Designing Vaccination Monitoring Service

Project 2 | Report

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Declaration

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/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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November 14, 2015

Approval Sheet

The project titled *Designing Vaccination Monitoring Service* by Indrajeet Roy, is approved for partial fulfillment of the requirement for the degree of 'Master of Design' in Interaction Design.

Guide : 

Chairperson : 

Internal Examiner : 

External Examiner : 

Date : 26/11/2015

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Lastly thanks to my family for their love, encouragement and support.

Indrajeet Roy
November 2015

Abstract

"400 Children die from measles every day - 16 children every hour[9]."
Immunization is a 5 year long process with 14 sessions for children till the age of 5 -7 and a total of 26 vaccines are included in this schedule with doctors/nurses. There is a tendency for parents to forget about their child's immunization after a part of the immunization is completed. It becomes important then to remind parents about the same. The aim of my project is to reduce the drop rate of immunization in India.

The project proposes a solution for a centralized system that hospitals and government would use to monitor parents and check those who might have missed their vaccination dosage. This enables better resource consumption on the hospital and government's part. It would also reduce the dropout rate of immunization through regular monitoring and reminders. Government can easily identify programmatic areas that are performing well and areas that need strengthening. Once areas that require strengthening have been identified, the issue of improving performance can be addressed easily.

The system consists of an application for parents to remind about the upcoming vaccines. The application would also work as a medium for educating parents about the immunization process. The system tries to connect a whole spectrum of stakeholders starting from parents, hospital managements, doctors, nurses and the government.

Table of Contents

Introduction

India sees a major dropout in the 5 year long vaccination process [6 & 7]. Parents who opt out of recommended immunization programs are unaware of the consequences their decision brings, for their own child. Any vaccine-preventable disease can appear at any time in the child's lifetime if it is not vaccinated.

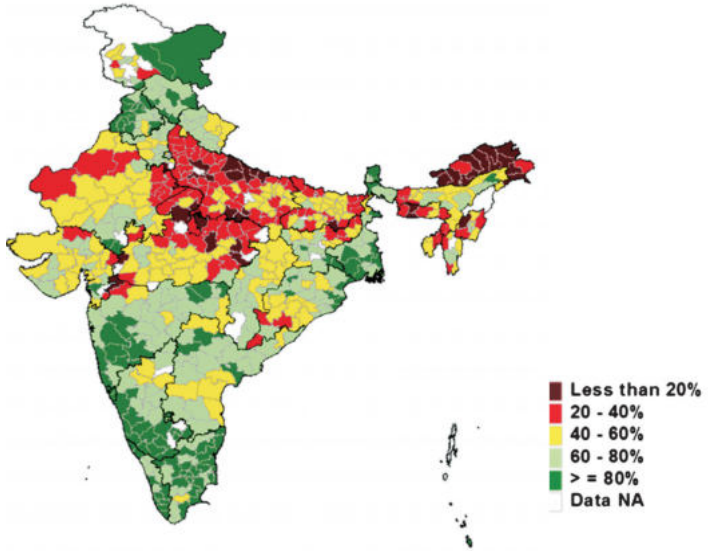

Figure 1. Evaluated full immunization coverage by district in India.
Source: Ref. 6.

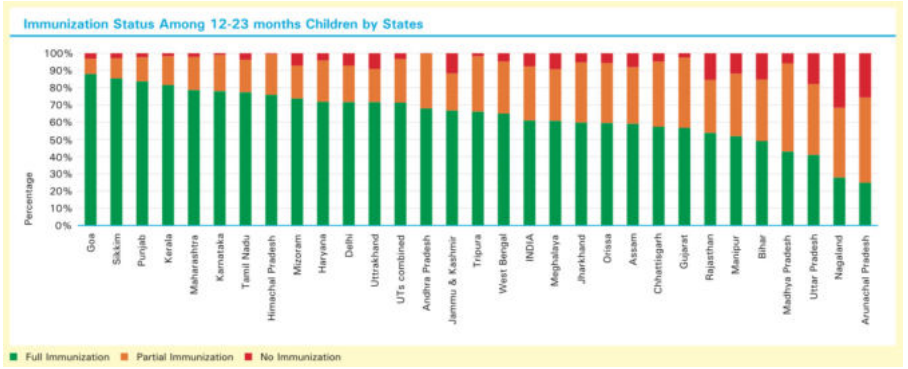

Figure 2. Immunization status among 12-23 months children by states in India.
Source: Ref. 7.

