



Development of a Connected Prenatal Mobile Health Application to Empower Pregnant Women During Prenatal Care in Morocco: A Pilot Study

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Abstract

Prenatal care is a set of routine preventive measures that pregnant women receive during regular visits with their obstetrician or midwife which purpose is to decrease maternal and child morbidity and mortality.

Many barriers to prenatal care implementation were identified such as low health literacy, low attendance to scheduled visits due to geographical and socio-economic obstacles, discomfort and anxiety reported by many women during these check-ups. Therefore, eHealth solutions were developed for the antenatal care in the past years to enhance women's involvement in their pregnancy.

To join this global effort, our obstetrical team in les Orangers Maternity, collaborated since 2019 with the software management research team of ENSIAS «National school For Computer Science», in a pilot project to create a personal mobile health record application connected to a simplified electronic health record. The purpose of this project is to evaluate the acceptability, access and ease of use of ehealth in our community, as a mean to improve women's attendance and health literacy.

Our results were promising, and this project will represent a cornerstone for the introduction of ehealth and mhealth technology and tools into Moroccan healthcare system, starting with prenatal care.

Introduction

Prenatal care also called antenatal care is a set of routine preventive measures that pregnant women receive during regular visits with their obstetrician or midwife (1,2)

Its purpose is to decrease maternal and child morbidity and mortality. Many risk factors, pregnancy-related complications and chronic medical conditions are easily identified and treated during prenatal visits. Pregnant Women also receive information pamphlets and are offered childbirth and parenting classes to improve their general health and prepare for birth. (3,4)

The World Health Organization (WHO) recommends at least eight prenatal care visits during pregnancy, for low risk pregnancy with additional visits in high risk pregnancy (5)

But, despite the WHO efforts to spread her preventive programs globally, many pregnant women especially in low income countries, don't receive the appropriate antenatal care(5)

Many barriers to prenatal care implementation were identified such as low health literacy, low attendance to scheduled visits due to geographical and socio-economic obstacles, discomfort and anxiety reported by many women during these check-ups.(6,7,8)

Therefore, many eHealth solutions were developed for the antenatal care in the last few years to enhance women's involvement in their pregnancy.(9)

To join this global effort, our obstetrical team collaborated since 2019 with the software management research team of ENSIAS «National school For Computer Science», in a pilot project to create a personal mobile health record application connected to a simplified electronic health record. The purpose of this project is to evaluate the acceptability, access and ease of use of ehealth in our community, as a mean to improve women's attendance and health literacy.

Background:

Prenatal care in low income countries:

Prenatal care in low income countries, is still a weak spot in the health care services, that is in need of strengthening measures(2,4)

Mothers and neonates health is still a big concern in these countries. The World Health Organization stated that every day in 2020, almost 800 women died from preventable causes related to pregnancy and childbirth, 95% of all maternal deaths occurred in low and middle-income countries. All health authorities agree that early and adequate prenatal care is essential to improve maternal and child health. (5)

Over the past 30 years, Morocco has made significant progress in the area of women and children's health. Maternal mortality rate decreased by over 60% from 1990 to 2015 according to the national survey published in 2015, this result was reached thanks to the government's efforts to improve access to hospitals and prenatal care that was offered free of charge to all Moroccan population.

In spite of these national measures, prenatal care attendance rates are still low in Morocco.

It faces many challenges to its implementation such as: The need of the spouse consent to visit a healthcare provider, the lack of sufficient financial resources, lack of transportation, long waiting time, anxiety and fear of health facilities, misinformation about what to expect during visits, the incidental

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cost (absence from work, transportation cost, costly lab work ups and scans, not available at the hospital) and lack of family support which is the reason women lack motivation to seek healthcare.

Telehealth as a solution to bridge the gap between patients and healthcare providers:

To improve antenatal care and decrease the above mentioned obstacles. Health information technology has rapidly become an essential part of healthcare systems all over the world thanks to their many advantages such as enhancing access and management, improving information sharing, and also the quality, safety and efficiency of healthcare delivery. And consequently, improving health outcomes and reducing medical errors and adverse events(9,10,11)

The concept of Telehealth refers to any healthcare delivery enhanced by telecommunication and Mobile health is one of its various aspects.(12,13)

Mobile applications, have proven to be pertinent in all stages of women's health. Especially in pregnancy during which digital health technology can have the most significant impact(15)

Many studies showed the accuracy of mobile apps to bridge the gap between patients and providers particularly in the under-served areas, leading to the rapid development of this field. Many experts predict a radical change in the landscape of medicine with the advent of new mobile health tools(16,17)

Maternities in Morocco have been lagging behind in adopting eHealth technology, because of the lack of technological infrastructure in public settings, the need of professional training, and patient education.

