken in order to assure a harmonised implementation of the project were identified.

6.2.2. Training of the health agents

With a goal of reinforcing the knowledge and to give necessary skills to health agents, a training on the use of project tools was given in Korhogo from the 17th to 18th June 2013. This training targeted the regional team, the district management team (ECD) and two health agents by target structure of the project. These trainings given by the technical team covered:

- ✓ The directives of routine EPI integrating Vitamin A supplementation
- ✓ Directives and methodology of the project
- ✓ The objectives and the results attained from the project.
- ✓ User guides of data collection tools (Consent forms, recruitment and follow-up forms, focal point supervision form)
- ✓ User guides of the mobile and web interface
- ✓ Operating sessions and practical exercises of the interface on the mobile telephones (Data collection and transmission)

These trainings enabled capacity reinforcing of 2 members of the team from the region, 4 members of the management team of the district (including the district focal point) and 56 health agents from the targeted centres.

6.2.3. Equipment and putting in place of inputs in health centres

For the implementation of the project as conforming to the directives, while also taking into account of the existence of EPI vaccination registers in the health centres, health agents received the following tools:

- smartphone mobile telephone (containing the mobile interface application) for collection and transmission of data ;

- Consent forms of the mother-child couples in order to have a clear consent given by the mothers or guardians of children aged 0 – 11 months and who have a telephone in order to participate in the project ;

- Recruitments forms of the mother-child couples (*Annexe 3*) in order to follow through with the vaccination appointment reminders ;

- The focal point monitoring forms for the central technical team (Annexe *4*).

- An endowment of Vitamin A capsules according to the targeted population of the health centre this is for routine supplementation

All the covered 29 operational health centres had at their disposal training as well as required tools for implementing the project.

6.2.4. Post-training monitoring

About six weeks after training, a post training follow-up mission enabled the consolidation of the knowledge in terms of reinforcing capacity in order to improve the data collection and transmission process and especially to achieve a follow up document of the recruited mother-child couples with an objective of verifying the variances between digital data and physical data.

6.2.5. Supportive Supervisions

With the perspective of addressing eventual problems in relation to the recruitment of the mother-child couples, the filling in of the tools, use of smartphones and data transmission, three supportive supervision missions were organised in support of the health district. These supervisions enabled through field visits the organisation of working sessions with the health agents in order to identify problems and propose solutions with a view of improving the execution of activities.

6.2.6. Mid-term assessment meeting

A meeting was organised from the 30th of April to 2nd May in Korhogo, the health agents from the 29 targeted health centres of the project were present, including members of the district management team as well the regional support team. The meeting was on one hand about presenting of the partial evaluation carried out from the 2nd to the 12th February 2014, and on the other hand bringing about a collective reflexion on the end of the second phase of the

project and indirectly by looking at an eventual third phase. In the course of this meeting, all the health agents presented the assessment of their activities and shared their recommendations and lessons learnt. In addition, the encountered causes of difficulties could be identified and solutions could be proposed. It emerged from this meeting that the activity was well perceived and was integrating perfectly well with the vaccination activities. However a reminder of the project directive was necessary for harmonisation and improvement of the recruitment of the mother-child couples and also in reinforcing the understanding of conceptual aspect of the study.

6.3. Data management

In the course of implementation of Phase II, a data collection plan was established. In this way, we can note different field activities executed since June 2013.

6.3.1. Data management and sharing of information

The monitoring of the execution of activities is done at the district level as well as in the central level. Through daily analysis of the database on the *e-voir* (*figure 4*), site, the result of the data analysis is shared with the technical team DC-PEV-District-HKI in order to analyse tendencies and identify measures to take in relation to the encountered technical problem.

The problems are normally of technical in nature, given for example when the vaccination monitoring information in the health centres does not appear in the *e-voir* central site. In these cases, the nurse is contacted in order to explain this situation, and also to see which actions to take (distance software update, IT support mission on the field, fixing of bugs in the site etc.)

Figure 4: Display of the data base in e-voir site

6.3.2. Data auditing

For an analysis based on reliable data, the data was audited at various levels. In consisted of data coherence, eliminating the realized variances, minimising missing values and verifying conformity of information captured line by line. The corrections were done from the physical questionnaires. After this operation, the information indicated in the Web platform and exported, gives sufficient guarantee for analysing data of the study.

6.3.3. Data analysis

Of the **1765** mothers or guardians of children aged from 0 -11 months residing in the district of Korhogo and who were recruited and registered on the Web platform, **169** were excluded from our analysis given that these mothers or individuals were not randomised[7]. Therefore the analysis covers 1596 observations randomised in the two research groups.

A plan to analyse data was elaborated in order to facilitate the statistical analysis. It was about formulating the indicators to elaborate (calculation formula), about choice of variables to tally, descriptive analysis of the data and use of statistical tests in order to show the significance of the Reminder effect. This analysis covered as a whole the randomised mother-child couples.

The qualitative analysis of data enabled the emphasising on the discussion of the parties who had participated in different interviews. A grid to analyse the contents of the discussion was formed for this particular purpose. It was composed of clear indicators, this grill enabled the merging of the elements that make sense in relation to specific objectives of the study. Extracts about the lives of certain parties enlightens their motivations and future projects underlined outside the analysis grid. These extracts of the narration of their experiences enabled putting of certain behavioural recurrences in their socio-economic and cultural contexts.

The SPSS software running on Windows version 19.0 was used to obtain the results of statistical analysis. The descriptive technical analysis and statistical indifference were used. The statistical tests and the confidence intervals at 95% were determined with an error threshold of 5%.

7. DIFFICULTIES ENCOUNTERED DURING THE STUDY

The implementation of the project faced difficulties in various levels.

7.1. Limitation of the study   *Type of study*

The study was to be of a randomised double blind controlled study, but we decided to abandon this terminology in consideration of very real possibilities of "contamination" between the groups and due to the involuntary absence of methodological orthodoxy by the health agents. If it is true that neither the health agents nor the beneficiaries did not know at the time of recruitment of the study to which group each couple belonged, we could therefore

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[7] These 169 couples were not randomiser either a) because they did not correspond to recruitment criteria, either b) because the block (2, 4 or 6) was not attained in the health centre where they were recruited, either c) because the randomisation was stopped on the interface since the minimal size required was already attained.

contest that this information cannot be known by certain health agents or by beneficiaries in the course of the study. Initially, the health agents were integrated in by following these methodological procedures:
- They were not aware of the randomisation procedures, so at the time of the mother-child couple recruitment, they could not know exactly in which group the couple was put ;
- They were not supposed to ask the beneficiaries if they were taking part in the study;
- They were not supposed to encourage the mothers to come for the vaccination appointments apart from their usual role of giving advice, and in particular not to encourage the mother to come " if the mothers receive telephone messages".

Unfortunately, we had already remarked in Phase I that despite the methodological recommendations reminder, certain health agents are a) either very proactive in reminding the mothers to come to the appointment while they receive telephone reminders b) either they ask the mothers why they came. This is not directly a methodological failure, but rather a problem in applying the methodology in the part of certain health agents. In fact, the health agent needs to encourage the mothers as a whole in their health zone of coverage to come to the appointments, independent of the existence or non-existence of a telephone reminder system. It should be noted that these examples were rare and that they were corrected rapidly.

It is also possible that in the rural health centres within smaller communities, the health agent could know well enough all his/her clients, and therefore remember who is in the Reminder group and who is in the Control group. In the small villages, there was also a possibility that the mothers could with other mothers (in the Control group) talk about received telephone reminders therefore "contaminating" the status of "blindness" of the mothers.

However, it should be noted that this is not probable in the big urban centres or in Korhogo city, where in fact the majority of the mother-child couples were recruited, therefore we are very positive that the methodology was concrete.

Despite these remarks, we hope that the study gives concrete proofs on the effect of mobile technology in attending vaccination appointments.

7.1.2. Limitations in the selection of targets
We could however contest that, by targeting beneficiaries who own mobile telephones, is not targeting the entire population. We could for example affirm that rural populations or certain categories of people don't have this type of technology. In reality, while analysing the socio-demographic data and the distribution of the study group as well as the general demography of Korhogo district, the possession of a mobile telephone does not seem to be liked to a particular zone or context.

If at a first glance we can affirm that the fact that most of the couples recruited in Korhogo shows that use of telephones is more pronounced in the city, in reality the proportions concerning the distribution of the population of study generally reflects an overall population distribution in the district.

Table 2 : Comparison between distributions of population (Korhogo District vs. Study)

ZONE	Korhogo District		Study	
	Inhabitants	Proportion of total population	Targeted	Proportion of the total target
Korhogo city	337605	46.2%	736	46.1%
Urban centre	207194	28.3%	560	35.1%
Rural centre	186280	25.5%	300	18.8%
TOTAL POPULATION	*731079*	*100%*	*1596*	*100%*

It is also convenient to note that Ivory Coast has one of the densest mobile sectors in the African continent, with a penetration rate that is more than 80% and a geographical coverage of 94%. We therefore believe that the results of the study can be generalised in one significant part of the population, it would be interesting to quantify more precisely by discussing with other different mobile operators.

During Phase I, the barrier of illiteracy had been identified as one of the most serious problems of the target, since the preliminary phase had been experimented only with Texts messages (SMS type). However, this limiting factor can be overcome thanks to the introduction of the voice message option.

7.1.3. Limitations in the data management of multi-vaccine
At the moment of installing the software, HKI did not foresee any possible nuances in the data analysis of the use of vaccination services that could have been caused by running out of stock of imputes. In fact, during the conceptualisation of the vaccination appointment monitoring software, the platform had been designed simply by assuming that "Presence = vaccination" and "Absence = non-vaccination". However, exceptions made for Vitamin A supplementation, where the input is unique in the appointments there is at least two products. For example in the case for appointment at 9 months, there is the YEL (anti yellow fever) vaccine and anti-measles vaccine, but by a response linked to the presence (YES or NO), we cannot make a difference in the case where the child only received the anti-measles vaccine but not the Anti-Yellow fever vaccine due to running out of stock. There can be therefore an overestimation concerning certain antigens. Likewise to the appointments at 6, 10 and 14 weeks, where beyond the pentavalent, we also vaccinate against poliomyelitis beginning 2015, we equally integrate the anti-rota virus vaccine as well as the PCV13.

7.2. Operational constraints
The supervision and evaluation of the project highlighted shortcomings related to various operational aspects.

7.2.1. Constraints related to health structures
In the course of the project, despite the prior recommendations to ensure stocking of necessary inputs at all times, we observed that there was running out of stock of certain inputs for long durations, for example the Anti-measles vaccine or the BCG syringes (This affected the mother-child couple recruitment for some weeks). This running out of stock could have affected the perceived effect of mobile technology by underestimating the actual attendance (since the data monitoring system does not differentiate between a person who does not come for the appointment and a person who does not receive the vaccines due to other reasons).

Beyond these logistical constraints, there are also constraints related to human resource management aspects at the level of the Ministry of Health and Fight against AIDS, among others:

- The occasional transfer of health agents who are trained in the framework of the project, causing a stop of activities in certain health centres.
- Delegation of activities for the trained agents/ focal points of certain centres to other agents and non-trained health caregivers.
- Limited central and local supervision on the part of EPI agents or of district management, and more generally lack of involvement by the national team, maybe due to absence of concrete information on the efficiency of the intervention.
- Failure to systematically fill in the EPI vaccination registers in order to facilitate tallying of data transmitted to the Web interface.

7.2.2. Technical constraints related to targets
Other operational constraints include:
- The knowhow on the use of mobile technology by certain agents.
- Rare problems of network coverage in certain zones.