The society we live in depends on complete immunization coverage to keep vaccine-preventable diseases from spreading. The more parents who choose not to vaccinate their children, the greater the risk of spreading diseases[12].

What Is Vaccination ?

Originating from the Latin word 'Variolae vaccine' meaning cowpox, which Edward Jenner demonstrated in 1798 by preventing smallpox in humans. A vaccine can be described as a biological solution providing active acquired immunity, often for a lifetime, to a specific disease. It is generally made from weakened or killed forms of the microbe, it's toxins or one of it's surface proteins, this mixture typically resembles the disease causing microorganism. When injected, this agent causes stimulation in the body's immune system by recognizing the agent as a threat, destroying it and further keeping a record of it. As a consequence, the immune system can easily identify and destroy any of these micro-organisms on further appearances.

The administration of the vaccines to the body is called vaccination. Thereby making it a treatment which makes the body immune against a particular disease.

Age groups 0-18 are highly vulnerable to infectious diseases and it is one of the major causes of morbidity as well as mortality. Immunization is one of the most practical and easy methods for ensuring child survival.

Vaccination Vs Immunization

Even though vaccination and immunization are often used in the same context, there is a bit of a difference in their meanings.

Vaccination is when a person is injected or given the vaccine orally to make the immune system identify and fight an infectious disease. Immunization is when a person's immune system learns to identify and fight an infection after the first occurrence of the disease. Immunization can happen through vaccination and can also occur from getting the infection in the first place. For instance, a person being affected with Hepatitis B can be immune to it. After a person gets hepatitis B and then gets well, he is immunized from getting it again. A person can also be immunized from to hepatitis B by taking the hepatitis B vaccination. The vaccine stimulates the immune system so that it can identify the disease and protect one from future infection (i.e. making one immune to the infection)

Why Are Vaccines So Important in the early years?

Disease prevention is one of the important concerns that parents have for the well-being of their children. An infant can be immune to diseases in the first year of his/her life, due to the presence of antibodies that were passed on to them from their mothers, but no further. On being exposed to a diseased germ, a child's immune system may not be capable to fight the disease.

Globally prevalent diseases like polio, measles, diphtheria, pertussis (whooping cough), rubella (German measles), mumps, tetanus, rotavirus and Haemophilus influenzae type B (Hib) can be prevented through vaccination. Even the presence of smallpox has

been made non-existent outside science laboratories as a result of its vaccine. Thus, preventing countless cases of disease and saving millions of lives at the same time.

Immunity Protects Us From Disease

Immunity is the ability of the human body to endure the material present in the body since birth and to eliminate foreign material. Making it the body's innate way of preventing disease.
Being composed of cells, glands, organs and fluids located throughout the body, a child's immune system is inbuilt to a degree. This immune system can identify the antigens that enters the body as '"Foreign invaders" and starts producing proteins called antibodies to fight them.

On the occurrence of being infected with a specific antigen, the immune system creates antibodies especially designed to fight it. The child tends to fall sick because this process takes time as the immune system is unable to work efficiently to produce the sufficient amount of antibody required to fight the antigen from causing the disease. Nevertheless, the immune system can now recall that antigen and if it enters the body again, after many years, the immune system will now be able to produce antibodies more efficiently. Thus, preventing the antigens from causing the disease for the second time. This cycle to protection is known as immunity.

Diseases

Here are the 14 diseases that can be prevented with routine childhood

Diphtheria
Hepatitis A
Hepatitis B
Hib
Influenza (flu)
Measles
Mumps
Pertussis (whooping cough)
Pneumococcal disease
Polio
Rotavirus
Rubella
Tetanus
Varicella (chickenpox)

Vaccines

There are ten routine childhood vaccines that protect children from these 13 diseases :

DTaP: Protects against Diphtheria, Tetanus & Pertussis
MMR: Protects against Measles, Mumps & Rubella
HepA: Protects against Hepatitis A
HepB: Protects against Hepatitis B
Hib: Protects against Haemophilus influenzae type b
PCV13: Protects against Pneumococcal disease
Polio: Protects against Polio
RV: Protects against Rotavirus
Varicella: Protects against Chickenpox

Resource: Vaccine - Preventable Diseases and Childhood Vaccines [8].

