SAKHI PRE CHILDBIRTH MONITORING APPLICATION

INTERACTION DESIGN - PROJECT II

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Approval Sheet:

The Interaction Design Project iii titled “Sakhi Pre Childbirth Monitoring Application” by Nazreen O Nizam (Roll Number 156330011), is approved, in partial fulfilment of the ‘Master in Design’ Degree in Interaction Design at the Industrial Design Centre, Indian Institute of Technology Bombay.

Guide: 

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I declare that this written document represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea, data, fact or source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Abstract

Access to healthcare facility is a fundamental problem with the vulnerable communities living in urban India [3]. The rise in urban population below poverty line has caused alarming concerns in the last decade. One of the main concerns being access to healthcare facility in India. The access to healthcare is confined to the local knowledge of health center or being a resident in a area. With high rise in urban migratory population, existing ecosystem is not able to cater to the needs of the patients [8].
Among the vulnerable population in the country maternal well being suffer severe health risks[7]. India is one of the countries which show significantly high rates of maternal and newborn deaths. The project aims to investigate the possibilities of a design intervention to improve maternal well being among the vulnerable communities in the country.

There are three different stages in maternal well being: Pre Birth Child Care, Institutional Delivery Care and Post Birth Child Care. Studies have proved that proved that improvement in pre birth care can improve the other stages of maternal wellbeing [8].
The project aims to understand the healthcare ecosystem of ANC in India. And how mobile health (a term used for the practice of medicine and public health supported by mobile devices.) can contribute to the pre birth care services in maternal healthcare.

The project focuses to demonstrate that the mobile health intervention (in the form of decision support, reminders, educational messages and report) will have positive impact on delivery and ANC practices in health facilities possibly through the monitoring of health workers.

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1. Introduction

India has the world's second largest urban population after China. By 2011, India's urban population had reached 377 million (the second largest national urban population in the world) [1]. India also has the world's largest urban population with below poverty line incomes and the world's largest population living in slums. By the 2011 census, cities in Uttar Pradesh, Rajasthan, Jharkhand, Madhya Pradesh and Maharashtra accommodated more than one-quarter of their populations in slums. In 2004–2005, 80.8 million urban dwellers (25.6 per cent) were below the poverty line and the largest concentrations of urban poor populations were in Maharashtra (14.6 million), Uttar Pradesh (11.7 million) and Madhya Pradesh (7.4 million) Tamil Nadu, Karnataka and Andhra Pradesh (each with between 6–6.9 million) [2]. The living conditions of the urban population below poverty line has been a growing concern to the government of India.

There are many factors for the rise of the urban migratory population in the last decade which include employment opportunity, severe drought in many states of India and drop in agricultural production[3]. The higher percentage in the urban migratory population are below poverty line. This urban population in India live in the unplanned urban sprawls in the metropolitan cities. Due to the rise in urban population and unplanned urban sprawl the cities are suffering from issues ranging from the basic needs like food and shelter, sanitation to healthcare [6-7]. In healthcare domain, itself the problems can be sectorize in communicable disease, mother and child care, family welfare and elderly care.

Among the above discussed sectors, India is one of the countries which show significantly high rates of maternal and newborn deaths. Each year globally, about 800 women die every day of preventable causes related to pregnancy and childbirth out of which 162 of these women are from India [3]. The MMR defined as the number of maternal deaths per 1,00,000 live births reduced from 212 in 2007 to 167 in 2013[2].

Mothers in the lowest economic bracket have about two and a half times higher mortality rate as compared to the national average [3]. Many women in this economic class, come from vulnerable communities in India which include construction workers, migrant population, daily wage workers etc. They suffer from severe health risks and complicated pregnancies. A major challenge among vulnerable communities is that they have little or no knowledge of pregnancy or childbirth. The lack of knowledge of healthcare practices and healthcare privileges is a major scenario . In addition to this, one of the major factors accelerating Maternal Mortality Rate (MMR), is the failure of a pregnant woman from accessing health facility promptly. There is a major setback in number of women registering for authorized medical care in India. These setbacks could be broadly divided into:

1. Recognizing the need for health care during pregnancy;
2. Access to a health care facility;
3. The quality and service care that a mother receives at a healthcare facility;

The research for the project starts with approaching the knowledge of the existing healthcare system that in established in India. Then the study focuses on maternal healthcare ecosystem within the urban locality. The second part of the study is to understand the existing research and pilot implementation of projects to promote maternal wellbeing within India. Also, how the implementations are able to cater to the needs of the patients.

Project idea:

Opportunities exist for mobile health support applications (mHealth) to aid in pregnancy health management.

2. Background Study

Appendix 1:
A detailed list and analysis on the content of is given .

2.1. Structure of Antenatal Care in India:

The Union Ministry of Health and Family Welfare (UMHFW) is the central authority responsible for the implementation of various program and schemes in areas of family welfare, prevention, and control of major diseases. In the case of health, term infrastructure takes on a wider role than physical infrastructure. Healthcare ecosystem in rural areas has been developed as a three-tier structure based on predetermined population norms.

The sub-centre is the most peripheral institution and the first contact point between the primary health care system and the community. Each sub-centre is manned by one Auxiliary Nurse Midwife (ANM) and one male Multi-purpose Worker [MPW(M)].

A Lady Health Worker (LHW) is in charge of six sub-centres each of which are provided with basic drugs for minor ailments and are expected to provide services in relation to maternal and child health, family welfare, nutrition, immunization, diarrhea control, and control of communicable diseases. The sub-centers are needed for taking care of basic health needs of men, women and children. Sub-centers are also expected to use various mediums of interpersonal communication in order to bring about behavioral change in reproductive and hygiene practices.

Primary Health Centres (PHCs) comprise the second tier in rural healthcare structure envisaged to provide integrated curative and preventive healthcare to the population. A medical officer is in charge of the PHC supported by fourteen paramedical and other staff. It acts as a referral unit for six sub-centers.

Community Health Centers (CHCs) forming the uppermost tier are established and maintained by the State Government under the Minimum Needs Program. Four medical specialists Surgeon, Physician, Gynecologist and Pediatrician supported by twenty-one paramedical and other staff are supposed to staff each CHC. Norms require a typical CHC to have thirty in-door beds with OT, X-ray, Labour Room, and Laboratory facilities. A CHC is a referral center for four PHCs within its jurisdiction, providing facilities for obstetric care and specialist expertise[6].

The aims of PHCs in ANC:

- ➔To educate mothers about pregnancy and labour by different mediums.
- ➔To prevent, detect or treat any early complication which would lead to complicated deliveries or stillbirths.
- ➔To ensure adherence to medical services provided by the PHCs during ANC period.
- ➔To identify and report high risk pregnancies to CHCs.

2.2. Maternal health routine in PHC:

(stated by UMHFW)

1. Minimum four ANC check-ups which include registration .
2. Avail services during ANC visit which include blood pressure and weight checkup.
3. Delivery services including normal, assisted and cesarean section.
4. Postnatal care, which includes stay after delivery, child monitoring for affect to communicable diseases.
5. Immunization and vaccination of infant.
6. Breastfeeding monitoring of the infant.
7. Management of malnutrition.
8. Emergency care and competence.

These are performed by an Auxiliary Midwife or an ASHA (Accredited Social Health Activist) worker. They serve as an interface between the community and public health center. Even though a well-structured public health care system exists; the infrastructure as well as the staff that are required to provide the health care services is inadequate from many different perspectives. Most mothers are not able to obtain treatment for basic ailments either due to reasons like lack of awareness about health facility services in their vicinity or due to other specific reasons to access the same. Even for basic health care services in reproductive and child health, it is found that significant proportions continue to remain untreated. Immunization, ante-natal care, deliveries in the presence of professionally trained personnel, and so on all show large unmet needs.

The empowerment of the primary point of contact, in this case being the Midwife or health worker is an essential focus to improve ANC in India. India lacks sufficient numbers of skilled healthcare workers, physicians, nurses, and specialists to serve their populations [6]. Access to healthcare remains highly dependent on income, status, and geography. Along with striking gaps between availability of health workers in large urban centers and that of remote rural areas [6].Healthcare processes tend to be complex and driven by the patients demand. Since the demand is high and the available personnel to meet the needs are low new approaches are to be introduced in the healthcare field in developing countries.

2.3. mHealth adoption in India

The world is undergoing an extraordinary progress in the field of communication. Several developing countries such as India have witnessed an explosive growth rate mobile phone user. Mobile technologies have

already changed and will continue to make an impact on the lives of millions [13].

mHealth (also written as m-health) is an abbreviation for mobile health, a term used for the practice of medicine and public health supported by mobile devices. mHealth broadly encompasses the use of mobile telecommunication and multimedia technologies as they are integrated within mobile and wireless health care delivery systems [9]. The field broadly defines the use of mobile telecommunication and multimedia technologies in health care delivery. The term mHealth was coined by Robert Istepanian as use of "emerging mobile communications and network technologies for healthcare"[11].

The scope of mHealth applications being introduced in mobile phone can initiate various compatibilities:

1. mHealth applications that use mobile devices for collecting community and clinical health data.
2. Delivery of health care information to different stakeholders through a mobile device.
3. Portability of the device to various locations.
4. Access to required health related data from various sources.

In the coming years, mHealth will remodel the way healthcare is delivered. The use of smartphones as medical devices capable of diagnostics and remote monitoring, in terms of reachability to different audiences will open wider arenas for research. In this process, mHealth technology will cut down the costs associated with health care provision while maintaining and improving quality of care and reaching patients for whom access to healthcare has until now been limited [7].