Thereby, this work aims to describe and evaluate an mHealth application connected to an electronic health record, developed to introduce technological improvements in Maternity les Orangers to support the obstetricians and midwives in their daily tasks in prenatal consults and motivate expectant mothers to seek healthcare.

Prenatal mobile app and Electronic Health Records: overview

Many prenatal mobile personal health record apps are available for download on apple store or playstore, they offer pregnant women the possibility to have their personal data registered and at hand on their mobile phone. They may choose to share it or not with their healthcare provider.

Most of these prenatal apps offer: accurate information on what to expect at each stage of pregnancy, behaviour change tools for healthy lifestyle habits. The expectant woman fills in her medical history

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(any medical condition, surgery, allergies, previous immunizations, treatments taken), her obstetrical history (previous pregnancies, abortions, or complications), and

current pregnancy's evolution and monitoring (temperature, weight, height, blood pressure, blood glucose, heartbeat, respiratory frequency). The woman can schedule her prenatal care appointment. A Calendar with reminders is provided. Some apps offer a chat in which the patient can reach their health care providers.

They were introduced as tools for patient empowerment, and also to help reduce health care costs, and encourage a better continuity of care (14,15,16,17)

Electronic Health Records:

An electronic health record (EHR) is a digital version of a patient's paper chart. EHRs are used routinely in developed countries. They are real-time, patient-centred records that make information available instantly and securely to authorized users. It contains patient's medical history, diagnosis, medications, treatment plans, immunization dates, allergies, scans, and lab results. It also allows access to evidence-based tools that help providers make their diagnosis. Thus offering an improvement in the quality of care and patient safety (19)

Research methodology

Authorization and funding

This project was a PEER 'Partnerships for Enhanced Engagement in Research' (PEER) and USAID funded project. Before proceeding to this research, consents were sought from all participants and permission from the ethics committee of university Mohammed V in Rabat was obtained.

Creation and adjustment of our mobile health solution " Mypregnancy app»:

A new mHealth solution tailored to Moroccan women's needs:

In 2019, the research team of the National school of computer science ENSIAS, reached out to our obstetrical team in Les Orangers Maternity to help in the conception and evaluation of a mobile health personal records application (mPHRs) connected to an Electronic Health Records (EHRs), called «MyPregnancy@».

This project aims to solve some of the challenges faced in our maternity such as doctors shortage, scarcity of technological infrastructure, resistance of healthcare providers to change their traditional ways, and women's absence of health literacy and interest in prenatal care.(18,19)

Our mission as the medical partners in the project was to evaluate the degree of acceptability of this mobile health solution by our colleagues [doctors and midwives], and the expectant women attending prenatal consults in Maternity les Orangers, from March 2019 to septembre 2019.

We had 8 content evaluation meetings with the computer science research team during this period . 2 female engineers attended prenatal consults with us, to understand the need of the futur moters visiting our maternity, and adapt the functionalities of the mobile health personal records app to make it easy to use and accessible to a population with low health and technological literacy.

A walk through our prenatal personal record app: MyPregnancy@ app

Our prenatal mobile app can be downloaded from playstore for free, it is available in 3 languages, French, Arabic, and English. Only android users can use it. After downloading the app, each user needs to fill in a registration request that is sent to us with her identity, age, phone number and email. (Fi g1) So that the patient's account can be created on the electronic health record connected to the app. She can access her secured data through Login authentication.(19)

During her first appointment, the healthcare provider completes the medical and obstetrical history and performs the physical exam of the patient, all data are saved on the platform of the new electronic health record, that she can access with her mobile app. She can find detailed information on pregnancy stages including all physical changes she may experience going forward in her pregnancy, and she is given some behavioural change tools on how to keep healthy during this period. She may schedule her appointments with our obstetrical team, monitor her weight, and blood pressure, count her foetal movement and contractions when they occur, keep all her appointments for futur visits and work ups on the app's agenda, and remember them thanks to the reminder's option. All the data can be shared with the doctors, since this personal app is connected to the electronic health record that our obstetricians manage.