Mobility of the mothers toward zones that are not covered by project, as well as their "health mobility" (especially in the urban zones or in the city of Korhogo, where mothers don't necessarily attend the same health centre for each vaccination)

8. RESULTS

8.1. Descriptive analysis

8.1.1. Type health structure
The implementation of phase II of the study covered 28 selected heath centres of the 29 for 3 types of structures. 46.1% of the mother-child couples came from the centres of the city of Korhogo, 35.1% form the urban centres and 18 .8% from the rural centres. This distribution is equivalent to the distribution of the general population of Korhogo given that 46% come from the city of Korhogo.
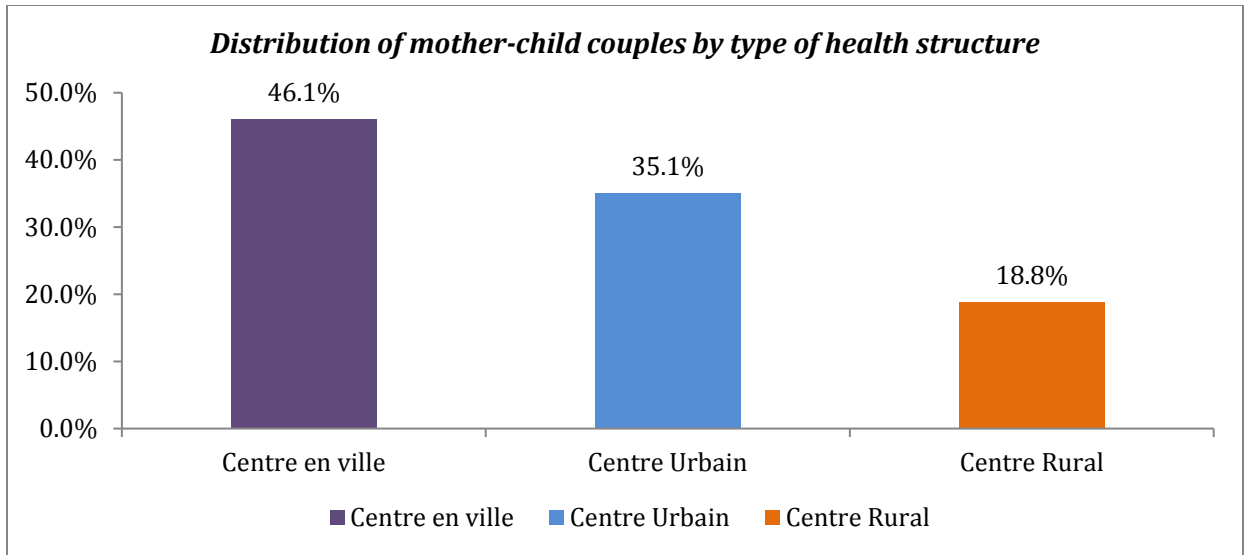
Figure 5 : Distribution of mother-child couples by type of health structure in the study.

8.1.2. Characteristics of the mothers
8.1.2.1. In terms of the age of the mothers by group and by type of structure

The results of the analysis show that 90.4% of the mothers or guardians of children aged 0 to 11 months were less than 35 years old; 89.6% in the vaccination reminder group and 91.5% in the control group. The average age of the mothers was 27 years old in the vaccination reminder group with a minimum age being of 14 years old and a maximum age of 48 years old. While it was 26 years in the control group with a minimum age of 15 years old and a maximum age of 44 years old. There is no difference between the groups in comparison to age of the mothers (P=**0.576**) in the two research groups.
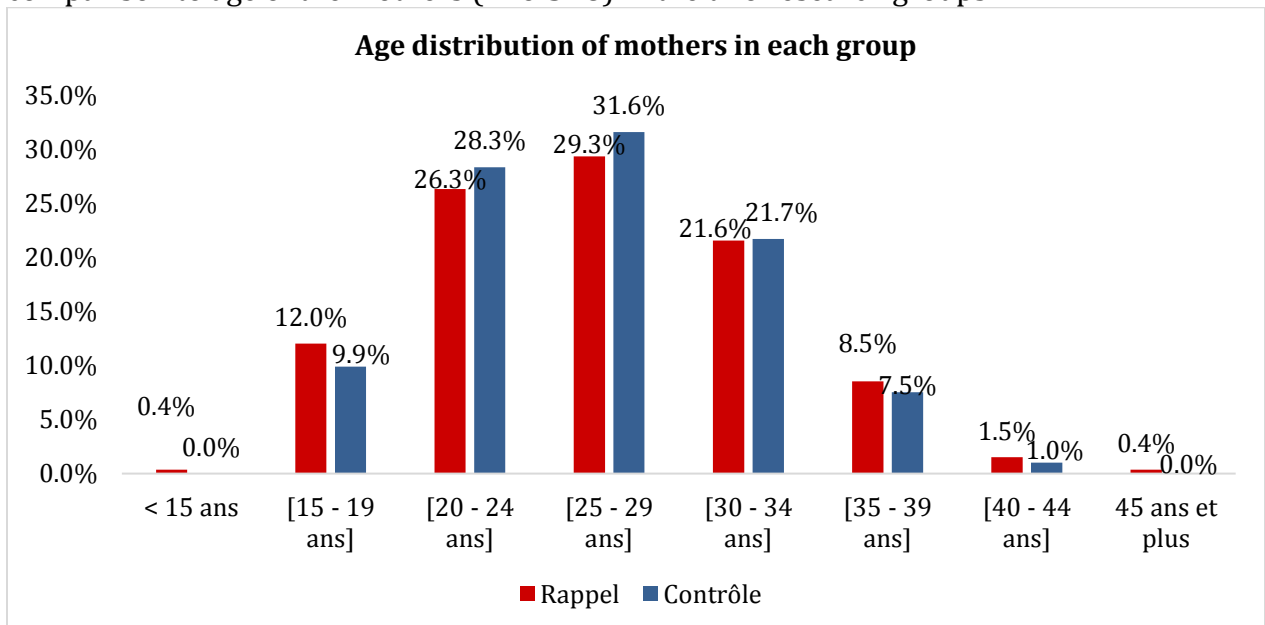
Figure 6 : Age distribution of mothers in each group

The distribution of the age of the mothers is considerably the same no matter the type of health structure.

Distribution of the age of the mothers by type of structure
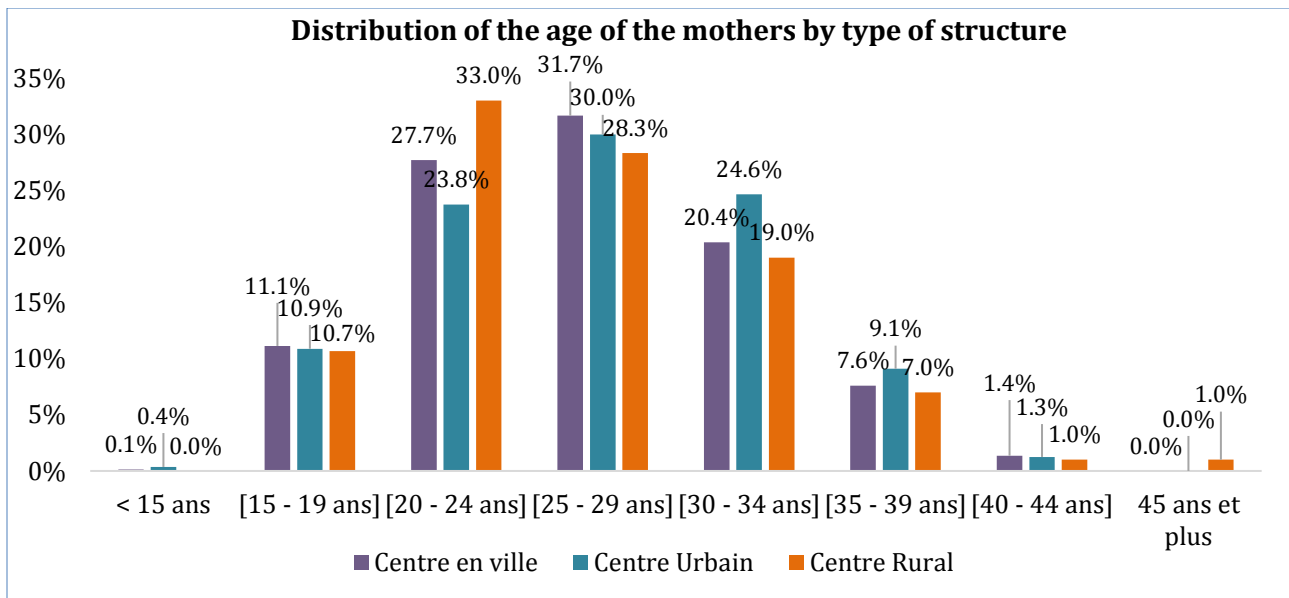
Figure 7 : Distribution of the age of the mothers by type of structure

8.1.2.2. Education level of the mothers by group and by type of structure

As a whole, most of the mothers are non-educated. In fact in the vaccination reminder group, 67.8% of the mothers are non-educated (Control group: 68.8%), 15.4% have primary school education level (Control group: 13.4%): 14.7% have secondary education level (Control group: 14.8%) and 2.1% have higher education level (Control: 3.0%). There is not a statistically significant difference concerning the level of education between the two groups (P= 0.499).
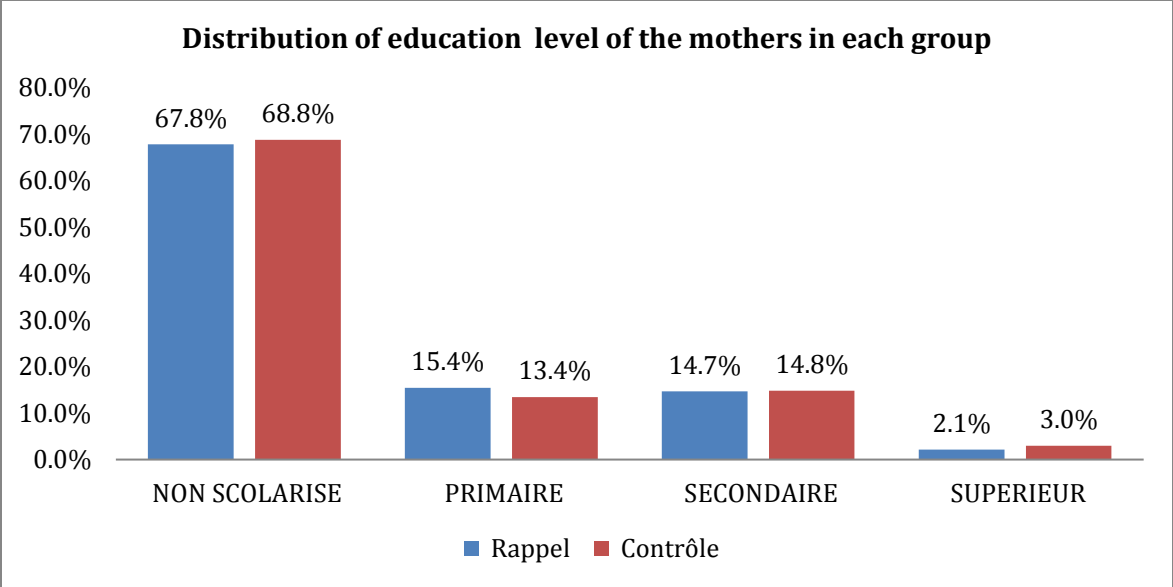
Figure 8 : Distribution of education level of the mothers in each group

In terms of distribution of the level of education by type of health structure, the non-educated mothers are the majority regardless of the type of structure with a much higher concentration of these mothers in the rural centres. The primary, secondary and higher education level is dominated by mothers who visit the centres of the city of Korhogo.
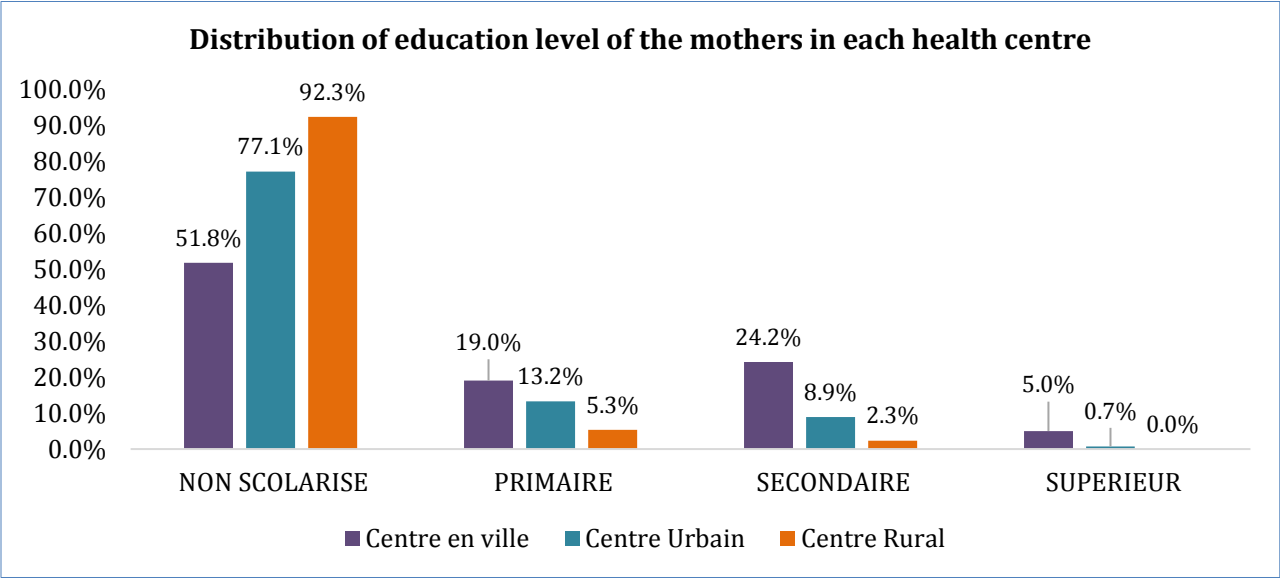
Figure 9 : Distribution of the education level of the mothers in each health centre

8.1.2.3. Language spoken by the mothers by group and by structure

We can note an almost equal distribution in the two groups. However, Senoufo is the most widely used language for communication in comparison to the other languages.