Focus users:
The critical lack of trained medical professionals in low-income urban setting in India has resulted in the establishment of community health programs that aim to provide vulnerable populations with access to essential health services.

3. Research in mHealth

With current increase in phone penetration [9] in the developing countries across the globe has opened up various platforms for research. This platform includes mHealth[11], which are concentratedly pilot efforts[15] targeting a set of defined goals. In many instances, these pilot projects have demonstrated how mHealth has addresses a specific problem (For example: treating children with tuberculosis) [13] targeting a specific set of users/patients and within a set of defined goals. As a part of the project to systematically understand the research in mHealth two projects in the domain were chosen and a specific format to analyses the two projects were chosen.

Analysis process:
mhealth pilot projects face a number of challenges in implementation in developing nations[21]. Hence the effectiveness of these pilot implementations cannot be measured with effectiveness with the population. To analyses the mHealth applications, a framework was designed in“mHealth innovations as health system strengthening tools”[19]. The paper can be briefly described as a framework which lays out 12

common mHealth applications used as health systems strengthening innovations across the health continuum[19]. This framework provides an opportunity to analyse various mHealth innovation projects.

3.1. Project 1: E-swasthya:

Piramal E-swasthya, which gives local literate women living in villages without any prior training in medical related knowledge collecting simple diagnostic data, advising preventive medicine and first-aid to patients. Armed with a medical kit, marketing material, and a mobile phone, they set up a tele-clinic in the patient’s homes. During patient visits they relate to a call center and enter the information into a simple diagnosis system, generating an automated response with a recommended prescription and treatment (validated by doctors at the call center). If the illness appears serious, the patient can be transferred to another center. For a low cost, the system gives thousands more Indians access to quality healthcare [11].

3.2. Table 1: Analysis of Primal E-swasthya:

Registries and vital events tracking	Voice communication service is used for vital tracking service
Data collection and reporting	The interesting point about e-swasthya application is that there is a live data reporting system which helps diagnosis of the patient.
Electronic health records	The reported data through the call centre is stored as e-health record and can be accessed by call centre employee when the patient calls back for further diagnosis.
Electronic decision support	The rule-based instructions help ensure quality of care in these task-shifting scenarios by prompting frontline health workers to follow defined guidelines.
Provider-to-provider communication	Voice communication is the simplest function to be fulfilled and e-swasthya takes advantage of this function.
Provider worker planning and schedule	This service is not included in e-swasthya program.
Human resource management	With the number of accessible physicians being very less in India, human resource management plays a vital role in e-swasthya.
Supply chain management	Not a feature of e-swasthya
Financial Transactions and Incentives	Not a feature of e-swasthya

3.3. Project 2: mMitra

mMitra is a free mobile voice call service that provides culturally appropriate comprehensive information on preventive care and simple interventions to reduce maternal and infant mortality and morbidity in urban India. The voice calls are in the local dialect, specific to the women's gestational age or the age of the infant and are sent weekly/twice a week free of cost directly to pregnant women and mothers with infants. The service provided by MAMA delivers vital health information via mobile phones to new and expectant mothers living in poverty throughout developing countries. Hosted by the United Nations Foundation, MAMA provides age and stage-based messages aligned with global best practices, empowering women to make the best decisions for themselves & their families.

3.4. Table 2: Analysis of mMitra

Client education and behaviour communication	IVR and pre- recorded support system. The information to each patient is pre-recorded and addressed as voice messages.
Sensors and point-of-care diagnostics	No sensors or monitoring devices are used for diagnostics
Registries and vital events tracking	No vital events tracking.
Data collection and reporting	No data collection or reporting.
Electronic health records	The only record maintained is the LMP and age of patient. The messages are sorted within these two parameters.
Electronic decision support	Defined probes to influence the patient behavior.
Provider-to-provider communication	Voice calling feature which is simplest to be used by emergent users.
Provider worker planning and schedule	This service is not included in m-mitra program.
Human resource management	There is no direct contact with any medical help through the application.
Supply chain management	Not a feature of m-mita
Financial Transactions and Incentives	Not a feature of m-mitra

To summarize this section was to understand the previous work in local context and gather meaningful insights from the above case studies.

4. Primary Study

4.1. Goal of study

The goal of the study is to deal with localised users within a framework. With help of secondary research we have established the structure of ANC system in India. But field studies are required about how much of this healthcare structure reaches out in a localized context.

To deal with scenario, an NGO which works affirmatively with maternal and child care was approached. All mothers registered with the NGO were chosen as users. There are two sets of users defined: mothers and LHW/ANM. The method to study both the set were also chosen differently.

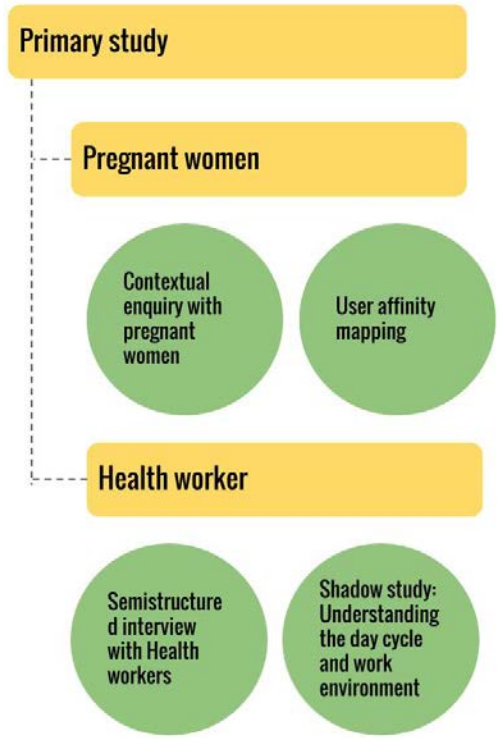


Figure 2: Structure of primary study.

4.2. User study - Mothers

Since this the first set of primary study with user's contextual enquiry model was followed. The women were registered with the NGO. The total number of women interviewed were 34. The group was chosen to be a heterogeneous group with mothers of different age group, number of kids, migrant mothers and so on. Women were interviews for a period of 21 days.All the individual interviews were conducted at the respondents' respective health facilities after taking written informed consent from them in Marathi or Hindi as per the preference of each respondent. Each interview lasted for about 45 minutes –1.5 hour.

All the interviews were audio -recorded after obtaining consent for doing so from the respondents. The interviews were conducted with the help of a semistructured interview schedule that lasted for 21 days during June–July 2016.

The conditions of choosing participants for contextual interviews:

- Smartphone user or owner (shared phone with husband is included).
- First time pregnant women.
- Women with different medical conditions like anemia, hypothyroid, underweight etc.
- Women with past deliveries conditions C-section, miscarriages, still births.
- Women with home deliveries and hospital deliveries in the past.
- Women staying alone (with husband) and women staying in joint family or with mother in laws.

After the contextual enquiry interview process, user problem affinity was done. The user statements were classified in an affinity diagram to understand the scope of enquiry.

Key Insights:

- Delivering elsewhere is common: Mother's place is the preferred place for the delivery (especially the first) as it provides the support system required. Even otherwise, people often go somewhere else for delivery - next door, same city, different city, village
- Explain procedures in government hospitals, manage expectations about time required, provide schedules of local hospitals
- Integrate with procedures to minimise delays where possible
- Use the app to improve image of government hospitals "friendly neighborhood government hospital"- give a face to a place - interviews with the doctors working in government hospitals, explain problems they might be facing and how patients can help, support their outreach and support

We conducted qualitative data collection methods, in which pregnant participants were asked to discuss how they found information related to pregnancy, share their perspective on what it takes to have a healthy pregnancy, and discuss the important people, care providers, organizations, and technological tools that they turned to for support during their pregnancy.

4.3. Detection of pregnancy:

The detection of pregnancy itself is handled by different users differently. The detection itself is not a clear process among many mothers. Pregnancy is assumed in most cases on missing the menstrual cycle. Different patients have given different statements on detection of pregnancy:

“When i started vomiting continuously for three days my mother in law said that I am pregnant.”

“Missed my periods for two months and I told my husband I might be pregnant. He told me we will go to the Aai (a local women who used to help with home births). She pressed on my stomach and said I am pregnant.”

“I missed my periods and took a pregnancy kit test at home. Husband bought me the kit and we checked in

mobile how to do it. Said two lines showed we are going to have a baby. I was very happy after seeing two lines.”

“ Vomiting starts early in the morning, the same had happened for my first child also. I did not go doctor immediately. When vomiting did not stop for a few days I went to see the doctor as I was tired all day.”

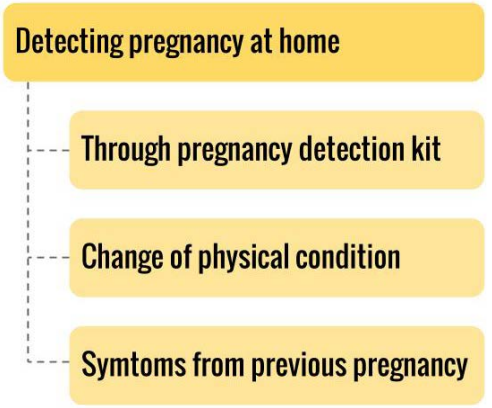


Figure 3: At a glance of how pregnancy is detected.