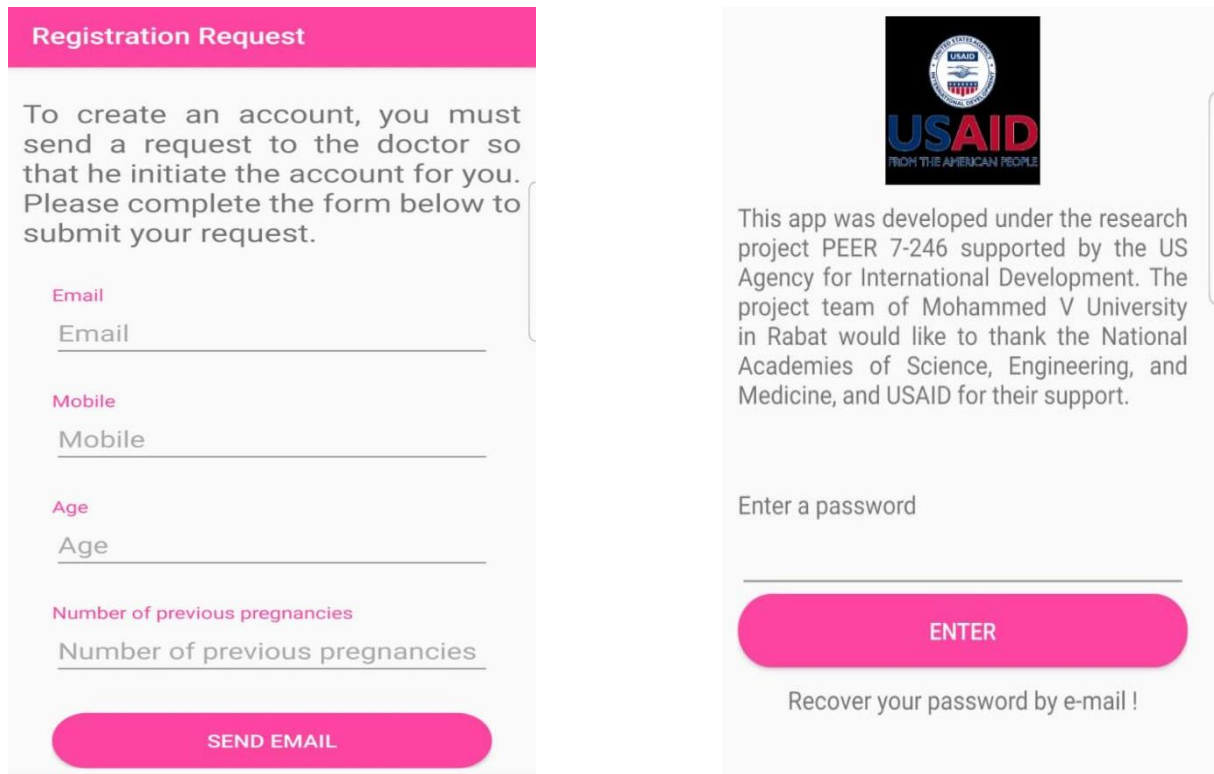
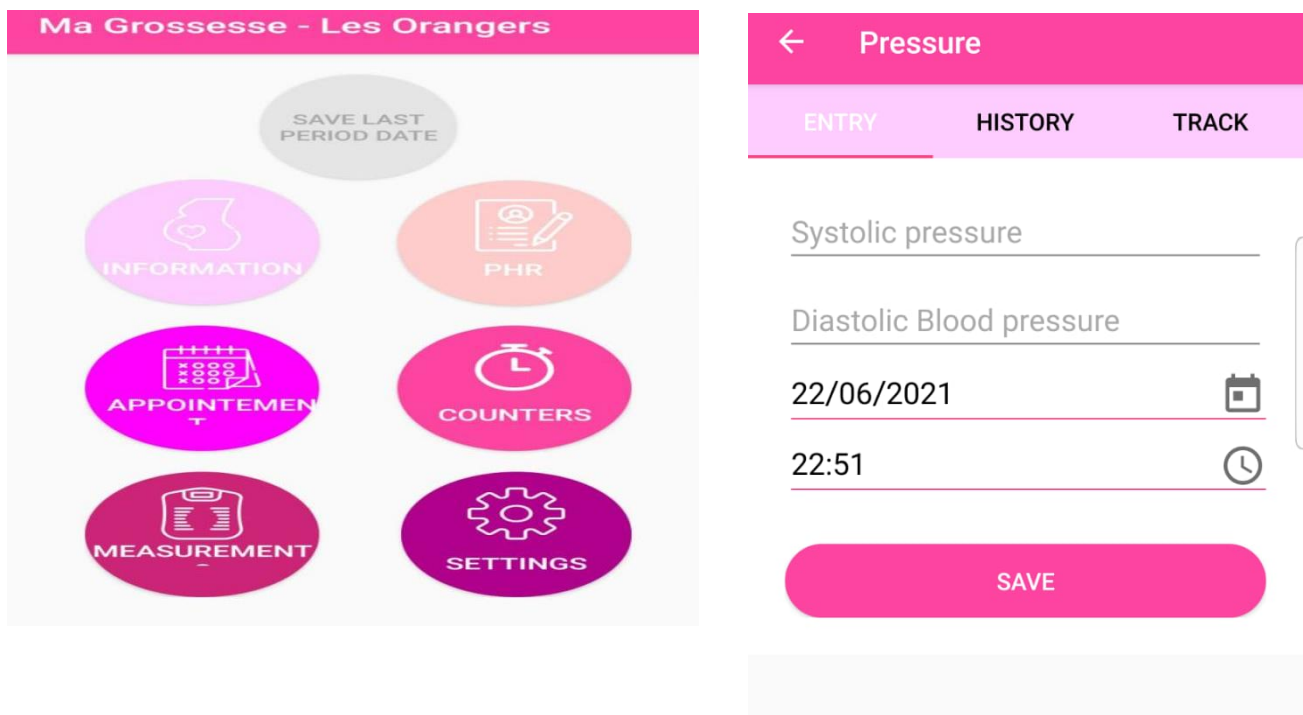