Secondary Research

Why Dropout in Vaccination ?

"In a survey, it was seen that 62.3% of the mothers and 13.4% of the fathers of the under immunized children were illiterate. It was also found that being the eighth child increased the risk of the under immunization in comparison to the first child.
We concluded that mother's education level, order of child, consoling after vaccination, giving vaccine card, home visits for vaccination were the factors related with vaccination dropout[10]."

People in urban scenario are very busy in their lifestyle. Negligence and ignorance may be a one more reason. I believe dropout can be overcome by reminding people about the vaccination dates and its importance. There are some products and services doing the same or trying to work for the cause.

Vaccine Delivery - Bill & Melinda Gates Foundation

Bill & Melinda Gates Foundation has been working to ensure that existing life-saving vaccines are introduced into countries where people need them most and to support the innovation needed to develop new vaccines and new delivery technologies and approaches.

Their focus is to prevent more than 11 million deaths, 3.9 million disabilities, and 264 million illnesses by 2020 through high, equitable, and sustainable vaccine coverage and support for polio eradication[1]. Vaccines are often expensive for the world's poorest countries, and supply shortages and a lack of trained health workers are challenges as well. Unreliable transportation systems and storage

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Rural children in India have better immunization rates:Report

PTI | Sep 15, 2015, 11.28AM IST

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WASHINGTON: Contrary to earlier studies, children in rural India have higher vaccination rates than those in cities and Hindu kids are more likely to get their shots than Muslims, researchers from a leading American university have said.

Said to be first of its kind of study, the report released by University of Michigan compares vaccination rates across religious groups in India.

It's also significant because the findings that rural kids are better vaccinated are contrary to earlier studies.

India is a leading producer and exporter of vaccines, the country is home to nearly a third of the world's unimmunized children.

The research by U-M's School of Public Health found that urban children between the ages of 1-3 years have an 80 per cent chance of not being vaccinated when compared to children in rural areas, the university said in a release.

"Urban areas have pockets of slums where health care services are not reaching," said lead author Nijika Shrivastwa, who recently finished her doctorate in epidemiology at the University of Michigan.

People in rural areas, she added, often have access to health care in government hospitals that deliver free vaccinations.

Community health workers and public health centers have also done a good job of spreading vaccination message in villages, she said.

Although India is a leading producer and exporter of vaccines, the country is home to nearly a

Figure 3. Article on rural children in India have better immunization rates - Times of India
Dated : 15 September 2015

facilities also make it difficult to preserve high-quality vaccines that require refrigeration[15].

Global Vaccine Action Plan 2011 - 2020

The Global Vaccine Action Plan (GVAP) endorsed by the 194 Member States of the World Health Assembly in May 2012 is a framework to prevent millions of deaths by 2020 through more equitable access to existing vaccines for people in all communities.

GVAP aims to strengthen routine immunization to meet vaccination coverage targets; accelerate control of vaccine-preventable diseases with polio eradication as the first milestone; introduce new and improved vaccines and spur research and development for the next generation of vaccines and technologies[16].

Gavi Vaccine alliance

Gavi is the Vaccine Alliance, which brings together public and private sectors with the shared goal of creating equal access to vaccines for children, wherever they live. A unique public-private partnership, Gavi was created to bring together the best of what key UN agencies, governments, the vaccine industry, private sector and civil society had to offer in order to improve childhood immunization coverage in poor countries and to accelerate access to new vaccines[14].

It was found that mass messaging can work is for advertising events like local polio or HIV/AIDS camps. For example, Project Masiluleke sent some 300 million “Please call me” messages using the unstructured supplementary service data (USSD) protocol to South Africans encouraging them to undergo HIV/AIDS test. The average daily call volume to the National AIDS Helpline tripled within a few months of this campaign[17].

Existing Works

Immunize India

IAP- Immunize india is the world's largest vaccination reminder service, and is available free of cost to parents anywhere in India. It is a Immunize India[18].

Parents opt-in to the service by sending a text message by SMS to the national short code 566778 from any mobile phone in India.