4.4. Hurdles to meet a Doctor:

The users specify different problems regarding the hindrance or reluctance to meet a doctor. Out of the 34 interviewed users specified different hurdles to meet a doctor.

“The Ayi said I look very weak and need to see a doctor immediately”.
U-MW2

“I don’t know a lady doctor nearby! I am shy to go to a male doctor.”
U-MW13

“How can a male doctor help with pregnancy?”
U-MW3

“Doctor gave me tablets to have but my mother=in-law said they are going to be bad for the baby.”
U-MW15

“The nearest clinic only has doctor 2 days a week. My husband works everyday. He does not have time to take me to the clinic the day the doctor is there.”

“My first pregnancy I did not go to doctor. But I had lots of pain in my 9th hence I was advised by everyone to go the doctor during my second pregnancy.”
U-MW4.

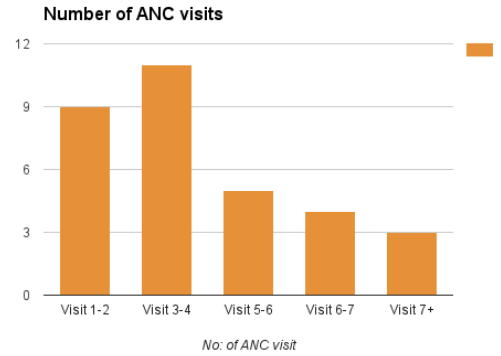


Figure 4: The graph showing number of ANC visits.

The users interviewed were currently registered with the NGO. Hence the questions were mainly asked on how onboarding was performed and on previous pregnancy without health program.

“ Lalitha didi (NGO worker) approached me when sending my older child to school. She told me she worked for health of pregnant women and told me there was a meeting in the afternoon nearby and to come and attend. During the meeting they spoke about so many problems which I had faced during my first pregnancy. I registered then and there and told my husband about it later.”

“During my first clinic visit the doctor told me that I have to come for 6 more ANC visits and gave me a card. But I shifted from my husbands house to my house after 6 months of pregnancy. Then the doctor there said that you have completed all checkups and come only when pain starts! I gave delivery at home as I was bleeding and could not reach hospital. Later the didi told me that position of baby caused bleeding and should have gone to doctor earlier.”

A typical pregnant patient has multiple healthcare touchpoints - GP, gynac, anganwadi, NGOs, private hospital, government hospital etc. t is hard to transfer medical records from one hospital / doctor to another. People feel shy in showing one doctor’s records to the other because of perceived or real competition and guilt. People may not tell the treating doctors all they know - may have parallel conditions like BP, TB, epilepsy or too many prior pregnancies. Often, doctors don’t explain patients what their condition is and what a specific medicine does. People may not tell the treating doctors all they know - may have parallel conditions like BP, TB, epilepsy or too many prior pregnancies. Often, doctors don’t explain patients what their condition is and what a specific medicine does.

4.5. Onboarding for health program:

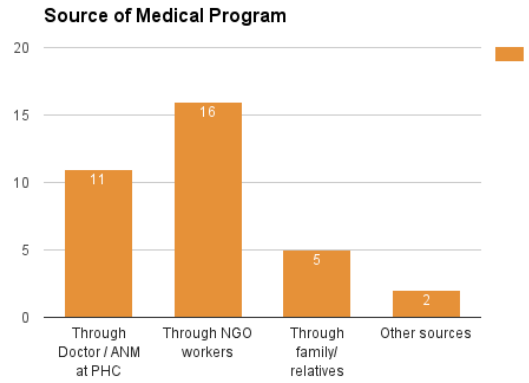


Figure 4: Where women hear / source of Medical health program.

4.6. Access to health information:

There is always an anxiety or curiosity to know the change that is happening to your child and body during pregnancy. There are several sources from which information of pregnancy is received by mothers. There are many misconceptions about pregnancy and transformation of information among mothers.

“How much should I work? How much weight should I lift? Can bending break the baby’s back? Can I stand on stools? Brooming? Utensils? Is household work the same as exercise? I am a sweeper in the school, till when can I continue working?”

“ My friend sends me photos of babies in different stages of pregnancy through Whatsapp. I look at the photo 3-4 times a day. Sometimes she also sends me movies.”

“ I ask my sister-in-law for all information as she has delivered three babies. Sometimes my mother-in-law also tells me what to eat or not to eat”

“The doctor showed me positions of how to sleep and how to sit when I went for my last clinic visit. My back pain reduced a lot. What my mother said did not help, but what the doctor said helped a lot!”

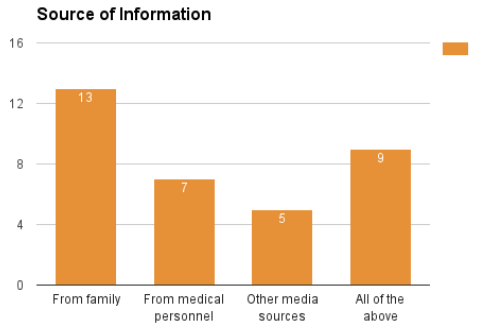


Figure 5: Where women hear / source of Medical health program.

The study with mothers give user statements which support onboarding health programs to health information are varied problems women face in low resource urban setting.

5. User study: Lady Health Worker / Auxiliary Nurse Midwife

Community Health Workers (CHWs) are often critical change agents for the health of

populations in low-income settings. They are recruited from the communities where they work, provide appropriate counseling and referrals during home visits, and serve as a critical link between communities and the public health system. Research has demonstrated repeatedly that CHWs can play a role in improving health indicators of their target populations in well-run community health programs. In Ethiopia, mortality rates for children under five years old were reduced by 40% when mothers received counseling from a CHW on how to recognize and respond to malaria symptoms [17]. A study in Bangladesh demonstrated that an intervention where CHWs played a critical role in reaching new mothers could reduce neonatal mortality rates by 34% [15]. Finally, in Uttar Pradesh, India, an intervention using CHWs to counsel on healthy pregnancies and newborn care led to a 54% reduction of newborn deaths [19].

Since the project exclusively focuses on pre birth care for women and how CHW are involved in this sector of the health system. section provides background information regarding the ANC visit.

5.1. What happens in an ANC visit?

History taking: A midwife collects details regarding patient, medical history and menstrual cycle details. Present weight and height are recorded.

Urine tests: The urine sample of the mother is collected and a strip test is performed. Initial diagnosis on:

- Glucose: To determine whether the patient is showing signs of diabetes.
- Protein: To determine whether the patient is showing signs of kidney or bladder infections or pre-eclampsia.

Blood tests: To ensure the blood group of the mother, To check Haemoglobin level, blood sugar, iron content, vitamin and Rhesus factor.

Blood pressure: Blood pressure is almost the correct indicator of whether a body is coping up with pregnancy. The normal adult blood pressure is between 100\60 and 120\80.

Physical examination?

- Checking mothers womb:
- The abdomen size is measured in each ANC visit to record baby growth. Also the position of baby, the with respect to uterus opening can determine the complication of the pregnancy.
- Breast examination is done in every ANC visit.
- Fetus heart rate measurement is also done from the second trimester.

5.2. Record of Antenatal care:”

RECORD OF PRENATAL CARE

NAME _____ AGE _____ NUMBER OF CHILDREN _____ AGES _____ DATE OF LAST CHILDBIRTH _____

DATE OF LAST MENSTRUAL PERIOD _____ PROBABLE DATE FOR BIRTH _____ PROBLEMS WITH OTHER BIRTHS _____

MONTH	DATE OF VISIT	WHAT OFTEN HAPPENS	GENERAL HEALTH AND MINOR PROBLEMS	ANEMIA (how severe?)	DANGER SIGNS (see p. 249)	SWELLING (where? how much?)	PULSE	TEMP.	WEIGHT (estimate or measure)	BLOOD PRESSURE *	PROTEIN IN URINE *	SUGAR IN URINE *	POSITION OF BABY IN WOMB	SIZE OF WOMB (how many fingers above (+) or below (–) the navel?)	
1														–	
2		tiredness, nausea, and morning sickness												–	
3														–	
4		← womb at level of the navel												0	
5		← baby's heartbeat & 1st movements												+	TETANUS VACCINE
6														+	1st
7 (1st week)		some swelling of feet												+	2nd or booster
(3rd week)														+	
8 (1st week)		constipation heartburn												+	3rd
(3rd week)		varicose veins												+	
9 (1st week)		shortness of breath												+	
(2nd week)		frequent urination												+	
(3rd week)														+	
(4th week)		← baby moves lower in belly												+	
														+	
BIRTH															

6. Terminology test

The terminology test is used to identify the familiarity with terminologies that are used among the health workers. Also local substitute words were identified for words with less than 3 rating. This methodology helps to identify the scope of visual graphic could assist in understanding the meaning or function of the term.

Some findings:

- ECG and Sonography were commonly termed as scans.
- The vertex and breech position will require visual cues.
- Abbreviations can be confusing such as Fetal heart rate was clear but not FHR.