Figure1: Login



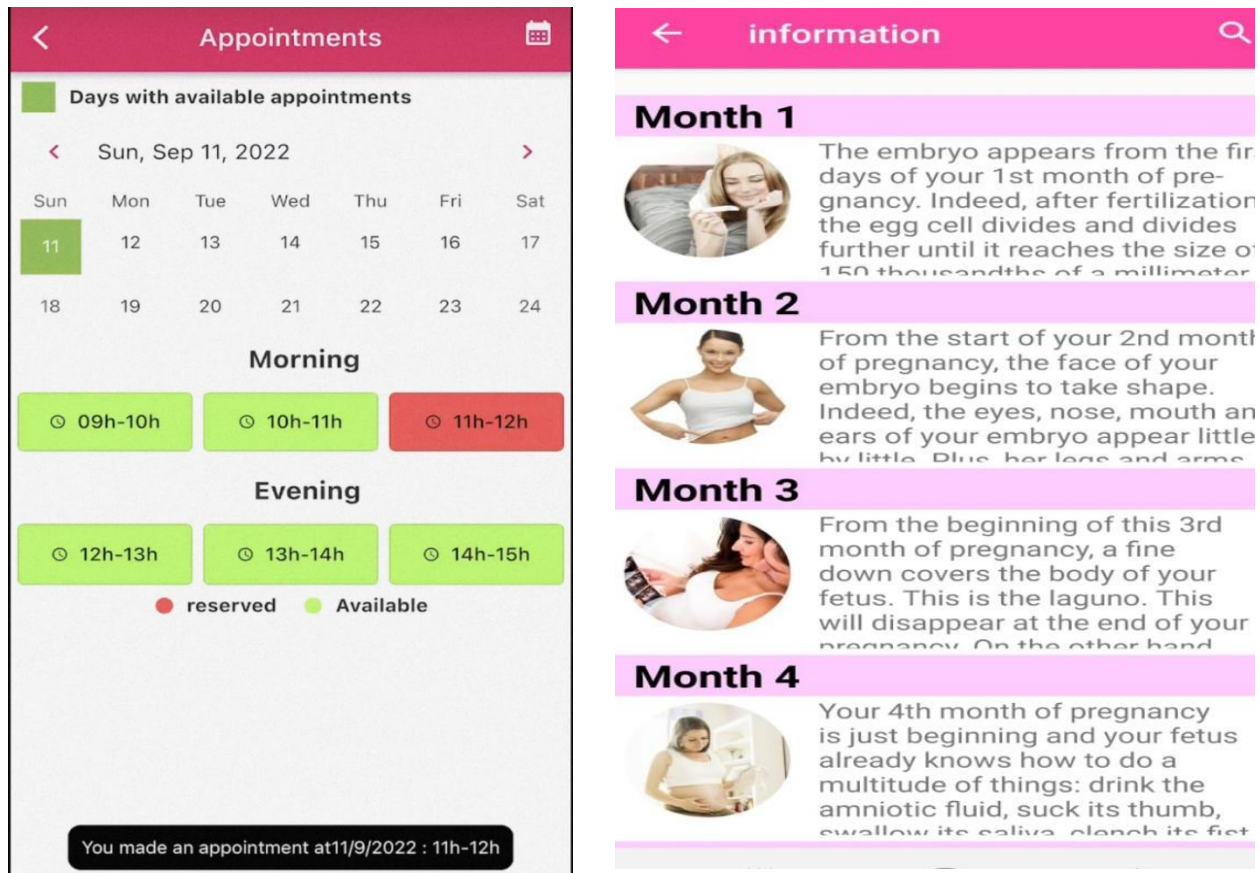


Figure 2: App's Features

Overview of the Electronic Health Record created for the purpose of this study

The EHR is hosted in a web app that provides a real-time database, and secures the authentication of the obstetricians.

After logging in, physicians can manage their patients health records by editing or deleting information. The list of doctors can be expanded at any time. And their availability specified.

They can also see in real time all their consult appointments for the day, and verify the data their patients upload in the mPRH such as weight, blood pressure and blood sugar, fetal movement and contractions. We are discussing the upload of Ultrasound scans, lab work and fetal heart monitoring into the EHR to have all relevant data in on electronic folder for the new version of the app.

Evaluation methods

We decided to conduct structured interviews with mixte questions qualitative and quantitative, to evaluate the participants information technology proficiency and the degree of acceptability and satisfaction of our prenatal solution.

During the study period, 14 providers accepted to participate in the project. For the patients group, we offered the opportunity to be part of the study to all expectant women who presented to our consultations from March to septembre 2019. We asked over 350 women, 65 of them agreed to take part in our study.

We organized several information sessions with the participants, in which MyPregnancy@ app's functionalities were explained, and participants could familiarize with the app. Providers has a separate training session for the EHR

Then we conducted separate structured interviews with each participant from both groups: Providers and patients (table 1 and 2).

Table 1: Questions for prenatal care providers
What is your level of proficiency with computers, internet, and apps?
How often do use your computer for study and work?
What do you think about using an electronic health record?
What do you think about the EHR prototype?
What do you think about the personal health mobile app being connected to the EHR?