Distribution of language spoken by the mothers in each group

	SENOUFO	DIOULA	FRANÇAIS	AUTRES
Rappel	57.6%	28.8%	6.9%	6.6%
Contrôle	59.0%	26.2%	8.4%	6.4%
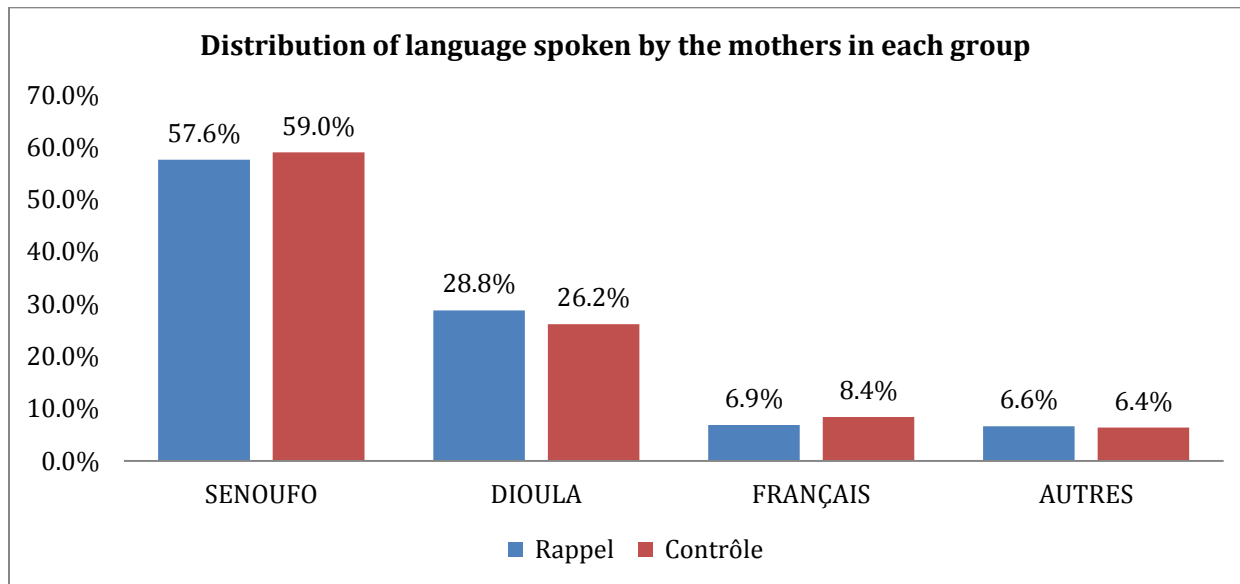
Figure 10 : Distribution of language spoken by the mothers in each group

Between the two majorly spoken languages, Senoufo is the most spoken in the rural centre level contrary to Dioula which is mostly used in Korhogo city.

Distribution of language spoken in each health centre

	SENOUFO	DIOULA	AUTRES	FRANCAIS
Centre en ville	43.6%	39.0%	10.7%	6.7%
Centre Urbain	66.4%	18.8%	4.5%	10.4%
Centre Rural	79.3%	15.7%	0.0%	5.0%
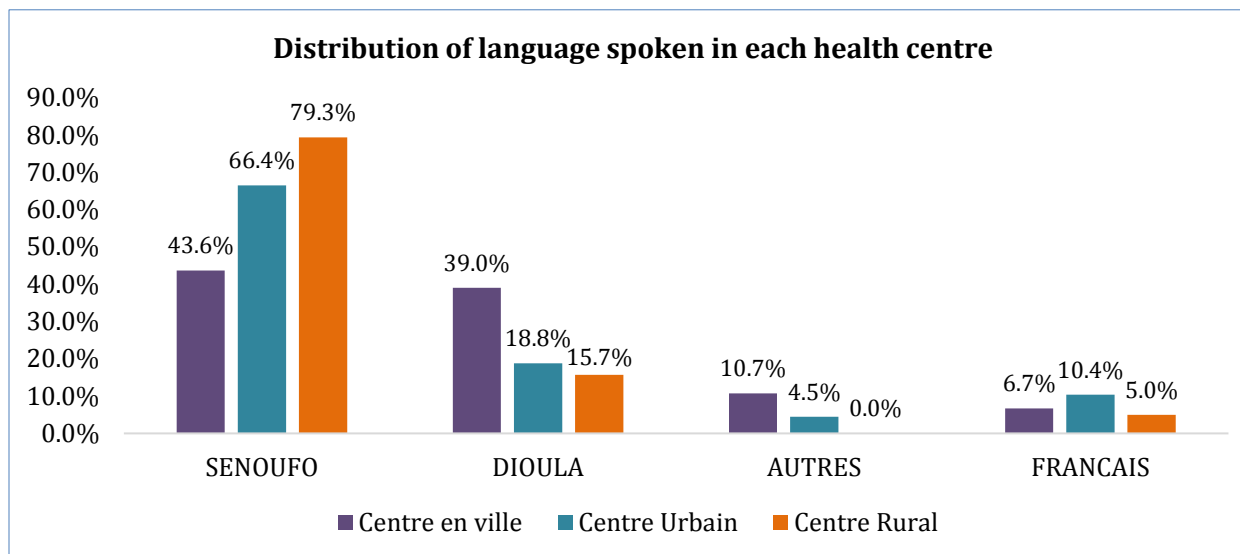
Figure 11 : Distribution of language spoken in each health centre

8.1.2.4. Activity of the mothers by group and by structure

Concerning occupations of the mothers or guardians of children aged 0 to 11 months, housewives comes on the first position followed by business people. Thereby, 69.0% of the mothers in the Vaccination reminder group are housewives (Control group: 70.3%), with 20.7% of the mothers in the Vaccination reminder group doing business (Control group: 20.1%). There are no remarkable disparities concerning other activities, notably farming (Vaccination reminder group: 0.9%; Control group: 0.1%), pupils/students (Reminder group: 2.6%; Control group: 3.1%). Formal employment (Reminder: 4.9%; Control: 5.1%) and informal employment (Reminder: 1.9%; Control: 1.3%).
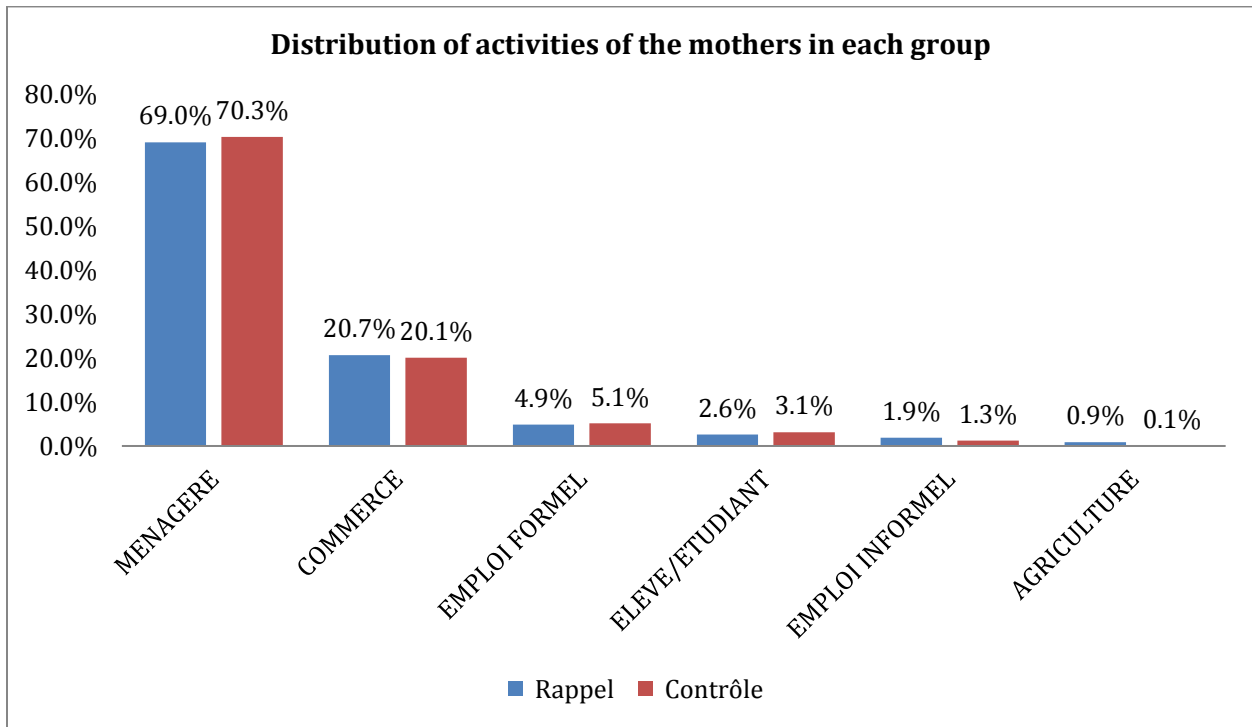
Figure 12 : Distribution of activities of the mothers in each group

In terms of distribution of occupations by type of structure, we can equally remark that the majority of mothers who frequent health structures are housewives and predominantly those who are in the rural centres. As exception for domestic activity and farming, the other activities are majorly carried out by mothers coming from the city of Korhogo or in the urban zones.
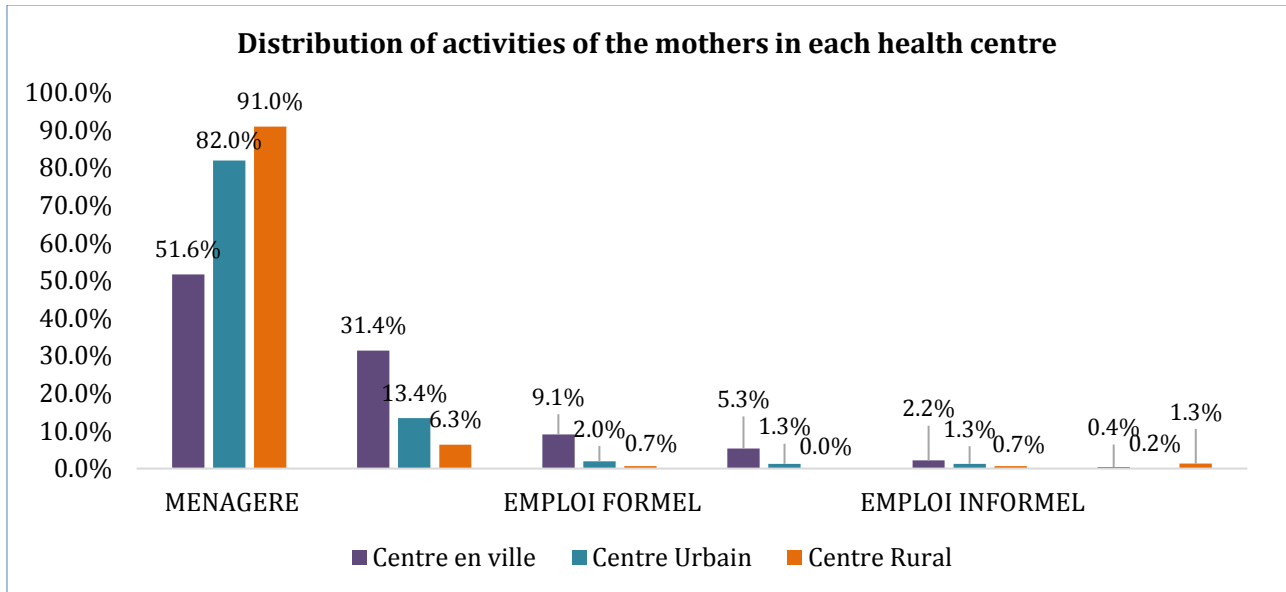
Figure 13 : Distribution of activities of the mothers in each health centre