Terminology test	HW1	HW2	HW3	Frequency
Blood pressure				3
Haemoglobin				3
Iron tablets				3
Fetal Heart Rate				3
Fetal Movement				3
Vertex position				2
Breech				1
Fundal Height / Fetus height				2
C Section				3
Normal delivery				3
Estimated date of delivery				3
FHR				2
FMH				1
EDD				1
Gynecologist				3
Paediatrician				2
Physician				2
General Doctor				3
Rhesus				0
Rh+				2
Anaesthesist				0
ECG				2
Sonography				2
Blood sugar				3

7. Health workers life

ANC service demand is generally higher in the urban areas as indicated by a relatively higher percentage of women having attended at least one antenatal care (ANC) visit from health professionals [13]. But yet women delivering in the presence of a skilled health professional even in urban areas is much lower than expected [14]. There are three

sections which ANMs work consecutively ANC, institutional delivery and PNC. Health workers in each center are allotted a section to handle within the clinic consultation time period. Everyday around 30-50 patients are attended in each section by a single health worker.

The ideal time of examination is specifies between 15 mins - 20 mins while in actual scenario hardly 10 mins is allocated per patient. The day schedule of health worker when working in the clinic and when working in outdoor space. Let's look at both setups.

Figure 6: ANM giving vaccination to a child

7.1. Table 4 : Work schedule in the clinic:

	Daily activity	Description	Time
1	Record management	Everyday morning 30 minutes is spent on records of the inventory in the clinic. Previous day records of patients and inventory is also entered during this time of the day.	9.30-10 a.m. / 10.30-11 a.m.
2	Clinic visiting hours	The clinic timings start at 10.30 in the morning till 1 p.m. There is 1 ANM along with 2 help members in the clinic. There are occasional house surgency students which visit the clinic.	10.30 a.m. - 1 p.m.
3	Clinic visiting hours	The clinic visiting and diagnosis period continues	2 p.m. - 4.30 p.m.
4	Classes and training	On alternate days there are classes on health practices by doctors. This is attended by all working in the clinic	4.30 p.m. -6 p.m.
5	Lab work	Collected urine samples and blood samples are analysed and noted against the data of patients collected. This occurs only 2-3 times a week	4.30 p.m. - 6 p.m.

7.2. Field sessions

Home visits and camp visits are far more complex than work in the clinic sessions. There are various reasons for this:

- Dealing with new registrations and registered patients at the same time.
- The cycle of performing tasks becomes very important during a field visit. For example: BP and blood sample collection happens at the field site while urine sample is to be brought to the field.
- The chances of error in records are higher in field visits than clinic visits. This maybe because of the environment condition.
- The time with each patient becomes limited at field visits.
- The ANM duties at each location keeps changing in which case there will be more discrepancy in data.
- Access to previous data is also difficult hurdle as the data entered might long time ago, follow up visits might not have been done and also personalised notes are hard to understand.

Various triage techniques are used to assign health workers to patient:

- Based on the locality that they are travelling to.
- Based on the criticality of the patients.
- Based on the Doctor's requirements (High BP/Sugar/Another Sample etc).

There is no specific sorting mechanism which is followed as protocol in assigning patients to health workers and AMNs. The workload is assigned equally and is calculated on the basis of number of patients.

8. Device selection

8.1. Device Selection:

The feature phones provided to CHWs presented substantial design constraints. For example, the devices had relatively small screen sizes and low resolution. This gave us a very small physical and virtual area in which to design visualizations that provided useful information to CHWs. We were also constrained by the limited functionality of the feature phone platform.

Infrastructural and Environmental Challenges:

Most ANMs worked in areas with relatively poor connectivity, so our intervention needed to work over a 2G network connection. It was also important that the application does not incur large data charges. The ANMs should have access to information during clinic and field visits. The physical working environment also presented a challenge since ASHAs frequently work outside in bright sunlight, which made it difficult to read detailed graphics or text.

The preferred application in theirs phones WhatsApp and IMO. The CHW were not comfortable with text input but were familiar with various other interactions offered by Android devices. They did picture sharing and emoji usage frequently. Basic tasks like photography and video sharing was also done by most of them. The phone was also used by their kids to play games, which implied on security of details within the application.

9. Prototyping of ideas

9.1. Scope:

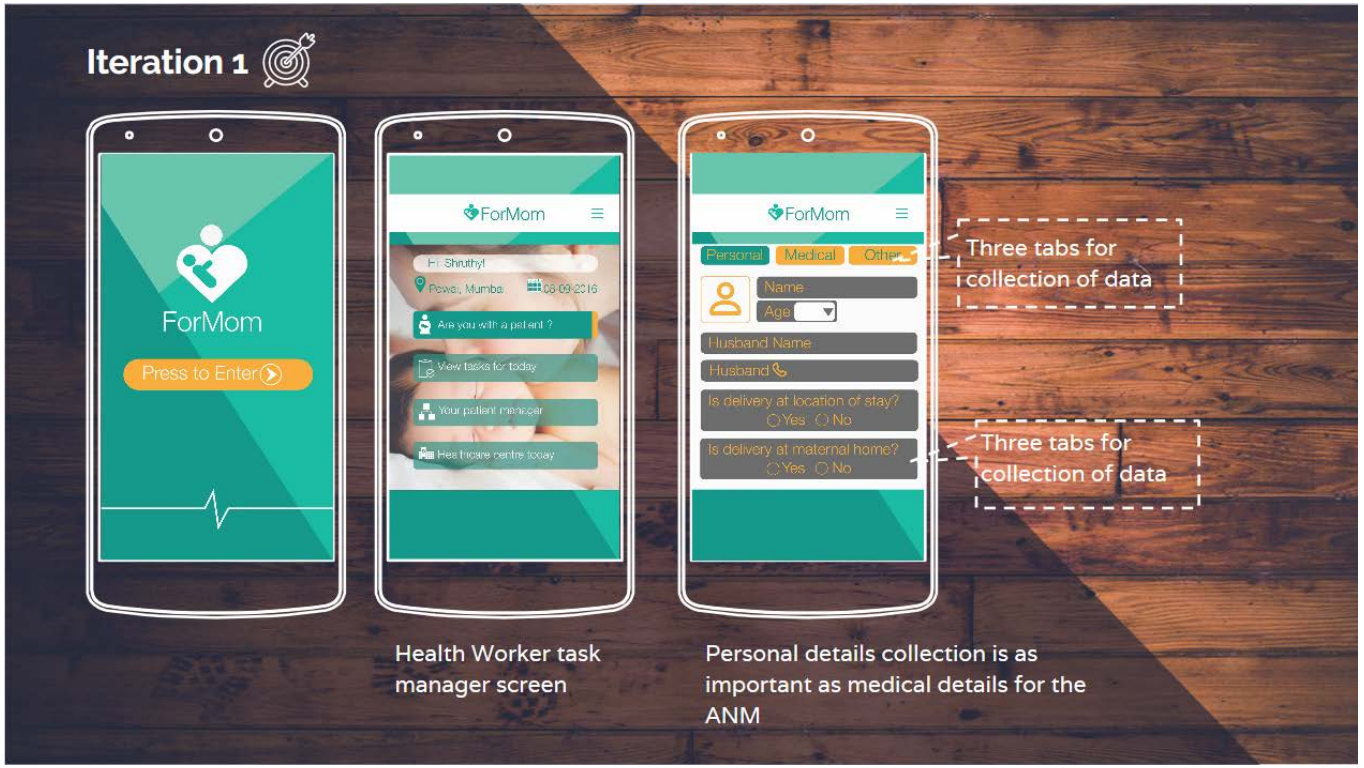
From both our primary and secondary study, we can conclude that there is a scope of an mHealth application intervention to help both ANC community and the mothers availing ANC from a health center. Hence, they can be termed as our primary users.

The applications catering to both the user groups serve different functionalities and modalities. The first part of the project was to understand the role a mHealth application would play in everyday routine and decision support to ANC. The different domains where the health workers could focus on with the interventions:

- Data collection
- Decision support
- Patient manager
- Patient tracker
- Data accessibility

The scope was tested first through a flow analysis and ideation process. There was no different ideation as the goal of the product was fixed and concentrated. The ideal solution should guarantee simplification of data entry, process manager model and data accessibility.