Was it confortable for you to fill in the patient file on the EHR?
Is the clinical data encompassed in the EHR similar to the patients file?
Do you find all the elements that are necessary for your diagnosis?
Would u like to use EHR in your everyday practice?
What are the difficulties that you see in using an electronic record?
What steps need to be taken to Implement it in your practice?

Table 2: Questions for the pregnant women
Do you own a mobile phone with android software?
Do you have access to internet ?
How many time do you use your phone everyday?
Have you ever downloaded any health oriented app?
Do you find this personal health record app easy to use?
Would you use it throughout pregnancy?
What did you like about the app?
Would you recommend it?
Would you attend your all of your scheduled prenatal visits?
How is your level of anxiety ?
Does using the personal health mobile app help with your anxiety?
Do you have any to make your experience enjoyable?

Results

The data was collected and responses of the participants were thoroughly scrutinized and analysed using statistical methods such as percentages, and proportions.

In The Health Providers Group:

Participants age was found to be less than 35, they were 3 males for 11 females, they all had more than 3 years of experience in prenatal care.

They reported that they were all comfortable manipulating computers and mobile devices such as tablets or mobile. The frequency of use is more than 5 times a day. About using electronic health records in their everyday practice, 57% of the participants (8/14) were motivated to use it regularly. 78 % (11/14) found that the EHR created by our team was easy to use and the platform easy to access. The clinical data encompassed in the EHR was found similar to the patients file by 85% (12/14). 92% (13/14) didn't like the idea of the patient having access to their medical file, saying that it may be source of misinterpretation, and anxiety for the patient especially for high risk pregnancy. 57% (8/14) felt comfortable writing the patient's electronic chart, but found it time consuming. They all agreed that the EHR has all the component of a complete patient's file.