Mother and Child Tracking system

The system called Mother and Child Tracker System (MCTS) is used for tracking women and child. The primary objective of the tracking system is to keep health track of the women during maternal period. Maternal deaths can be avoided if women gets proper health care during pregnancy, Birth of child and immediately afterwards. From the observations of user study, this system is mostly used in rural India. ANM worker updates and access the system. This system is mostly used in rural India. ANM worker updates and access the system.

Figure 4. Tasks needed to complete the installation of the application.

Audio visual messages for immunization

Fairly recent work in IDC on immunization talks about sending audio and visual messages to parents to educate them on immunization and immunization process. A mobile application was created to remind users about the next vaccine. The phone application demands parents to fill a huge form containing all the information of child and parents. This filling of form at the first place add huge

cognitive load on parents. Secondly, the form contains number of edit fields on one page, parents cannot skip lot of fields and also cannot go to next fields as lot of fields are mandatory. On top of all these, there is continuous bombardment of audio-visual messages which in turn adds to cognitive load.

Uday foundation

Uday foundation is based in south delhi, it provides free consultation, medicine, a child health and immunization program.

The foundation provides free OPD consultation, free medicines, basic investigations on reproductive and child health, immunization programme.
It works with the people of 10 slums & villages of South Delhi and the goal is to arouse adequate consciousness and awareness about health and hygiene among villagers.

Primary Research

Primary research from began from a Primary Health Centre in Khadavali(east) in the Thane District

A Contextual Inquiry was conducted with 6 Parents, 1 Anganwadi worker, 1 Asha worker and 1 Auxiliary Nurse Midwife. It was seen that in rural areas ASHA workers are appointed to collect medication information of all villagers. They promote vaccination and motivate the villagers to provide vaccination to their off springs. The auxiliary nurse midwifes medicate all patients in the village and document the information. They also vaccinate children, document the activity and then update it on the Mother and Child Tracking System (MCTCS) website. She maintains the records of all the pregnant ladies in the village and connects them with Public health centers. In rural India people themselves are part of reminder system because of the close knit nature of the community.

It was found that in the urban sector there is no one to remind parents about vaccination[2]. The only available reminder system is the physical card that the PHC or the hospital provides. People in cities are busy and assume that the vaccination process would consume an entire day, whereas in reality vaccination doesn't take more than 20-30 minutes. It was observed that mothers in urban scenarios do not have any detailed knowledge about vaccination and or its significance. This could possibly be one of the major reason why they tend to forget about vaccination. There are USHA workers and community health workers in Cities, however these are in many cases understaffed and overworked.

From the user studies it was found that major and immediate problems lie in the urban sector and it was decided to focus on

Figure 5. Sushma Kulkarni with her daughter in PHC, Khadavali.

urban India over rural India[1].

Contextual inquiry with a semi-structured interview was the method used to gather primary data.
The user study was focused on
Understanding the problems faced by parents, doctors and nurses.
Understanding the process of vaccination.
Observing the interactions between nurses, doctors and parents to understand the cross stakeholder problems and generate insights.

Data was collected with 3 Hospitals in Mumbai.
1. King Edward Memorial Hospital, Mumbai
2. Dr L. H Hiranandani Hospital, Mumbai
3. Powai Hospital, Mumbai

Interviews were conducted with
8 parents
2 doctors
3 students
4 nurses

All 17 interviews were a part of the primary data collection.

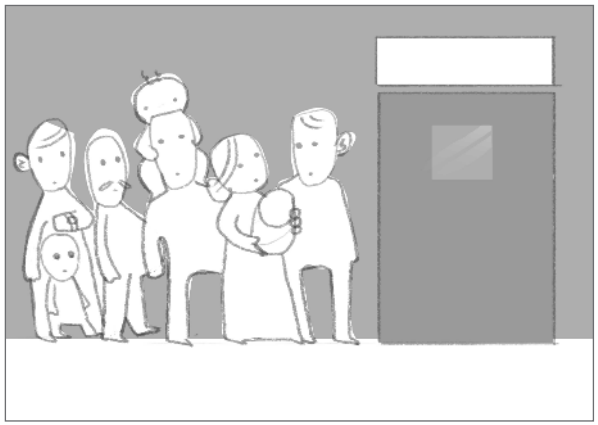
Contextual inquiry was conducted with medical students/nurses to understand what difficulties they face. Mostly they run the vaccination program in the hospital. One doctor supervises the program. Every day their role changes. The process of vaccination is more complicated for nurses/students. First of all in the registration counter there is a huge rush everyday and after that they have to enter the details in the child's card thereafter update the same information in the master diary of the hospital. So to expedite the process they maintain a duplicate diary. The mother has to visit three other counters where the child's health is checked, child gets vaccinated, then in the end health tips with next vaccination date are given.