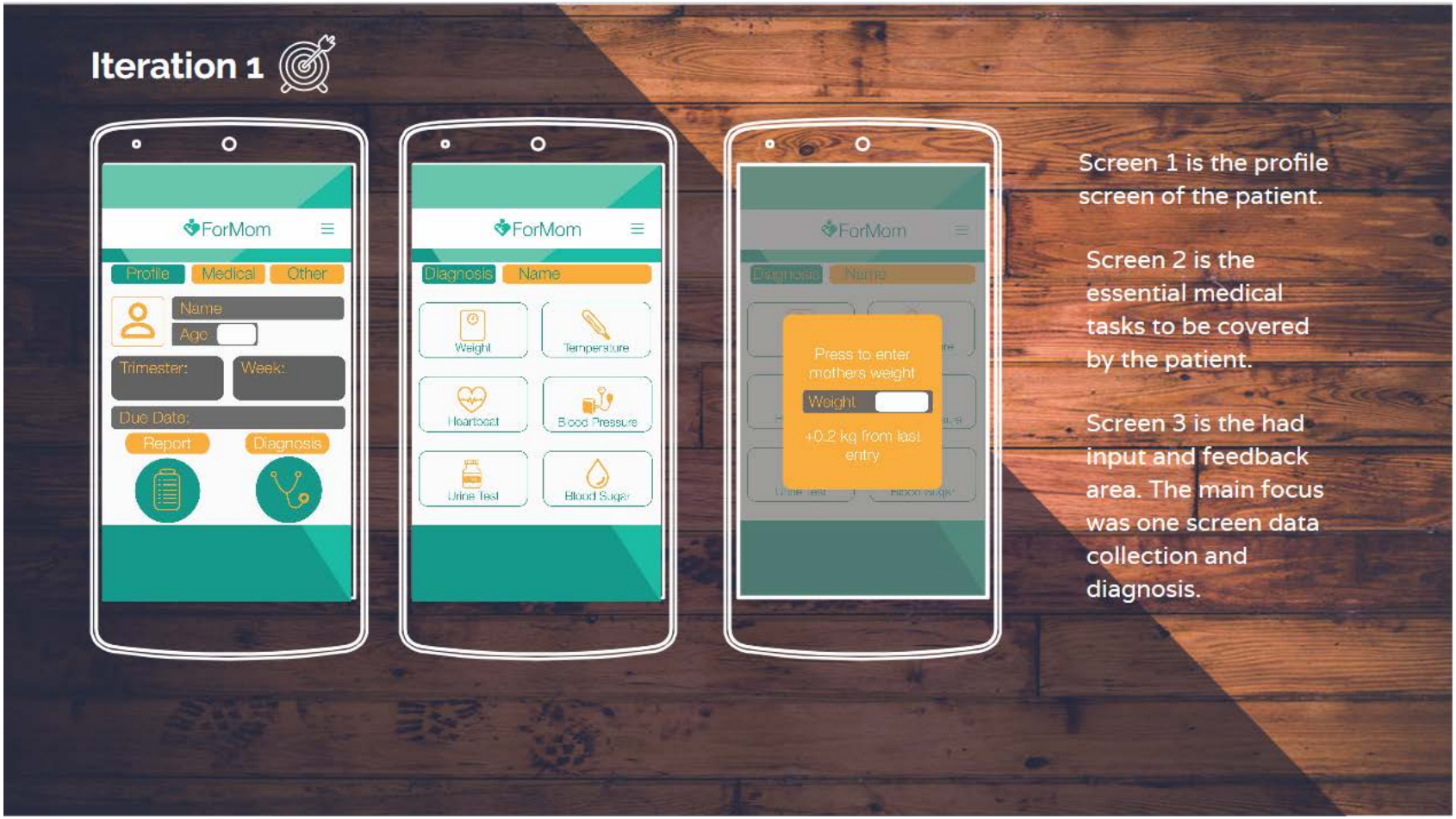
10. Iteration 1

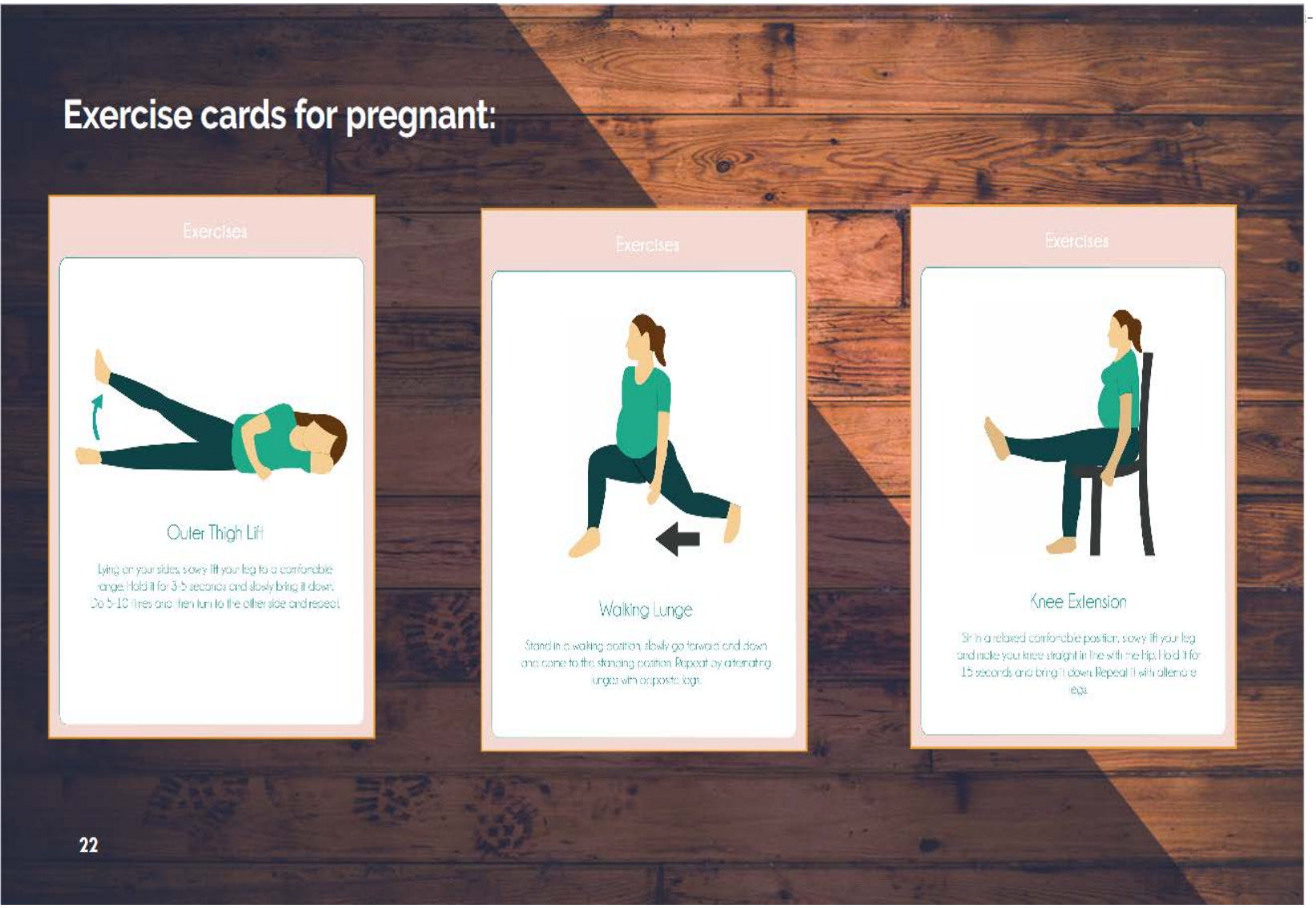


The UI follows a conversation or chat bot language. the health worker has tasks both inside the clinic and with the patients which mentioned separately. Also, there is very less text input required in the collection of dta.

Also, contextual and personal information is collected from the patients regarding their place of stay to place of delivery.

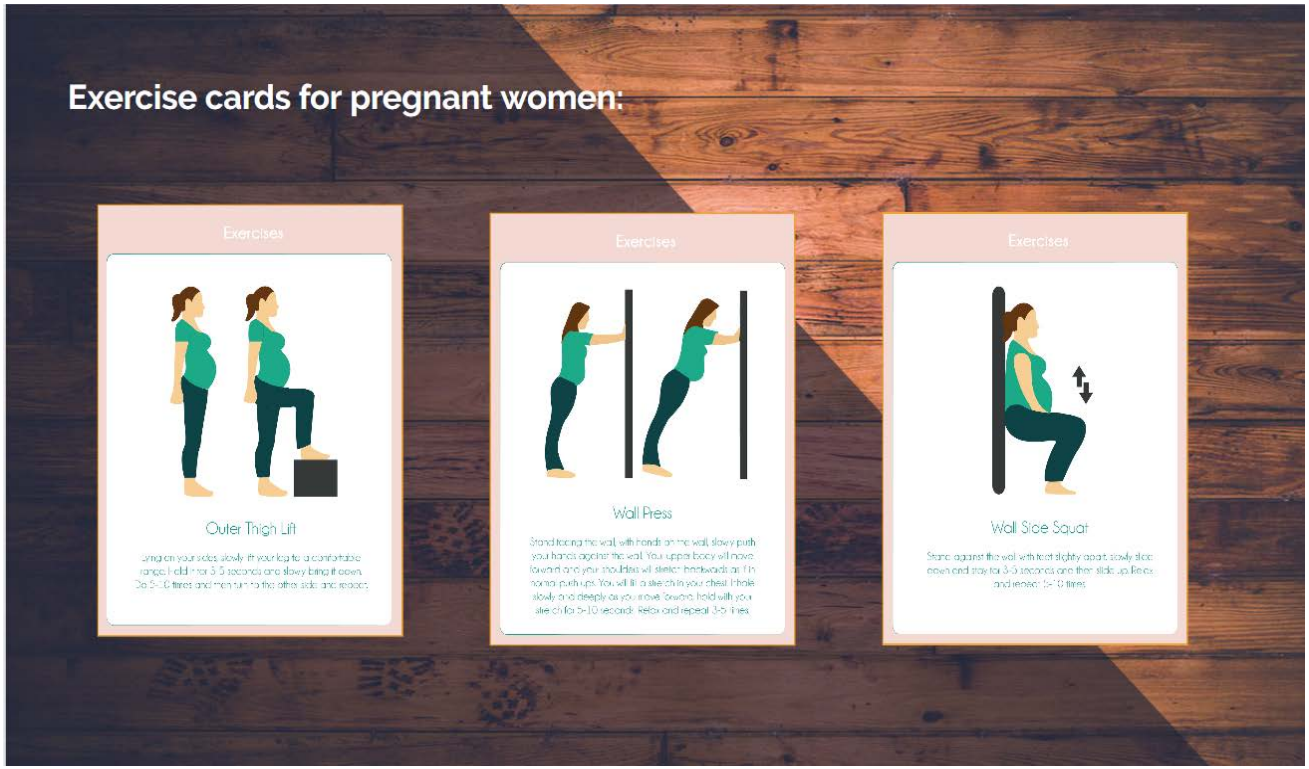
10.1. Diagnosis screen:


Iteration 1
ForMom
Profile
Medical
Other
Name
Age
Trimester:
Week:
Due Date:
Report
Diagnosis
ForMom
Diagnosis
Name
Weight
Temperature
Heartbeat
Blood Pressure
Urine Test
Blood Sugar
ForMom
Press to enter mothers weight
Weight
+0.2 kg from last entry
Screen 1 is the profile screen of the patient.
Screen 2 is the essential medical tasks to be covered by the patient.
Screen 3 is the had input and feedback area. The main focus was one screen data collection and diagnosis.