Nevertheless, they mentioned some difficulties to adopt this solution permanently such as: physicians shortage, lack of experience and computer literacy, lack of infrastructure such as a secure internet connection and enough computers for all. They also complained of the difficulty of data entry that requires more time than writing information in paper files, which consumes most of the time of the consult and thus shortens the time of interaction with the patients. Another point is that the patient file access is denied to other physicians other than the main caregiver. Some of them didn't find using computers in cluttered workspaces practical. And all of them feared a security breach and loss of data.

To implement this electronic health record system, more provisions are needed such as adequate equipment, up to date work stations, information technology support teams, appropriate network, and more training for the professionals.

Results in the pregnant women group

The epidemiological features of the participant were: age between 19 and 26, all married, and lived in the region of Rabat. They all attended prenatal care visits in les Orangers Maternity, owned an android mobile phone, and had a level of education above high school certificate. We had 45 primiparas and 20 multiparas. 85% were in their third trimester. 10% in the second trimester and 5% in the first trimester. They all had low risk pregnancies in the beginning of the study. And delivered their babies in our maternity. All consents were secured before starting.

All participants were regular mobile users and had internet access. They reported using their devices more than ten times a day for calls, messaging, and social media. Only 30% (20/65) downloaded a mobile health app before the current pregnancy (weight loss, menstrual cycle, and gestational age apps). 38% (25/65) found the app easy to use, and 46% (30/65) needed more manipulation to get used to it. 61% (40/65) accepted using it throughout their pregnancy.

They all liked the idea of being connected to their prenatal care provider through the app.

They felt empowered choosing their appointments and accessing their records anytime. They said that they would recommend it to their expectant friends.

All primiparas reported a high level of anxiety in their first trimester, and said that using the app, they felt supported, and their anxiety dropped.

All participants would like to have a chat to communicate with their healthcare providers, and a forum for all app users for support.

All expectant women who participated in the study attended their prenatal care appointments and followed their prenatal providers treatment plans. They delivered safely in the maternity. Their satisfaction scores were high 92%. 23% (15/65) developed gestational diabetes, 4% (3/65) of them developed pre-eclampsia in the third trimester and 2 had foetal demise.

Out of our 65 participants, 45 had a normal vaginal delivery, and 20 had a c-section for obstetrical indications.

Discussion

Prenatal care is one of the best preventive measures to decrease mothers and neonates morbidity and mortality. Still, expectant women in developing countries don't attend their scheduled visits, resulting in complications during pregnancy (1,2)

Electronic health was introduced as a solution to connect the patients to their physicians using Communication technology, reducing the distance and improving access to healthcare, to reach patients in remote areas.(11,12,13)

MyPregnancy@ app, is an easy to use personal mobile health record application connected to an electronic health record used by the obstetricians and midwives in les oranges maternity, to reinforce women's attendance to prenatal care consults, and raise their self awareness about the progression of their pregnancy, while offering them support and a reliable source of information in their native language. The feedback we obtained from this study was promising, since the participants in this study all registered the best rate of attendance and acceptance of their provider's diagnosis and treatment plan at every step, a decrease in anxiety scores and high levels of satisfaction.

The electronic health record used in the study was welcomed with enthusiasm at first by the medical participants, they were convinced that the use of electronic health resources has the potential to improve prenatal care in our country. But we registered a lot of resistance when discussing its implementation in our Maternity. The obstetricians were set in their traditional ways of practice. They believed that eHealth solutions need time and efforts to be put into practice in the Moroccan context, even though the benefits are greater than the effort it requires.

The generalisation of prenatal mobile health solutions and electronic health record will face many challenges in Morocco, that would need more of the ministry of health's attention to be implemented. However, we anticipate that Morocco will raise to the challenge, and will join the other countries in the adoption of electronic health tools for the betterment of our healthcare system.

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Conclusion

Prenatal care is a fundamental component in obstetrics. It allows the detection of high risk pregnancies that need to be followed closely, the education and preparation of expectant women for their pregnancy and childbirth. It is the best time to teach women about health literacy, and selfcare.

In Morocco, prenatal care registers a very low attendance, for reasons such as women living in remote areas, poor health literacy, social and economical reasons. Which explains our high rate of maternal and fetal morbidity and mortality.

In an effort to improve this situation, we offered a mobile health solution to shorten the distance between women and their healthcare providers, to empower them, support them and teach them health literacy and selfcare.

There are many challenges on the way of implementing this solution. But we believe that electronic health with the wide range of tools it offers , will change the practice of medicine in the near future. Several Moroccan teams are working on similar projects in other specialities. We believe that we will overcome all the barriers mentioned in this work in the upcoming years.

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