8.1.3. Characteristics of the children

8.1.3.1. Sex of the child by group and by structure

In terms of the sex of the children, generally the male sex represented 50.4% of the total (Reminder: 49.7%; Control: 51.0%), and the female sex represented 49.6% of the total (Reminder: 50.3%; Control: 49.0%). The sex ratio was therefore 1.02.
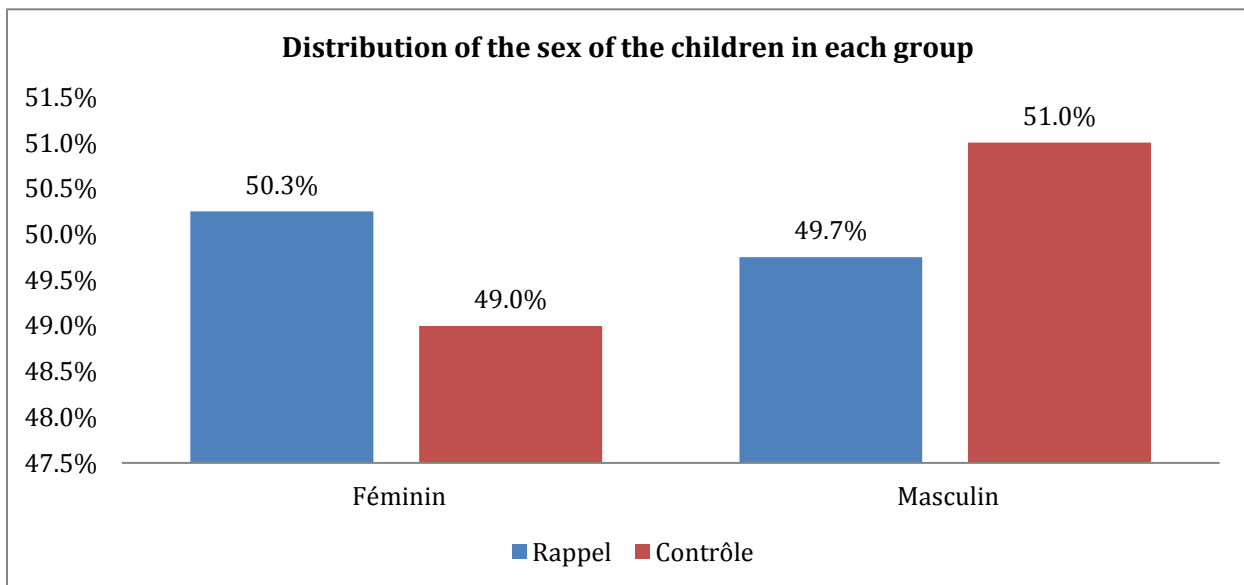
Figure 14 : Distribution of the sex of the children in each group

8.1.3.2. Age of the child by group and by structure

Concerning the age of the children, all the children at the time of data analysis (February 2015) were aged 9 months old or older, age for the last vaccination (MMR/YEL) according to the EPI routine. However, it was the same in the Reminder group as well as the Control group, the average age of the children was 17 months. Both in the Reminder and in the Control groups, the minimum age was 9 months and 6 days and the maximum respectively was 21 months 15 days and 21months 4 days.

This result shows that all the children randomised (1596) had attained the age of 9 months required for the last PEV routine vaccine at the moment of data analysis.
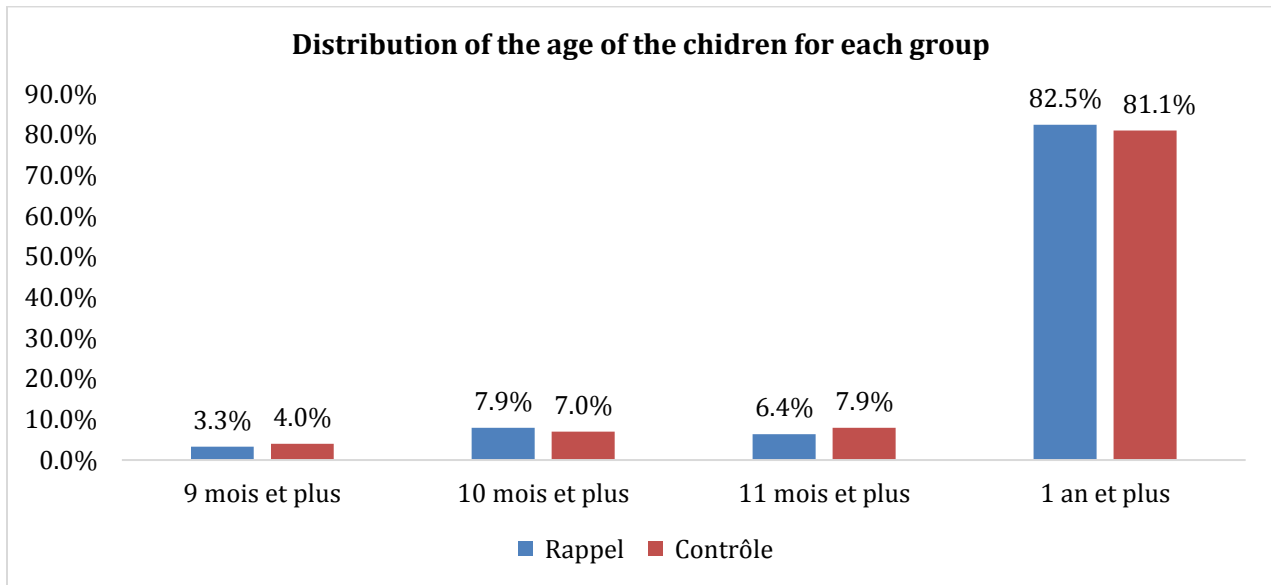
Figure 15 : Distribution of the age of the children for each group of study.

The statistical results gives: Fisher = 2.388   P = **0.496**

Therefore a significant statistical difference does not exist between the "Reminder" and "Control" of the age of the children in months. However, all the children regardless from any group were eligible for EPI routine.

8.1.4. Characteristics of the messages
8.1.4.1.   Preference of the type of message by group and by type of structure

In terms of sent messages (voice or SMS) as reminders for the vaccination appointments to the mother-child couples or guardians of children aged 0 to 11 months, the voice messages were the most preferred (85% of recruited couples) in comparison to text messages (15% of the recruited couples).

It should also be noted that the mothers in the Control group, contrary to the mothers in the Reminder group who receive reminder messages as well as activation SMS, only received one activation SMS message. Nevertheless, at the time of recruitment before automatic randomisation, all the mothers had to clarify a preference in terms of the type of message.

We remark that as this preference expressed for the Control group is not divergent in terms of preference proportion of the Reminder group.
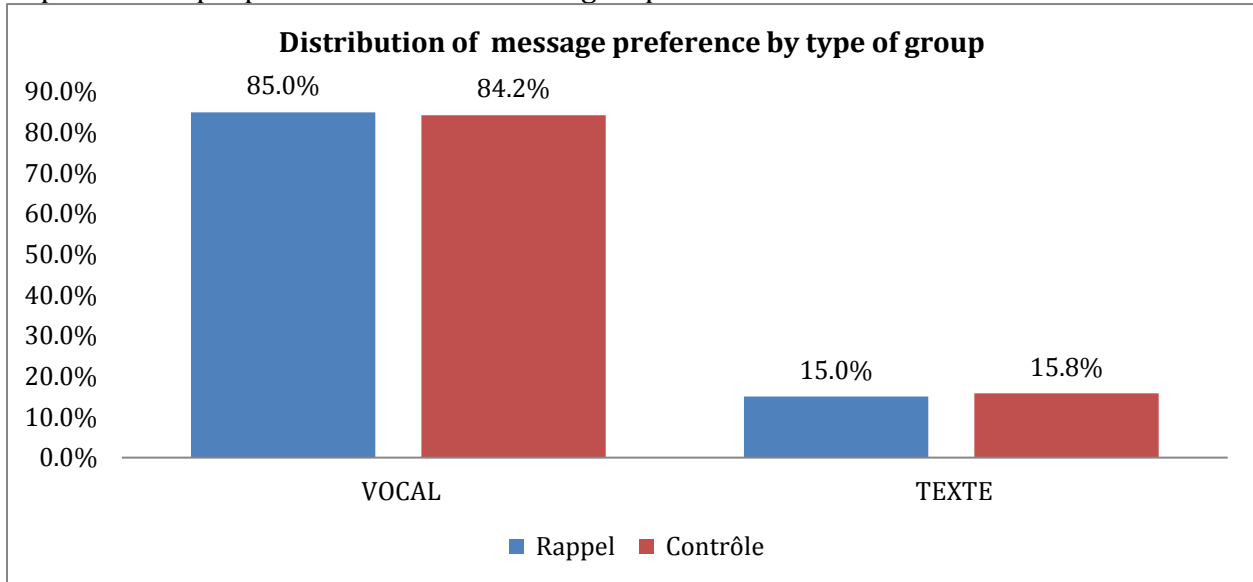
Figure 16 : Distribution of message preference by type of group

The distribution of message preference (Text or voice) by type of structure, shows a predominance of text message preference in the city of Korhogo but an almost absolute preference for voice message at the rural level.
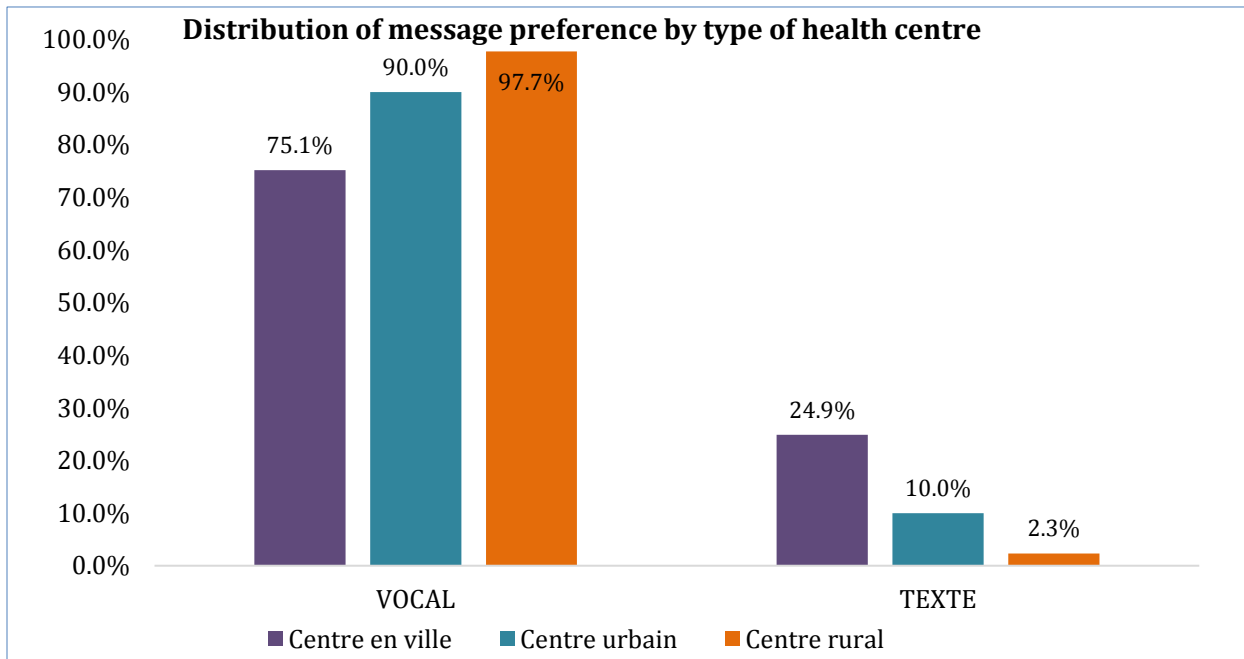
Figure 17 : Distribution of message preference by type of health centre.

8.1.4.2. Language of the message by group and by type of structure

The distribution of preferred language is practically equal for each one of the languages in the two groups. There is not a significant statistical difference in regards to the choice of language for sending voice messages between the two groups.