Design of exercise cards to be sent through the application after diagnosis.

10.2. Diagnosis screen:



1. These cards can also be used during the clinic visits to help them understand the problems better.

11. Design

The final design was detailed out after Think out loud tests with 3 ANMs. The icon and card test also performed with these users to refine the application.

The prototype was tested among the health workers to get feedback and observations regarding flow of the application and icon structure. Since the terminology test already proved the efficiency of the workers, the connect to icons, legibility were parameters that were tested using the iteration stage 1 of the project.

Observations:

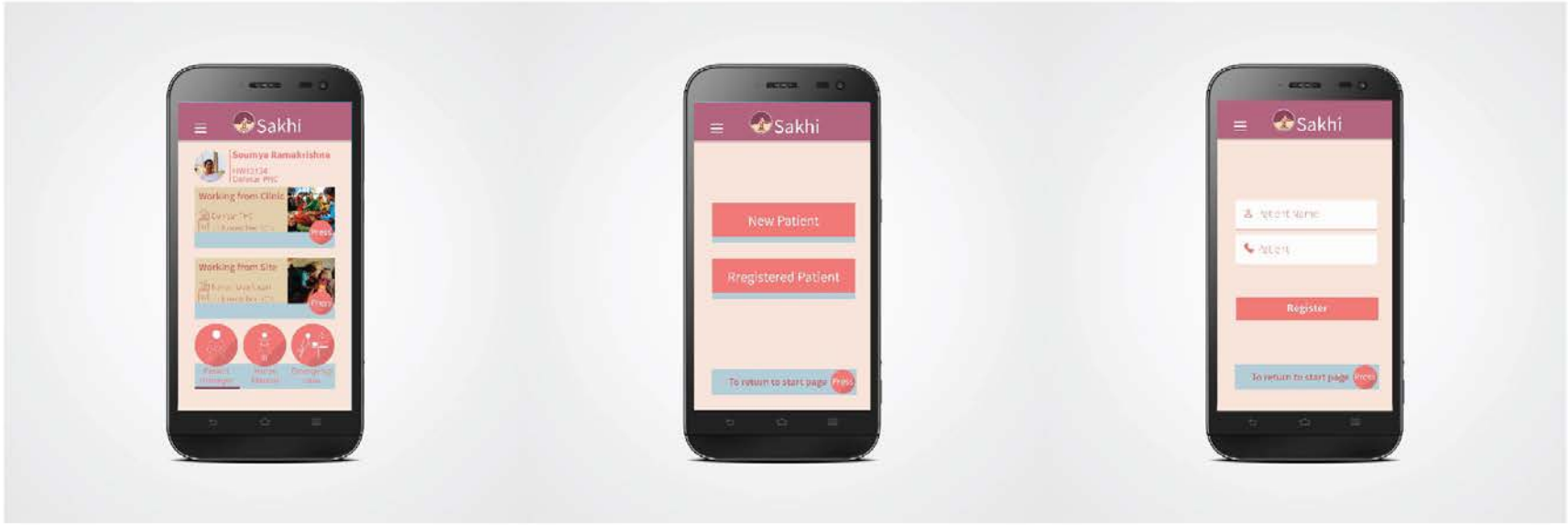
- The learning curve of the health workers were moderate.
- Familiarity with using smartphones were evident during the implementation.
- The homepage was not clear concept to the workers.
- The shifting between each activity also was not clear.
- Data input was done swiftly but required a summary check which did not exist in the present application.
- The test icons except blood sugar was `recognized easily and the functions associated with the icon was easily

Insights:

- There was no emotional connect to the application.
- More personalization features were required to help the connection with patient.
- The switching between functions were not easy as there was a heterogeneous way of working.

Feedbacks:

The feedbacks given by the health workers were regarding the color scheme of the application.
The colors were not compatible to both indoor and outdoor working conditions.
Also the number of data parameters filled in the data forms were more than the physical form. This task was also completed better by the workers through the application data form.



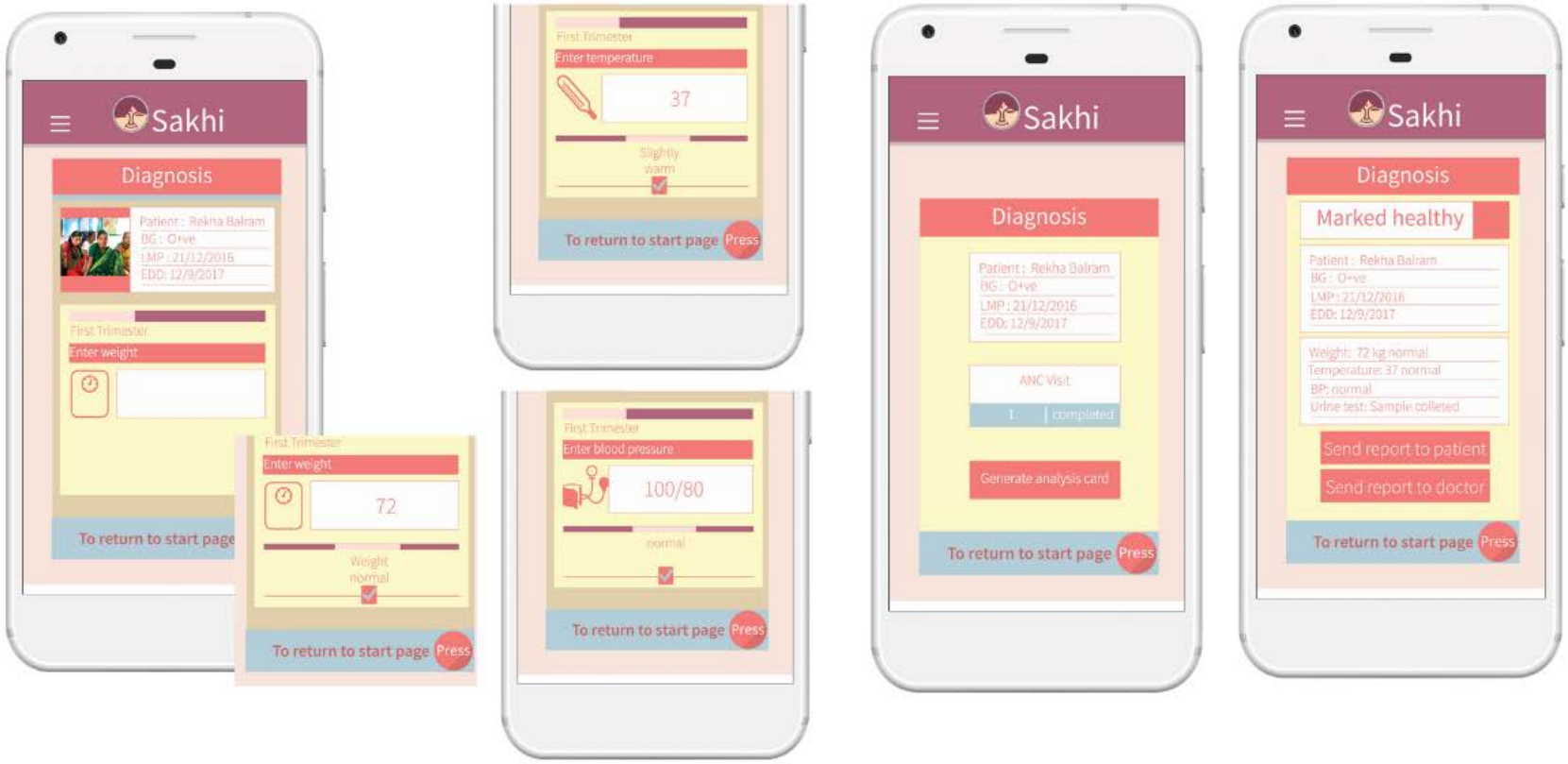
1. The home screen had two parts dealing with both in clinic activities and outdoor clinic activities.

2. To extract information there were two points of identification.

3. The new patient registration was liberalized by giving only phone number was identification point.

11.1. Diagnosis screen:

Diagnosis screens



The final design application was named as Sakhi an interactive help tool for Health Workers. The design and workflow was to match the work and data collection cycle of health workers. The design followed a participatory iteration method, for which each step was tested to get response in layout and functionality.

The application structure contains various components:

1. Data entry of patients at clinic
2. Data entry of patients at work site
3. Patient follow up
4. Patient manager
5. Data analyzer

The priority task of the application was:

1. To conveniently enter patient's data
2. To provide summary of previous visits
3. Analyse previous medical conditions with the present medical condition.
4. To improve attendance to ANC visits.

To personalize the connect of the Health worker to the application a character called ‘Sakhi’ was introduced. This character was to help them understand the tasks and give personalized messages on completion of routine to the health workers.

The other strategy that was implemented to the health workers was that images of their daily tasks were added as icons to help them understand tasks easily.

12. Conclusion

The study has demonstrated that the mHealth intervention package(in the form of decision support, reminders, educational messages and report) had positive impact on delivery and ANC practises in health facilities regardless of residence, age and parity of women possibly through the monitoring of health workers.

The study showed that the benefit in terms of ensuring the connect and improvement of data collection technique can improve the ANC services within the health centre facility. One of the key motivating factors for the health workers to use the application was the fact that the application made it easier for them to understand the condition of the patient irrespective of the number of visits. This helped them to avoid the manual work they had to do previously to compile the information, and it also showed them the level of adherence of their clients to the scheduled visits.
One of the key lessons we learned in the implementation process was to be responsive to the immediate demands of health workers as much as possible to ensure proper utilization of the application. I also believe that active participation of health workers in the whole process with flexibility to address real challenges in the health system helped to ensure local ownership and contributed to the success of Sakhi as an mHealth intervention.Finally, although I could not conduct a cost-time analysis, where the number of working hours could serve more patients than in the existing medium.

13. Improving Prenatal Care in Low Resource Urban Regions

(Research paper)

ABSTRACT

This paper describes the early design of a diagnostic system to support prenatal care of urban Indian pregnant women in low resource setting. Our design is based on interviews and feedback from health workers and midwives who have worked in urban low resource healthcare centers. Based on the interviews we identified key issues in prenatal care and properties of a basic diagnostic system applicable in a low resource setting. The design requirements and challenges were verified with midwives and a concept was developed. Pilot studies were conducted to evaluate the limitations of proposed diagnostic system in low resource setting.

Keywords

Prenatal care; diagnostic support system; midwife; maternal health.

INTRODUCTION

This India has the world's second largest urban population after China. By 2011, India's urban population had reached 377 million (the second largest national urban population in the world) [1]. India also has the world's largest urban population with below poverty line incomes and the world's largest population living in slums. The living condition of the urban population below poverty line has been a growing concern to the government of India. Among the above discussed sectors, India is one of the countries which show significantly high rates of maternal and newborn deaths. Each year globally, about 800 women die every day of preventable causes related to pregnancy and childbirth out of which 162 of these women are from India [3]. Mothers in

the low resource urban India bracket have about two and a half times higher mortality rate as compared to the national average [3].The ongoing high maternal mortality rate in low-resource communities shows that there is a need to identify and implement strategies that are most effective to reduce maternal mortality [3]. Care for a safe motherhood is strategizing effective medical monitoring in the three phases of antenatal or prenatal period, institutional delivery period and postpartum period [4]. Prenatal
care consists of a number of interventions administered to women during pregnancy, including screening tests, immunizations, and treatment for identified complications. It has been established that the detection of early signs or risk factors for, morbidity and mortality can be detected and effective interventions are possible [7]. A major challenge among low resource urban vulnerable communities is that they have little or no knowledge of pregnancy or childbirth. In this pilot project we investigate the possibility to design a tool for healthcare workers to support antenatal care. The diagnostic support system has the following objectives: (a) storing and accessing electronic healthcare records of the pregnant woman, so that the information can be used at any stage of prenatal care, (b) improving point of care diagnostic by with support of the electronic healthcare record, (c) supporting the contextualized access to prenatal care-related services like high risk pregnancy women should be referred to secondary healthcare institutions and (d) providing contextualised advice/tips and monitoring services from physician or an expert to a mother without being physically present at both environments. A user centered design approach has been followed in this project. The design process is heavily dependent contextual problems faced by both parties that is the mothers and health workers [4]. The concepts are generated from contextual interviews of mothers, midwives and health workers which give refined insights into the diagnostic support system. Furthermore the feasibility of the generated concepts were evaluated against the present diagnostic system.

BACKGROUND

Union Ministry of Health and Family Welfare (UMHFW) is the central authority responsible for the implementation of various programmes and schemes in areas of family welfare, prevention, and control of major diseases. In the case of health, term infrastructure takes on a wider role than physical infrastructure. Healthcare ecosystem in rural areas has been developed as a three tier structure based on predetermined population norms.

The sub-centre is the most peripheral institution and the first contact point between the primary health care system and the community. Each sub-centre is manned by one Auxiliary Nurse Midwife (ANM) and one male Multipurpose Worker (MPW). A Lady Health Worker (LHW) is in charge of six sub-centres each of which are provided with basic drugs for minor ailments and are expected to provide services in relation to maternal and child health, family welfare, nutrition, immunization, diarrhoea control, and control of communicable diseases. The sub-centres are needed for taking care of basic health needs of men, women and children. Sub-centres are also expected to use various mediums of interpersonal communication in order to bring about behavioural change in reproductive and hygiene practices.

Primary Health Centres (PHCs) comprise the second tier in rural healthcare structure envisaged to provide integrated curative and preventive healthcare to the population. A medical officer is in charge of the PHC supported by fourteen paramedical and other staff. It acts as a referral unit for six sub-centres.

Community Health Centres (CHCs) forming the uppermost tier are established and maintained by the State Government under the Minimum Needs Program. Four medical specialists Surgeon, Physician, Gynaecologist and Paediatrician supported by twenty-one paramedical and other staff are supposed to staff each CHC. Norms require a typical CHC to have thirty in-door beds with OT, X-ray,

Labour Room, and Laboratory facilities. A CHC is a referral centre for four PHCs within its jurisdiction, providing facilities for obstetric care and specialist expertise [11].

The aims of PHCs in prenatal care:

1. To educate mothers about pregnancy and labour by different mediums.
2. To prevent, detect or treat any early complication which would lead to complicated deliveries or stillbirths.
3. To ensure adherence to medical services provided by the PHCs during prenatal period.
4. To identify and report high risk pregnancies to CHCs.

Maternal health routine in PHC: (stated by UMHFW)

1. Minimum four ANC check-ups which include registration.
2. Avail services during ANC visit which include blood pressure and weight check up.
3. Delivery services including normal, assisted and caesarean section.
4. Postnatal care, which includes stay after delivery, child monitoring for affect to communicable diseases.
5. Immunization and vaccination of infant.
6. Breastfeeding monitoring of the infant.
7. Management of malnutrition.
8. Emergency care and competence.

The midwives and health workers serve as an interface between the community and public health centre. Even though a well-structured public health care system exists; the infrastructure as well as the staff that are required to provide the health care services is inadequate from many different perspectives. Most mothers are not able to obtain treatment for basic ailments either due to reasons like lack of awareness about health facility services in their vicinity or due to other specific reasons to access the same. Even for basic health care services in reproductive and child health, it is found that significant proportions continue to remain untreated. Immunization, ante-natal care, deliveries in the presence of professionally trained personnel.

FIELD STUDY AND RESULTS

The goal of the study is to deal with localised users within a framework. With help of background research we have established

the structure of prenatal care system in India. But field studies are required about how much of this healthcare structure reaches out in a localised context in low resource setting.

Study of mothers in low resource setting

Since this the first set of primary study with users' contextual interview model was followed. The total number of women interviewed was 34. The group was chosen to be a heterogeneous group with mothers of different age group, number of kids, migrant mothers and so on. Women were interviews for a period of 21 days. All the individual interviews were conducted at the respondents' respective health facilities after taking written informed consent from them in Marathi or Hindi as per the preference of each respondent. Each interview lasted for about 45 minutes –1.5 hour. After the contextual enquiry interview process, user problem affinity was done. The user statements were classified in an affinity diagram to understand the scope of enquiry.

Understanding pregnancy as a medical state

The detection of pregnancy itself is handled by different users differently. The detection itself is not a clear process among many mothers. Pregnancy is assumed in most cases a change of marital relationship than as a medical condition. One mother (M4) motioned, "Missed my periods for two months and I told my husband I might be pregnant. He told me we will go to the Aai (local women. She pressed on my stomach and said I am pregnant." The crucial unpreparedness and lack of knowledge for pregnancy adversely affects prenatal care.

Hurdles to meet a Doctor/ Medical help:

The users specify different problems regarding the hindrance or reluctance to meet a doctor. One mother (M21) mentioned, "I don't know a lady doctor nearby! I am shy to go to a male doctor." One of the key issues identified was to include all the people involved in providing care for pregnant women such as from the traditional birth attendant to community health workers and doctors faced social and cultural barriers. M14 mentioned,

"The nearest clinic only has doctor 2 days a week. My husband works every day. He does

not have time to take me to the clinic the day the doctor is there."

Access to healthcare information:
There is always an anxiety or curiosity to know the change that is happening to your child and body during pregnancy. There are several sources from which information of pregnancy is received by mothers. There are many misconceptions about pregnancy and transformation of information among mothers low resource vulnerable communities. M19 mentioned, "I ask my sister-in-law for all information as she has delivered three babies. Sometimes my mother-in-law also tells me what to eat or not to eat." In developing countries especially in low resource areas people have less knowledge about nutritious food. Therefore, the diagnostic system should have capability to suggest healthy foods based on local situation and affordability of the mother. To gain trust of mothers with proper information on pregnancy in an understandable format should be incorporated in the diagnostic system. "The doctor showed me positions of how to sleep and how to sit when I went for my last clinic visit. My back pain reduced a lot. What my mother said did not help, but what the doctor said helped a lot!" is one such case.
Study of health workers/midwives in low resource setting

This section describes some of the problems that affect the prenatal care system in a low resource urban health centre setting. These problems are specific to the low resource urban Indian setting addressing the vulnerable communities which are described earlier in the paper. The in study focuses on health centers and to how the prenatal care is structured in India. The Indian prenatal care aims at providing a good assistance for pregnant women with low resources, but it presents restricting resource limitations. In the following, we detail the main insights that were reflected from our study with 9 health workers/midwives.