Distribution of language chosen for the message in each group
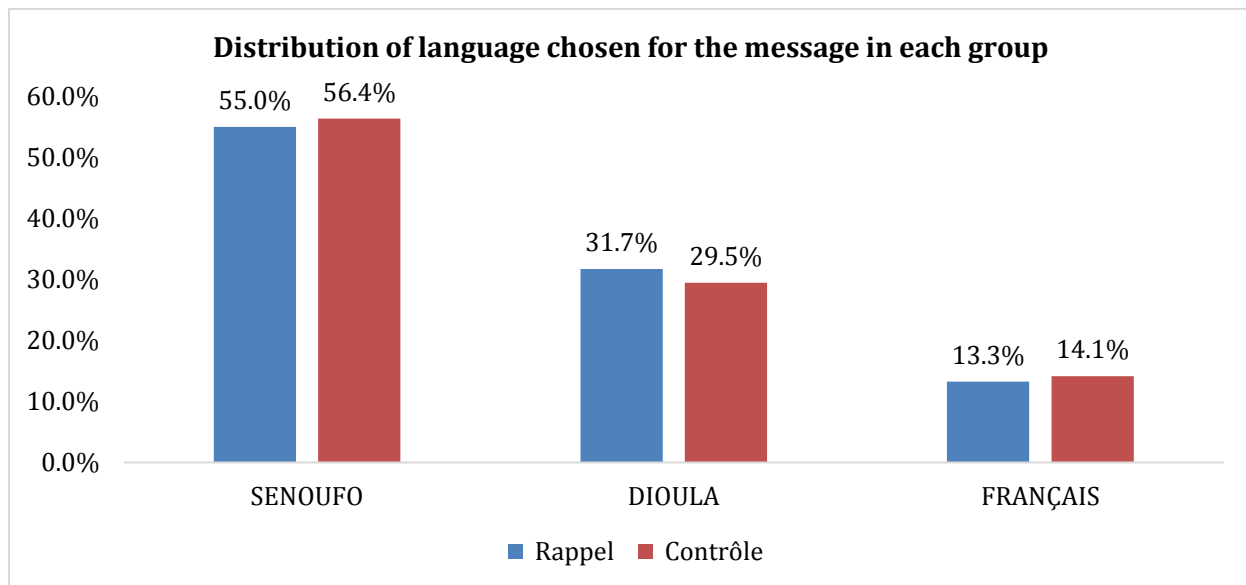
Figure 18 : Distribution of language chosen for the message in each group.

Statistical results gives: KHI² = 0,856   ddl = 2   P =0.652

The distribution in each structure for language of voice messages shows that 46.7% of the mothers in the urban city centres chose Dioula, in comparison to 16.0% in the rural centres and 21.4% in the urban centres. Concerning Senoufo language, 29.7% of the mothers chose it in the city centres, 80.9% in the rural centres and 69.6% in the urban centres. Finally 23.7% of the mothers preferred French in the city centres, 3.1% in the rural centres and 8.9% in the urban centres. These data reflect highly identified linguistic aspects.

Distribution of language chosen for the message by type of structure
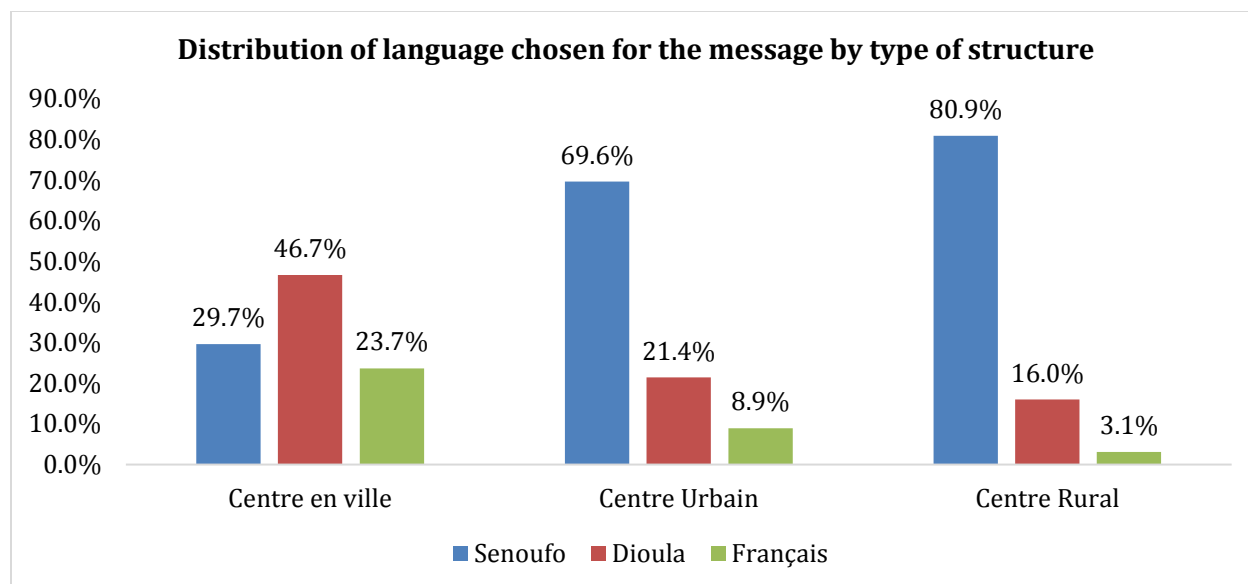
Figure 19 : Distribution of language chosen for the message by type of structure.

8.1.5. Characteristics linked to vaccination coverage
8.1.5.1. Penta 1 Vaccination coverage

In terms of vaccine coverage of the total 1596 mother-child couples recruited at the time of BCG + Polio 0 vaccination, 81.3% of the children (1298 children of the total 1596) had been vaccinated for Penta 1. With a vaccine coverage of 86.6% in the Reminder group and 76.1% in the Control group, there is a significant statistical difference of 10.5% in the alpha threshold = 5% ($P< 0.05$). We can therefore note a positive association (3 times more probability) between being a member of the Reminder group and being vaccinated for Penta 1 in comparison to being a member the Control group (RR= 2.84, 95% IC [1.85 ; 4.37]).

Table 3 : Distribution of children vaccinated for Penta 1 at the end of February 2015.

Children vaccinated for Penta 1 at the end of February 2015					
Group	*Eligible*	*Vaccinated*	*% vaccinated*	*Not vaccinated*	*% not vaccinated*
Reminder	798	691	86.6%	107	13.4%
Control	798	607	76.1%	191	23.9%
TOTAL	**1596**	**1298**	**81.3%**	**298**	**18.7%**

8.1.5.2. Vaccination coverage for Penta 2

In terms of Penta 2, the proportion of vaccinated children was 74.1%; 1183 of the 1596 children in total to be vaccinated. The Vaccination coverage of Penta 2 was 81.0% in the Reminder group in comparison to 67.3% in the Control group making a significant statistical difference of 13.7% to the alpha threshold = 5% ($P< 0.05$). There is therefore a positive association (3 times more probability) between being a member of the Reminder group and

35

being vaccinated for Penta 2 in comparison to the Control group(RR=2.80, 95% IC [1.88 ; 4.16]).

Table 4 : Distribution of vaccinated children for Penta 2 at the end of February 2015

Children vaccinated for Penta 2 at the end of February 2015					
Group	*Eligible*	*Vaccinated*	*% vaccinated*	*Not vaccinated*	*% not vaccinated*
Reminder	798	646	81.0%	152	19.0%
Control	798	537	67.3%	261	32.7%
TOTAL	**1596**	**1183**	**74.1%**	**413**	**25.9%**

8.1.5.3. Vaccination coverage for Penta 3

For Penta 3, the proportion of children vaccinated was 66.2%; 1057 of the total 1596 children to be vaccinated. In the Reminder group, the vaccination coverage of Penta 3 was 74.2% in comparison to 58.3% in the Control group making a significant statistical difference of 15.9% to an alpha threshold = 5% (P< 0.05). Equally, there is a positive association (3 times more probability) between being a member of the Reminder group and being vaccinated for Penta 3(RR=2.68, 95% IC [1.83; 3.91]).

Table 5 : Distribution of children vaccinated for Penta 3 at the end of February 2015

Children vaccinated for Penta 3 at the end of February 2015					
Group	*Eligible*	*Vaccinated*	*% vaccinated*	*Not vaccinated*	*% not vaccinated*
Reminder	798	592	74.2%	206	25.8%
Control	798	465	58.3%	333	41.7%
TOTAL	**1596**	**1057**	**66.2%**	**539**	**33.8%**

8.1.5.4. Vitamin A supplementation coverage

As for Vitamin A supplementation at 6 months, the proportion of the children given the Vitamin A supplement was 52.7% (841 of the total 1596). 64.7% of the children in the Reminder group in comparison to 40.7% of children in the Control group had been given Vitamin A supplement. Making a significant statistical difference of 24% to the alpha threshold = 5% (P< 0.05) with a positive association (6 times more probability) between being a member of the Reminder group and receiving Vitamin A in comparison to the Control group (RR=5.66, 95% IC [3.47 ; 9.22]).

Table 6 : Distribution of children vaccinated for Vitamin A at the end of February 2015

Group	Eligible	Received	% received	Not received	% not received
Reminder	798	516	64.7%	282	35.3%
Control	798	325	40.7%	473	59.3%
TOTAL	**1596**	**841**	**52.7%**	**755**	**47.3%**

Moreover, we note that among the children given vitamin A supplementation at 6 months and those beyond 6 months, the children in the Reminder group have a much higher rate of them than those in the control group. 67.9% of the children given vitamin A supplementation at 6 months are from the Reminder group (Control: 32.1%) and 52.1% of the children are given supplements beyond 6 months of age (Control: 47.9%)

8.1.5.5. Vaccination coverage for Measles + Yellow fever

In terms of vaccination of children against measles and yellow fever, 49.2% of the children vaccinated were 786 of the total 1596, with 60.7% in the Reminder group and 37.8% in the Control group. Therefore there is a significant statistical difference of 22.9% to the alpha threshold = 5% (P< 0.05) with a positive association (5 times more probability) between the fact of being a member of the Reminder group and attending the vaccination appointment against measles and yellow fever in comparison to the Control group (RR=4.52, 95% IC [2.83 ; 7.19]).

Table 7 : Distribution of children vaccinated against Measles and Yellow fever at the end of February 2015.

Children vaccinated YEL/MMR at the end of February 2015

Group	Eligible	Vaccinated	% vaccinated	Not vaccinated	% not vaccinated
Rappel	798	484	60.7%	314	39.3%
Control	798	302	37.8%	496	62.2%
TOTAL	1596	786	49.2%	810	50.8%

In general, we note that there is a clear increase in the use of vaccination services by the mothers receiving SMS reminders in comparison to those who don't receive them. However, this use of vaccination services reduces progressively in the two groups from Penta 1 to the time of vaccination against Measles and Yellow fever. This tendency is comparable to the general routine vaccination tendencies in Ivory Coast. Nevertheless, we remark that the gaps between Penta 1 and vitamin A – YEL/MMR remains moderate in the Reminder group. In addition, the rate of attendance in the city is lesser than in the other urban centres and in the rural areas. It would certainly be interesting to look at in depth the reasons for these differences, however in all cases the effect remains independently significant form the type of structure.
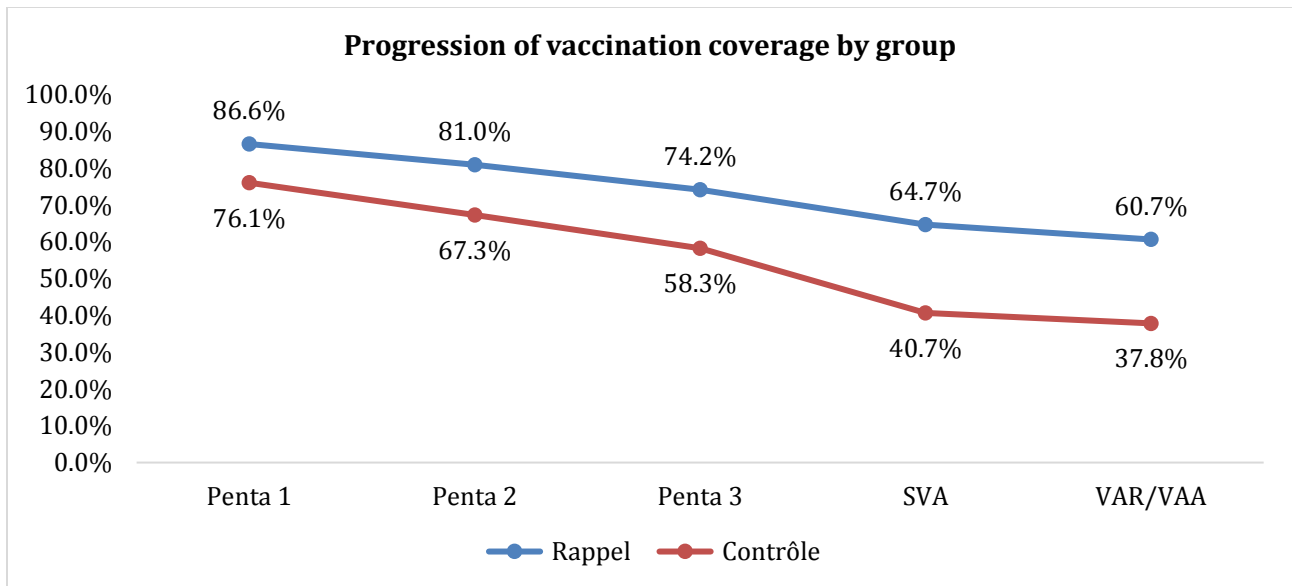
Figure 20 : Progression of vaccination coverage by group