Pregnant women data is still mostly stored manually:
In India, all prenatal care records are maintained in a paper card which is issued to

the patient during the first prenatal visit to a health centre. All relevant data collected along the appointments, such as weight, cardiofetal beats and blood pressure, are registered in a paper “pregnant woman card”. Every pregnant woman has a card like this and she must carry it with her in all the appointments throughout the prenatal care. If the pregnant woman presents a condition that requires her to be transferred to a more specialized healthcare institution, she must also bring this card. From this scenario, it emerges the need for electronic health record management for prenatal care systematization. One midwife (U7) mentioned, “Most women do not understand what is being written in the card, both information for doctor and patient are written without any distinction between them.”

Low grading for prenatal care:

There are three sections which midwives and health workers engage continuously prenatal care, institutional delivery and postnatal care. Health workers in each centre are allotted a section to handle within the clinic consultation time period. Everyday around 30-50 patients are attended in each section by a single health worker. The ideal time of examination is specifies between 15 minutes - 20 minutes while in actual scenario hardly 10 minutes is allocated per patient. Since higher number of patients is found in the latter categories, prenatal care is given less importance within the setting.

DESIGN IMPLICATIONS

The key design features are distilled out from an affinity model which looks at the three perspectives (a) existing protocol and service structure of the prenatal care (b) mothers in low resource setting in urban India (c) Health workers and midwives working in prenatal care in India. Here we present the key design requirements that are distilled from the affinity model.

Responsive of application to contextual problems

The diagnostic support system cannot function only as a database where demographic information, visits to the primary healthcare center information and previous pregnancy details are stored. It needs to be responsive to the contextual

needs of a low resource urban healthcare centre. Encouraging prenatal visits among low resource setting:

In India, the number of women attending prenatal visits is less due to striking reasons from all three causatives. The design tool should encourage personal bonding between the mother and heath worker. Many means like automated personalized messages based on the health record and so on. Conducting self checkups based on remote monitoring could also help in low resource setting.

Contextual workflow based application tool

The idea was create a consolidated platform which helps to handle data collection from patients and stores then in required format. It also supports decision making with reference to the patients data entered. The work cycle of the day was converted to interface elements. The data collection screen had very less text input (information like names etc). The numeric input entry and choosing between options like checkboxes and radio buttons were given priority during form design. Many contextual questions were added in the form to make decision support easier. The prototype was tested among the health workers to get feedback and observations regarding flow of the application.

DISCUSSION

The study showed that the benefit in terms of ensuring the connect and improvement of data collection technique can improve the prenatal services within the health centre facility. One of the key motivating factors for the health workers to use the application was the fact that the application made it easier for them to understand the condition of the patient irrespective of the number of visits. This helped them to avoid the manual work they had to do previously to compile the information, and it also showed them the level of adherence of their clients to the scheduled visits. The feedback session was exploratory and the objective was to find out the potential of the proposed system in a low resource setting. One of the key lessons we learned in the implementation process was to be responsive to the immediate demands of health workers as much as possible to ensure proper utilization of the application. the work of our field.

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15. Appendix

15.1. Literature review on ‘when there is no doctor’:

The chapter deals in identifying sectors to address challenges faced by pregnant women. It systematically describes the strategies to be performed in each week of progression into the pregnancy.

Confirming that you are pregnant:

- The woman misses her period (often the first sign).
- ‘Morning sickness’ (nausea or feeling you are going to vomit, especially in the morning). This is worse during the second and third months of pregnancy.

How to stay healthy during a pregnancy:
The body needs food rich in proteins, vitamins, and minerals, especially iron hence the importance of how to monitor if the mother is eating enough or eating well.

Handling minor symptoms at home:

- Morning sickness
- Burning or pain
- Swollen foot
- Lower back pain
- Swelling of feet
- Constipation

Danger signs of Pregnancy:

Bleeding:If a woman begins to bleed during pregnancy, even a little, this is
a danger sign. She could be having a miscarriage or the baby could be developing outside the womb. The woman should lie quietly and send for a health worker.

Severe Anemia:The woman is weak, tired, and has pale or transparent skin. If not treated, she might die from blood loss at childbirth.

High blood pressure or other signs of pre-eclampsia: Blood pressure
of 140/90 or greater can be a sign of a serious problem called pre-eclampsia
(toxemia).

If you cannot check for high blood pressure or protein in the urine, watch for
these other signs of preeclampsia:
• Swollen face, or swelling all over in the morning upon awakening
• Headaches
• Dizziness
• Blurred vision
• Pain high in the belly

HIV and Pregnancy: If the mother has HIV, HIV can spread to her baby while it is still in her womb or during birth. Medicines can help prevent the baby from getting HIV. Talk to a health worker who has experience working with people who have HIV, and see p. 398 for more information.

Prenatal care should cover:

1. Sharing information
Ask the mother about her problems and needs. Find out how many pregnancies she has had, when she had her last baby, and any problems she may have had during pregnancy or childbirth. Talk with her about ways she can help herself and her baby be healthy, including:

- Eating right. Encourage her to eat enough energy foods, and also foods rich in protein, vitamins, iron, and calcium.
- Good hygiene.
- The importance of taking few or no medicines
- Getting enough exercise and rest.
- Tetanus vaccination to prevent tetanus in the newborn. (Give at the 6th, 7th, and 8th month if first time. If she has been vaccinated against tetanus before, give one booster during the 7th month.)

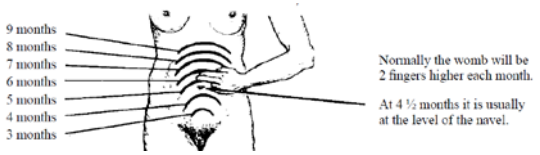
2. Nutrition
The mother should be well nutritional leading lesser chances to her being anemic, discuss ways of eating better. If possible, see that she gets iron pills preferably with folic acid and vitamin C. Advise her about how to handle morning sickness and heartburn. Is she gaining weight normally? If possible, weigh her each visit. Normally she should gain 8 to 10 kilograms during the nine months of pregnancy. If she stops gaining weight, this is a bad sign. Sudden weight gain in the last months is a sign of preeclampsia.

3. Signs of danger and special risk
Check for each of the danger signs. Take the mother's pulse each
visit. This will let you know what is normal for her in case she has problems later
(for example, shock from pre-eclampsia or severe bleeding). If you have a blood
pressure cuff, take her blood pressure. And weigh her. Watch out
especially for the following danger signs:

- high blood pressure (140/90 or greater)
- protein in the urine
- sudden weight gain
- swelling of hands and face
- headaches
- dizziness and blurred vision

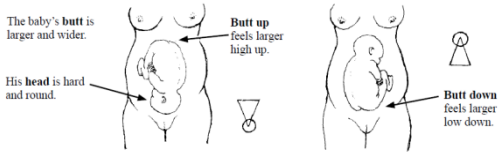
4.Growth and position of the baby in the womb:
Each month write down how many finger widths the womb is above or below the navel. If the womb seems too big or grows too fast, it may mean the woman is

having twins. Or the womb may have more water in it than normal. If so, you may find it more difficult to feel the baby inside. Too much water in the womb means greater risk of severe bleeding during childbirth and may mean the baby is deformed.



Try to feel the baby's position in the womb. If it appears to be lying sideways, the mother should go to a doctor before labor begins, because an operation may
be needed.

5. Baby's heartbeat (fetal heartbeat) and movement:
After 5 months, listen for the baby's heartbeat and check for movement. You can try putting your ear against the belly, but it may be hard to hear. But recording heart movement determines the preparedness for the position of baby, static birth etc.



SIGNS THAT SHOW LABOR IS NEAR
A few days before labor begins, usually the baby moves lower in the womb.
This lets the mother breathe more easily, but she may need to urinate more often because of pressure on the bladder. (In the first birth these signs can appear up to 4 weeks before delivery.)
A short time before the labor begins, some thick mucus (jelly) may come out.
Or some mucus may come out for 2 or 3 days before labor begins. Sometimes it is tinted with blood.

The contractions (sudden tightening of the womb) or labor pains may startup to several days before childbirth at first a long time usually passes between
contractions—several minutes or even hours. When the contractions become stronger, regular, and more frequent, labor is beginning.
Some women have a few practice contractions weeks before labor. This is
normal. On rare occasions, a woman may have false labor. This happens when the contractions are coming strong and close together, but then stop for hours or days before childbirth actually begins.

MISCARRIAGE (SPONTANEOUS ABORTION)

A miscarriage is the loss of the unborn baby. Miscarriages are most frequent in
the first 3 months of pregnancy. Usually the baby is imperfectly formed. Most women have one or more miscarriages in their lifetime.
Many times, they do not realize that they are having a miscarriage. They may think their period was missed or delayed, and then came back in a strange way, with big blood clots. A woman should learn to know when she is having a miscarriage, because it could be dangerous. A woman who has heavy bleeding after she has missed one or more periods probably is having a miscarriage. A

miscarriage is like a birth in that the embryo (the beginning of the baby) and the placenta (afterbirth) must both come out. Heavy bleeding with big blood clots and painful cramps often continues until both are completely out.