In different frameworks here bellow, we can appreciate the proportion of children vaccinated as well as the different effects of the reminder on the rate and variance between the two groups in terms of type of structure. For example, we remark that the variances are much more reduced in the case of urban health centres in comparison to other centres.
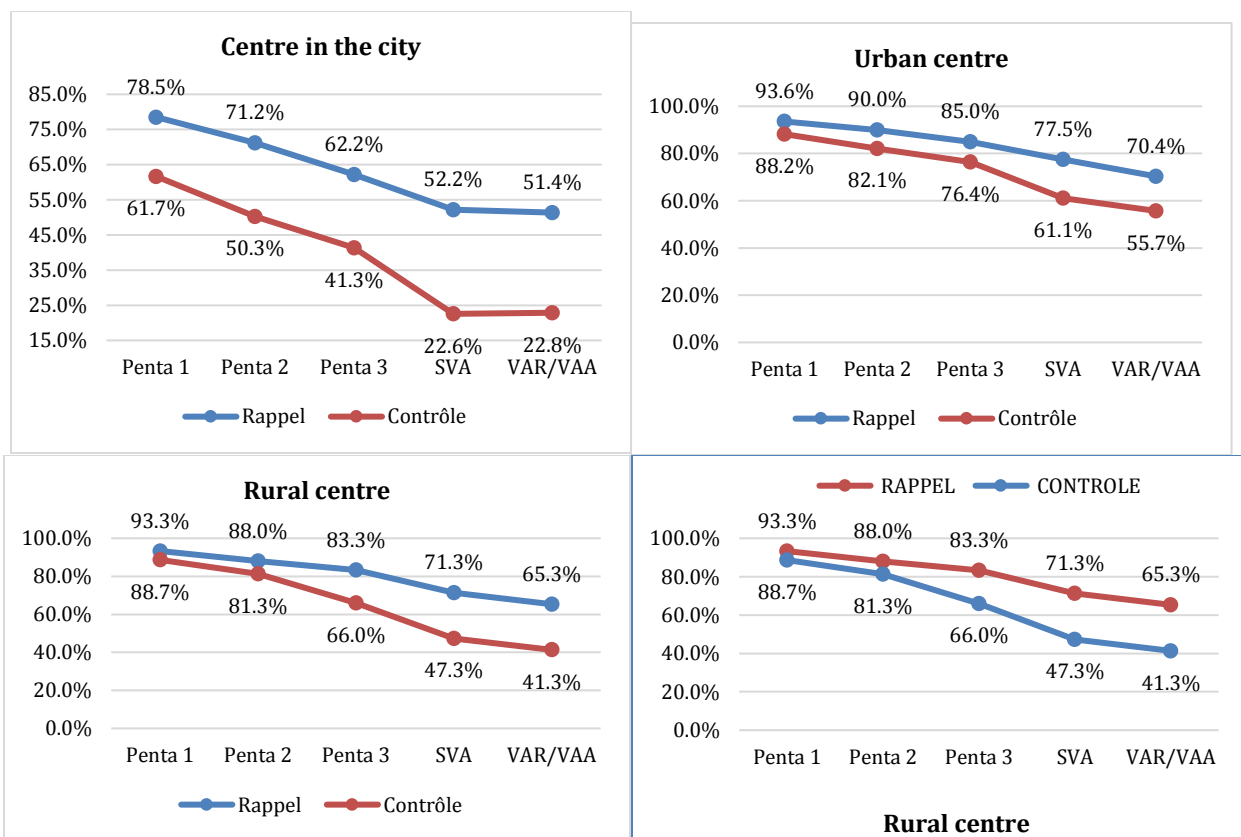
Figure 21 : Proportion of vaccinated children according to the type of structure

8.1.6. Completeness

We define completeness as the proportion of eligible children completely vaccinated and who are "of age" (from BCG to YEL). Generally, this rate for the project was 58.3% for the Reminder group compared to 35.7% for the Control group while it should have been 100% in an ideal case since the whole group attained 9 months or less in terms of age; the age required to undertake the last EPI routine vaccine including the first dosage of Vitamin A supplement. If we include appointments for vitamin A supplements, these rates would be distinctly much higher with 55.6% for the Reminder group compared to 32.8% for the Control group.

Table 8 : Rate of overall completeness by type of structure for the two groups

Type of structure	Group	BCG	VAS	YEL	Including VAS	Completeness BCG/YEL
Overall	Reminder	798	444	465	55.64%	58.27%
	Control	798	262	285	32.83%	35.71%
Centres in the city	Reminder	368	161	174	43.75%	47.28%
	Control	368	61	72	16.58%	19.57%
Urban Centres	Reminder	280	192	195	68.57%	69.64%
	Control	280	147	153	52.50%	54.64%
Rural Centres	Reminder	150	91	96	60.67%	64.00%
	Control	150	54	60	36.00%	40.00%

8.1.7. Dropout rate

The whole cohort having matured at the end of February 2015 during the data analysis, for penta 3 and for YEL/MMR, the specific dropout rate (Penta 1 – Penta 3) was 14.3% in the Reminder group in comparison to 23.4% in the Control group. Furthermore, the overall dropout rate (Penta 1 – YEL/MMR) was 30.0% in the Reminder group and 50.2% in the Control group.

8.1.8. Characteristics related to deceased children and the lost from sight

Of the total 1596 children coming from the recruited mother-child couples, eight are deceased (0.5%), of which five come from the Reminder group and three from the Control group. The distribution is 4 children for each sex. The majority of mothers or guardians of these deceased children are non-educated. Seven out of eight had attained the age of receiving all the vaccines. Among these, four had been vaccinated for Penta 1, two for Penta 2 and 1 for Penta 3.

Concerning the lost from sight, 146 children out of 1596 were declared as lost from sight[8], making 9.1% of the total, of which 61 came from the Reminder group and 85 from the Control group. It is also convenient to note that of the 146 lost from sight, 135 came from the urban centres (City centre = 99 and urban centre = 36), this could be explained by the fact that women go to other centres which are not included in the project depending on the vaccination days when they receive the messages. More than 60% of the mothers or guardians of the lost from sight are uneducated.

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[8] Couples having received BCG but absent for Penta appointment, VAS and YEL/MMR and unreachable by telephone.

8.2.   Analysis of the variables

In this part, it's about showing the significant effect of different variables on the vaccination coverage. For this, we will use multiple logistic regression model.

In terms of penta 1 (annexe 8)

The probability of receiving Penta 1 if the language spoken is Dioula is 0.48 times much more higher than if other languages are spoken (RR=0.22, 95% IC [0.14 ; 0.35]).

The probability of receiving Penta 1 if the centre is in "the city" is 0.22 times much higher than if the centre is in the "rural" area.

In terms of penta 2 (annexe 9)

The chances of receiving Penta 2 if the language spoken is Dioula are 0.59 times higher than if other languages are spoken. (RR=0.59, 95% IC [0.35; 0.85]).

The chances of receiving Penta 2 if the age group of the child is 1 year old are much more statistically significant (RR=1.95, 95% IC [1.08 ; 3.52]).

The chances of receiving Penta 2 in the city centres are significantly much higher than in the urban centres (RR=0.27, 95% IC [0.18; 0.40]).

In terms of Penta 3 (annexe 10)

The chances of receiving Penta 3 if the spoken language is Dioula are 0.57 times much higher than if the other languages are spoken (RR=0.57, 95% IC [0.35 ; 0.92]).

The chances of receiving penta 3 if the age group is 1 year old and more is statistically significant (RR=2.07, 95% IC [1.16; 3.68]). The test also shows significant differences between the age groups of 10 months old and much older, and that of 1 year old and much older as well as differences between 11 months old and much older, and 1 year old and much older.

The chances of receiving Penta 3 are much more significantly higher in the city centres than in the urban centres (RR=0.36, 95% IC [0.26; 0.52]).

Concerning Vitamin A (annexe 11)

The age group of 10 months old and much older and the age group of 1 year old and much older are respectively statistically significant (RR=0.29, 95% IC [0.13; 0.63]) and (RR=2.16, 95% IC [1.20; 3.90]). They have 0.5 times more chances of receiving vitamin A supplementation if they are of the age group of 10 months old or older and have 2 times more chances if they are of age group of 1 year old or older. The test comparing the age groups shows that each of the groups is statistically significant of the other.

The age of the mother and the number of SMS received have both a statically significant association with being vaccinated. For a unit increase of the mother's age, the chances of receiving Vitamin A supplements is 1.02 (RR=1.02, 95% IC [1.00; 1.04]).

Concerning yellow fever and measles *(annexe 12)*
Children who have more chances of receiving measles and yellow fever vaccines are of the age group of 10 months old or older and of age group 11 months and much older, they are respectively statistically significant (RR=0.36, 95% IC [0.17 ; 0.74]) and (RR=0.23, 95% IC [0.10 ; 0.50]). The test also shows significant differences between the age group of 10 months old and much older, and 1 year old and much older as well as between 11 months old and much older and 1 year old and older.

8.3. Qualitative monitoring
To better understand the perception of the project by the vaccinating health agents and the mothers, interviews were conducted with the vaccinating health agents who were part of the project as well as the mothers (*Annexes 6 and 7*) and certain mothers were excluded from the interviews due to having missed many appointments.

8.3.1. Perception of the project by the interviewed vaccinating agents
The visits covered 25 of the total 28 targeted centres, with a workforce of 36 vaccinating agents interviewed. In a general manner, most of the vaccinating officers (30 out of 36) think that the telephone reminders enables to constantly remind mothers that they have to make their child vaccinated. In addition, most of them affirm that they had been surprised by the positive effect in a large scale by a simple telephone reminder on the frequent vaccination sessions, given that they had been the very sceptical of the project at the beginning. According to vaccinating agents, the telephone reminders enabled the mothers to appreciate and reconsider the vaccination practice. "They have much more interest in coming to vaccinate their child when they receive the message that tell them to go to the health centre in order to vaccinate their child" according to one vaccinating agent from the health centre of Torgokaha.

In a personal manner, the health officers recognise that the project enables them to use smartphones, that they consider to be a mini-computer and also enabled them to adapt to new information and communication technology, and having a good command of a new technology associated to vaccination and EPI data management. In addition as mentioned by the health officer from Katiali "The project reinforced our capacity by allowing us to familiarise ourselves with IT tools. Before, data storage was only done in the registration level at the end of the month" Today according to him, the digital option has come to revolutionise the collection and transmission of EPI data. The telephone equally provides information as much the register according to health officers.

In a practical level, according to all health officers interviewed, the implementation of the project enabled them to save time and be more efficient in the vaccination sessions especially during the Penta 1 to 3 appointments. They noted that women were coming regularly to vaccination sessions thanks to information sent to them via telephone, and that vaccination

reminders by telephone became fashion for women who were registered in the project. In addition, it was noted that by effect of learning, women who did have telephones were now wanting to possess one so as to be recruited in the project. The reminders boosted the visits to health centres by the hesitant mothers and had their children vaccinated for their own personal reasons.

Taking an example form Bahouakaha, the project is appreciated by the population and has now become a subject of discussion in the village. It was equally noted that mothers from far-off villages and sometimes those who come from other health zones of whom were not making vaccination visits, now show up precising that they had not been informed via a vaccination reminder. This is a high morale, a feeling of pride to the vaccinating officers who feel that they have accomplished their assignments.

8.3.2. *Perception on the project by interviewed mothers*
In terms of mothers or guardians having children aged from 0- 11 month, old a total of 97 mothers were interviewed. They all gave their consent within the framework of the project. The results of the interview of the mothers show that:

8.3.2.1. **Concerning received messages**
92% of mother affirm that they did receive the activation SMS in comparison to 8% who did not receive it. The majority of the mothers who affirm that they did not receive the activation message are generally illiterate or are mothers whose telephones are owned by their husbands.
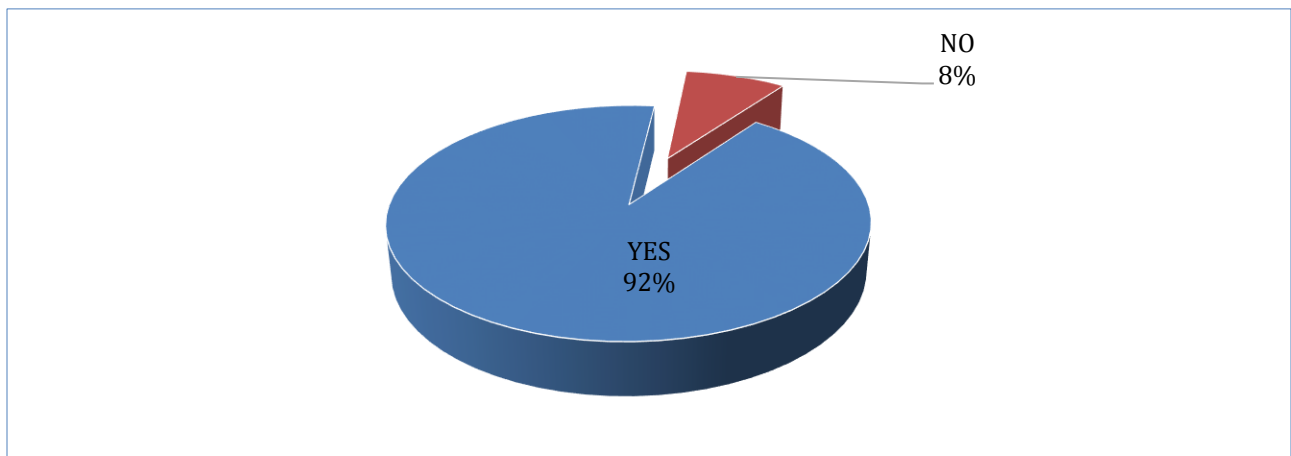
Figure 22 : Proportion of mothers who received activation SMS

Among the mothers who received the reminder SMS, 83% of the mothers attest having attended their appointments in comparison to 17% who did not attend their appointments. The reason why these mothers did not take their children for vaccination is justified by the fact that the inputs run out of stock (Annexe 14 gives the availability of and shortage of vaccine and consumable during the year of carrying out the project). Furthermore, we note that among the women who came to the vaccination appointments, 52% of the mothers affirm that they would not have come if they would have not

received the SMS reminder for the vaccination in comparison to 48% of the mothers who would have come.

Table 9 : Distribution of mothers who came for the vaccination appointment

	When you received the SMS, did you come to the appointment?		Yes, could you have come if you did not receive the message?	
	headcount	Percentage	headcount	Percentage
YES	26	83.3	11	47.8
NO	4	16.7	12	52.2
TOTAL	30	100.0	23	100.0

NB: *3 missing values for mothers who attended their appointments*

Concerning the question ***"Would you like to receive messages to remind you of your different PNC appointment dates if you were expectant?"*** The majority of the mothers (99%) interviewed on the subject affirmed wanting to receive PNC appointment reminder messages if they were expectant but only one woman (1%) refused since she did not wish to get pregnant. Among those who wished to receive reminder messages for PNC appointment, 95% affirmed that it was because of the concern for their health and that of their baby in comparison to 5% who wanted the appointment reminder so as not to forget. They are unanimously in agreement that their spouses would agree if they were to be sent reminder messages for their PNC appointments.

8.3.2.2.   Reasons for not attending vaccination appointments

Various reasons prevent the mothers from coming to the health centres for the vaccination of their children. We note that 8 women making 8.3% feel that they are prevented from coming due to lack of information, while 5 women who make 5.2% site continued running out of stock of the vaccine. A part from these recurrent reasons, there are isolated cases like forgetfulness, health problems and the long journey that could be an obstacle to following the vaccination calendar by the mothers.

On the other hand, we realise that the majority of the mothers worry about the health status of their children that is the reason why they think that nothing can prevent them from having their child vaccinated. This point of view is shared by 75 women making 78.1% of the total.
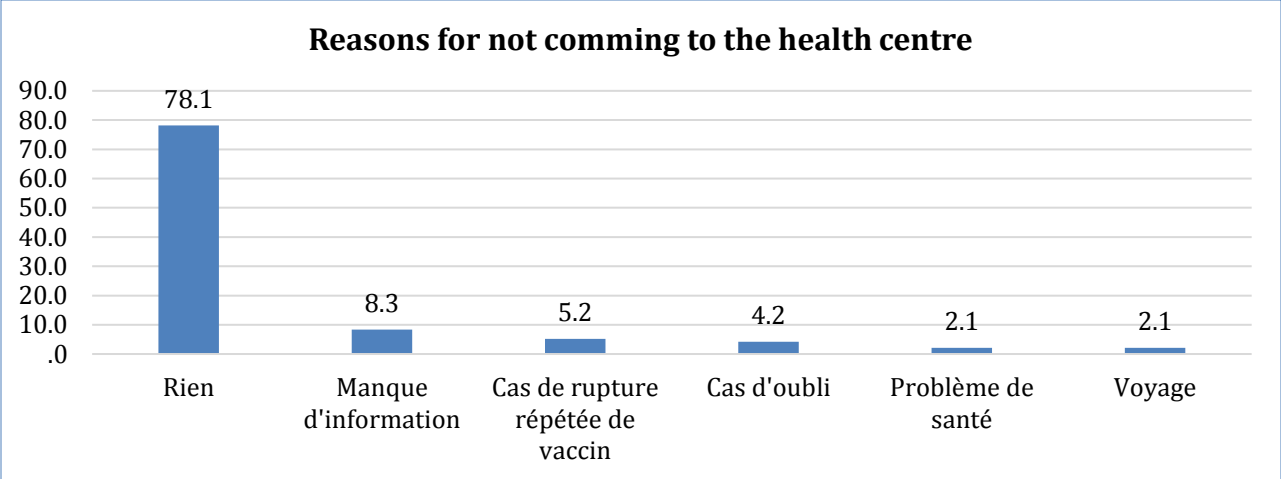
Figure 23 : Proportion of reasons that could prevent the mothers from coming to the health centre.

8.3.2.3. Concerning knowledge of the mothers about vitamin A and reasons for their children not receiving vitamin A supplementation

We note that 69% of the mothers affirm having heard of Vitamin A. Among these, only 4% of them know diseases that their child is receiving Vitamin A against. They think that blindness is the reason why their child is receiving Vitamin A.
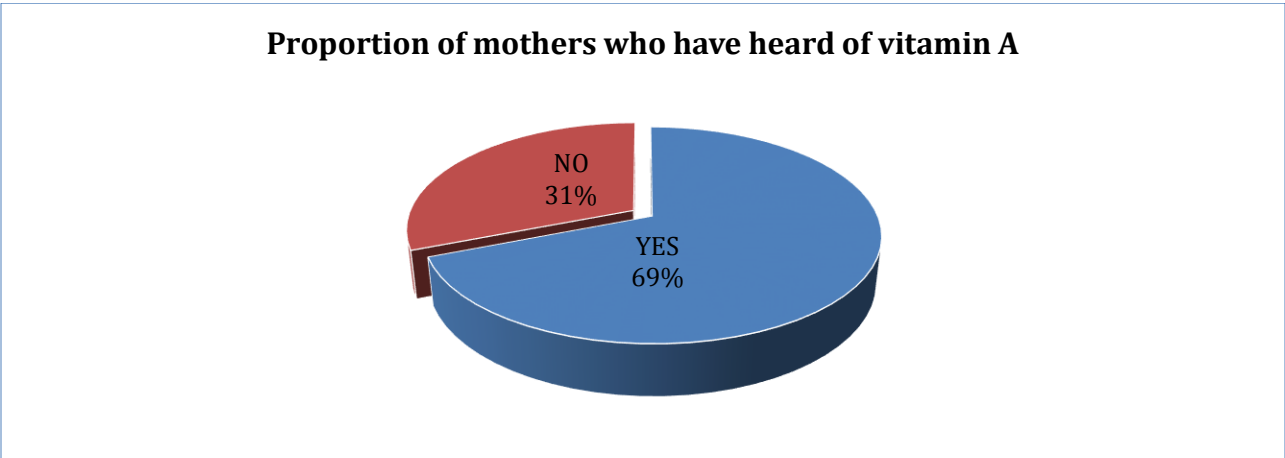
Figure 24 : Proportion of mothers who have heard of vitamin A

There are various reasons for children not receiving vitamin A supplementation. In addition, we note that 60% of the mothers did not know that their child was supposed to receive vitamin A supplementation in comparison to 27% and 13% respectively who did not received it due to running out of stock and the mother transferring to another location.

Reasons for non supplementation of vitamin A

- SHORTAGE OF VITAMIN A 27%
- DID NOT KNOW 60%
- CHANGED LOCATION 13%
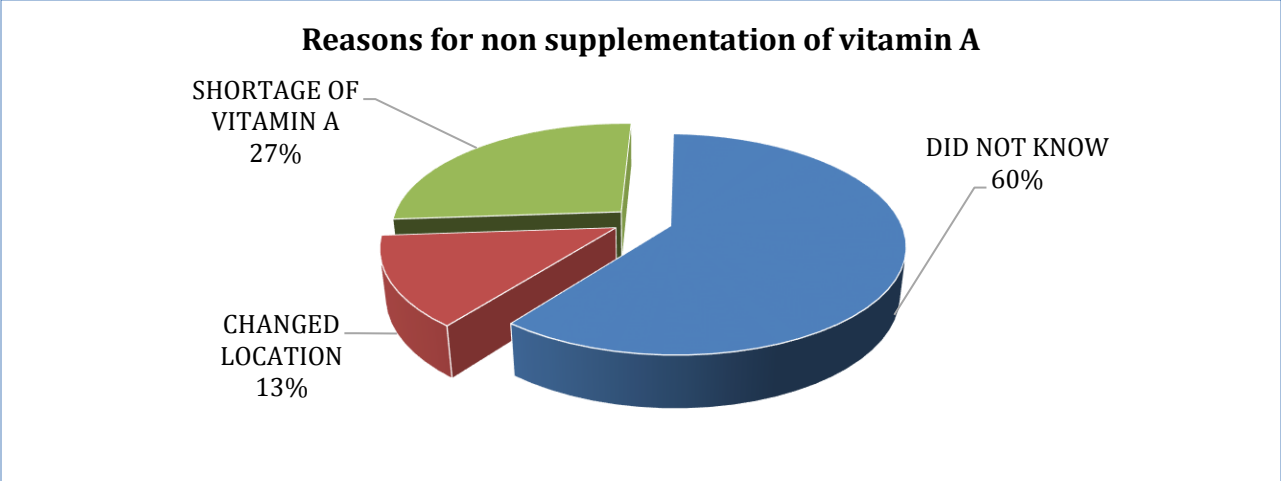
Figure 25 : Proportion of reasons of non-supplementation of vitamin A to the children

8.3.2.4. Suggestions made by the mothers

To end the interview, suggestions were asked from the women in the framework to make improvements on the project. In capacity, the majority of the mothers interviewed could not make suggestions because they were illiterate. However among them, those who wanted to expresses their opinions on the subject matter, 6.3% wished to see health centres equipped with Vitamin A supplements in order to avoid cases of running out of stock and 2.1 % also wished to receive more reminder messages in order to avoid cases of running out of stock.

Suggestions for the improvement of the project

- RAS 91.7
- Eviter ruptures 6.3
- Plus de SMS de rappel 2.1
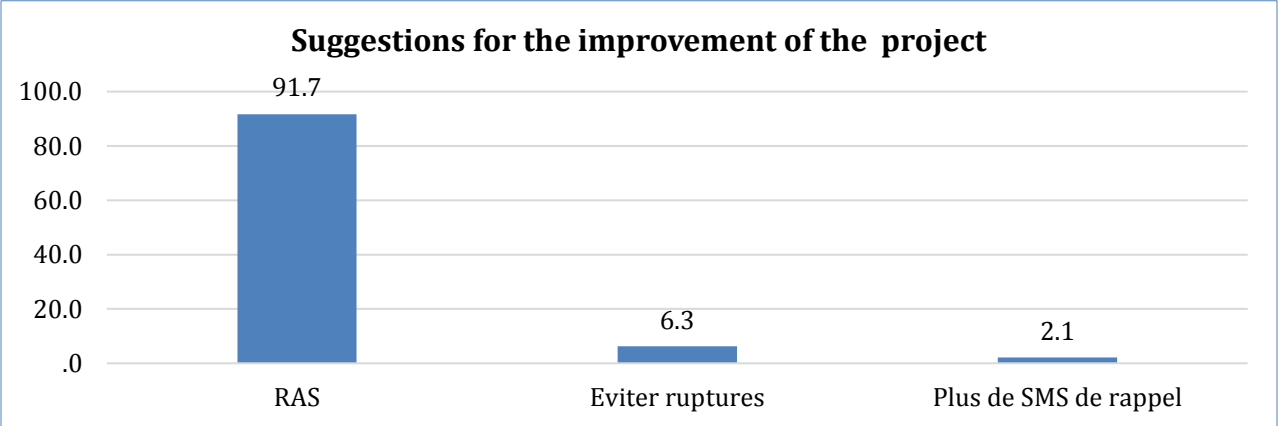
Figure 26 : Proportion of suggestions made by the mothers for the improvement of the project

In conclusion, the women feel valued and complain "of their sisters who are not registered in the project". For them, receiving messages coming from the Ministry of Health is a sign of consideration and an interest shown in them.

These responses were collected at the moment when the cohort was still beginning to mature, with the majority of the cohort having completed only three pentavalent doses, and

HKI was planning to carry out qualitative monitoring when the cohort will have fully matured for all the appointments.

9. DISCUSSIONS
9.1. Effect of the intervention

Sending of messages to the mothers for vaccination appointments of children has a significant effect in the use of vaccination services. In fact, the dropout rate of the children of these mothers in the Reminder group (30.0%) is much less in comparison to those from the Control group (50.2%). The results clearly shows that there is a significant statistical difference between the Reminder group and the Control group. The degree of significance is very weak and lower than the margin of error of 5% for all the vaccines. Consequently we can affirm that the introduction of mobile technology in the management of EPI routine activities integrating vitamin A has had a favourable effect in the health district of Korhogo. In particular, the relatively high rate of attendance of the appointments at 6 months for the vitamin A supplementation shows that even for the relatively new intervention case, the rate of use could be higher. The routine vitamin A supplementation is a new concept and was formalised in 2012 in Ivory Coast with the revision of the mother child health diary. However, the implementation is still not good due to the absence of inputs and of clear operational directives, as well as information beneficial to the clients of the health structures. For the example of the district of Korhogo, in the year 2013 only 2% of the eligible population received the routine vitamin A, and probably the majority did so in the framework of treatment of a specific illness rather than as a prevention measure. By achieving a higher rate as 60%, (reminder 64.7% ; Control 40.7%), the research project shows how a simple availability of vitamin A capsules assured by the project in the health structures for routine can have a big impact on the rate of supplementation at the first contact[9] (6 months).

In fact, the telephone reminders and absence of any other type of formalised sensitization, all have had a significant impact on the use of routine services in the framework of perpetuation of the continuum of survival care of the child integrating the EPI vaccines and other key activities like vitamin A supplementation, monitoring of growth and family planning.
It is also interesting to remark potential effect "contamination" that could justify how, even in the absence of reminders, 40.7% of the children from the Control group did benefit from the routine vitamin A supplementation.

Concerning the dropout rate, a notable improvement can be noted at the end of the evaluation. The specific rate of withdrawal is 18.6% with 14.3% in the Reminder group and 23.4% in the control group. However, for the general dropout rate for children "of age" (Meaning those age close to or 9 months old) at the end of the evaluation was 39.4% making 30.0% in the reminder group and 50.2% in the control group.

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[9] And, in perspective, potentially of the 2nd contact at 12 months. This option will be tested from February 2015 in another health region (Comoe-South).

9.2.   Lessons learnt

This operational research initiative which had an objective to evaluate the impact of the appointment reminders through a mobile telephone network on the demand and use of vaccination services including vitamin A supplementation had a positive effect. Phase II can be considered as a success inasmuch as the results attest that sending of simple reminder messages to the mothers to inform them of vaccination appointments of the children for the five main vaccination appointments have a real effect on the rate of attendance.

At the end of the implementation of activity, the following lessons learnt could be identified.

i.   It is therefore possible to use mobile technology in the management of EPI routine activities in integrating Vitamin A supplementation, for which there can be positive effects in terms of frequenting health centres, vaccination coverage and improvement in the coverage of routine Vitamin A supplementation at 6 months.

ii.   The use of mobile technology in appointment reminders and monitoring of vaccination activities is a well perceived means of intervention by the targeted people of the project :
   o   by the health agents, who remark a facilitation in collection and management of data, as well as the positive effect produced of the attendance levels ;
   o   By the mothers, who get organisational support in the form of vaccination calendar reminders in the framework of responsibilities of the very busy housewives;

iii.   The mothers receiving telephone reminders can be a vector of information for other mothers in their entourage, which could contribute to the increase in use of vaccination services even by the "non-beneficiaries".

iv.   The increase in training period and frequent supportive monitoring on the use of the hardware and software enable a better knowhow of using the technological tools while minimising operating errors.

v.   The adaptation of the appointment reminder messages with an option of a direct response voice message represents a key element for the success of these type of initiatives if we target zones where there is low level of literacy.

vi.   The mother-child online data base facilitates the research of the lost from sight in the framework of reducing the dropout rate; overally, the provision of smartphones and a digital health data collection system shows potential opportunities for integrating promotion services in demand in the national information system.

vii.   The automatic sending of messages to mothers and guardians enables them to expand their access to health information.

viii.   The SMS and/voice messages are perceived by the mothers as a sign of consideration and interest shown in them by the Ministry of Health.

10. RECOMMANDATIONS

At the end of Phase II of the project, the following recommendations were addressed so as to improve the implementation of the second phase of the project:

➢ **To the attention of health agents**
  o Elaborate and send vaccination instructions and Vitamin A administration to the district according to the need so as to avoid running out of stock.
  o Implement the project according to the directives.
  o Avoid asking mothers to come upon receiving the reminders.
  o Select the mother-child couples from the time of birth to the time of receiving BCG.

➢ **To the attention of the health district**
  o Assure supervision and continuous training of the health agents on the technical and technological aspects of the project.
  o Assure monitoring and supervision of the implementation of the project via ***e-voir*** site, during meetings and supervisions.
  o Assure a continuous supply of vaccines, syringes and vitamin A in the health centres.

➢ **To the attention of the Regional Health Management**
  o Support the districts in the implementation of research activities of the lost from sight of the vaccination cycle.
  o Reinforce the authority of political and administrative leaders, local authorities/governments including religious leaders in the vaccination promotion activities in order to reinforce social mobilization.
  o Supervise activities in the centres having the highest numbers of lost from sight.
  o Pursue the intervention and expand to other interventions and to other districts to better appreciate the impact before scaling up.

➢ **To the attention of DCPEV**
  o Appropriate the use of mobile technology to enhance the use of routine vaccination services and improve the vaccination data management.
  o Advocate for supply of individual dose of BCG according to rate of utilization.
  o Assure the supply of vaccines, BCG syringes and vitamin A in the district, eventually in collaboration with other health programs.
  o Assure the maintenance of the cold chain.

➢ **To the attention of HKI**
  o Include pre-test and post-test of the tools in the community during training in order to improve the competencies of the vaccinating agents on the knowhow of using the smartphones.
  o Carry out regular supportive supervisions.
  o Revise the preparation of the consent forms with an objective of including the consent of the spouses as well.
  o Extend the pilot initiative in order to benefit the expectant women, so as to evaluate the impact of the telephone reminders on the demand and use of prenatal

consultation services (PNC) and deliveries within institutions (Phase III, in preparation)

➤ **To the attention of the Ministry of Health and Fight against AIDS**
  o Evaluate more the interest and relevance of using mobile technology in monitoring and evaluating the campaigns and routine activities far beyond just vaccination.
  o Do an analysis on the operational costs in order to evaluate sustainability options of such an intervention, by identifying potential partners interested in supporting it in the future.

11. CONCLUSION

According to the National Health Development Plan, the challenges in terms of health consists of offering quality service, and also increase the demand and improve use and attendance to these services by the population. It is in this framework that this project fits in, of which Phase II which kicked off in June 2013 and it aims to evaluate that in what manner through new technologies can we increase the use of Routine EPI services that integrate Vitamin A supplementation.

The implementation of the project brought about an advanced level of technology and technique with a good bond between health service providers and the mothers. This project that was initiated in Korhogo district covered a total of 1596 mother-child couples and enable us to note a clear improvement in the rate of vaccination service usage by the mothers participating in the study in comparison to the control group. Randomisation was used in order to limit selection biasness and also to assure a homogenous distribution between the groups of persons.

The important results show that:

- Concerning vaccination coverage, we can note a positive association between being a member of the Reminder group and going to the appointment and/or being vaccinated/ receiving supplements for all types of appointments in comparison to the Control group. In particular, the differences between the two groups are summarised here bellow :
  o Penta 1 : 86.6% in the Reminder group and 76.1% in the Control group ;
  o Penta 2 : 81.0% in the Reminder group and 67.3% in the Control group ;
  o Penta 3 : 74.2% in the Reminder group and 58.3% in the Control group ;
  o VAS : 64.7% in the Reminder group and 40.7% in the Control group ;
  o YEL/MMR: 60.7% in the Reminder group and 37.8% in the Control group.

- Concerning the dropout rate, in the hypothesis that the tendencies remain the same (Even the rate of use at the end of the cohort) we had the following results :
  o Specific dropout rate (Penta 1 – Penta 3): 14.3% in the Reminder group and 23.4% in the Control group.

- o Overall dropout rate (Penta 1 – YEL/MMR) : 30.0% in the Reminder group and 50.2% in the Control group ;

- The multivariate analysis shows that the intervention has a positive statistical significance, an independently different demographic, economic and sociocultural aspects, except for the socio-demographic criteria such as certain types of occupations or level of study that does not cover a very small number of persons.

- In terms of messages, 85% of mothers prefer voice messages in comparison to 15% who prefer text (SMS) messages. This confirms that the low literacy level of women in the interior regions of the country is a major challenge and that it would be advisable not to use text (SMS) messages for health and nutrition sensitization or health services promotions.

- In terms of language preference of the messages, Senoufo language represents 47.1% in comparison to 25.9% for Dioula and 27.0% for French. This reflects the fact that messages must be adapted to local languages in order to clearly have a much bigger effect.

- Specifically concerning Vitamin A, it appears that rate of usage of this routine service during the implementation of the project was at 40.7% for the Control group. This is a bit high compared to the rate of available routine supplementation as per the administrative data or study that shows them to be constantly at the lows of 20%. This shows that beyond the always positive impact of the telephone reminders on the use of routine supplementation services of Vitamin A, a simple availability of vitamin A capsules in the health centres for routine was assured by this project after years of a chronic shortages. This could have a big impact on the rate of supplementation from the first contact and in perspective represent a hypothesis to be tested for the 2nd contact to 12 months. This is equally important in the continuum up skilling of treatment and child survival while integrating the EPI vaccines as well as other key activities like supplementation of vitamin A, growth monitoring and family planning.

Thus in view of the above, it could be affirmed that the vaccination appointment reminder project by telephony could reinforce the vaccination gaps as much by increasing the attendance of the mothers to vaccination sessions as well as a better monitoring of the children's' vaccination calendar by vaccination agents. We therefore believe that this type of project can represent an effective communication complementary intervention for improving the demand for the routine health services and as well enable the Ministry of Health and Fight against AIDS to improve routine vaccination.

Following the lessons learnt and the recommendations made, it would be convenient to pursue the intervention, to expand other preventive health interventions or curative priorities, and to other districts to better appreciate the impact in different sociocultural backgrounds before scaling up. For example, an ideal option of operational research would be to extend this pilot initiative in order to benefit expectant women, with an objective of

evaluating the impact of telephone reminders on the demand and utilisation of pre-natal consultation services (PCS) and on deliveries done in institutions.

Innovation and technological advancement that this project represents needs to be capitalised by Ministry of Health and Fight against AIDS and carried out to benefit a much bigger population. In addition, a much profound analysis of operational costs will have to be carried out in order to evaluate cost-efficiency ratio compared to other promotional interventions of demand and health data management, feasibility at the scale and the sustainability of such an intervention. An approach of increased interaction between public sector, technical partners and financiers and as well private sector partners who could be interested to support the initiative (IT companies, telecommunication multinationals etc.) could be envisaged to expand the coverage of this intervention in a possible measure and to study more on the possibilities of applying new technologies for health in the specific case of Ivory Coast. Finally, it would be desired that the authorities could appropriate actively monitoring platforms in order to be able to harness all useful data to improve initiatives of strategic and operational planning.