On the other hand it was observed that young and first time mother visits the hospital for the vaccination of the baby, without having any prior knowledge about vaccination(3). Mostly women are accompanied by a family member, husband, mother, etc. Most of the parents in the user group interviewed were from a middle income group. First hand information about vaccination of the child comes from the doctor. None of the parents had any detailed knowledge about why vaccines were given to their children. They are very keen to know about what does the vaccine do. But as there is a huge rush in the hospital so somewhere the question does not arises in the scenario.

Apart from this people who are staying on the IIT Bombay campus were also spoken to understand their mindset about child vaccination.
All this helped in gaining a better understanding of the system and its problems from various perspectives.

Figure 6. Vaccination dates highlighted on a calendar

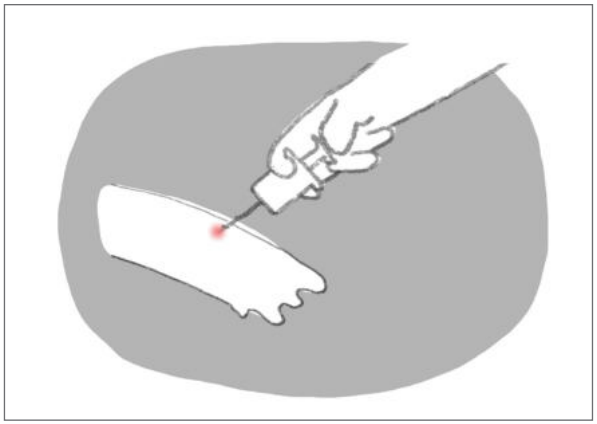
User Story



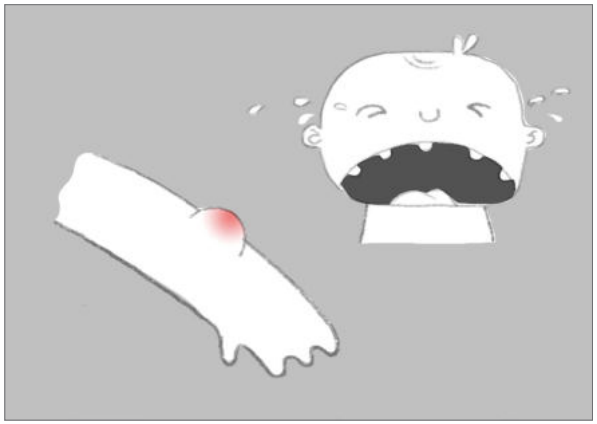
Mother was waiting for a long time to get her child vaccinated at the doctor's clinic at the government hospital.

She takes the child to the vaccination counter.

The doctor was in hurry and was looking at his watch all the time



The child receives the first vaccine on his leg.

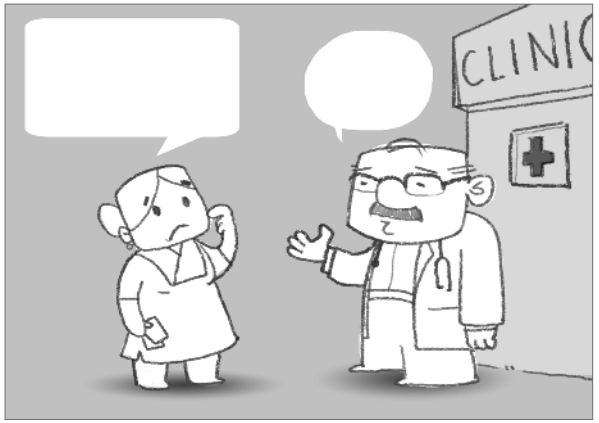


However, he gave the second vaccine on the same leg hastily. This causes a lump on the child's leg.

The Mother saw this and was terrified. She decided not to vaccinate her child in government hospital ever again.

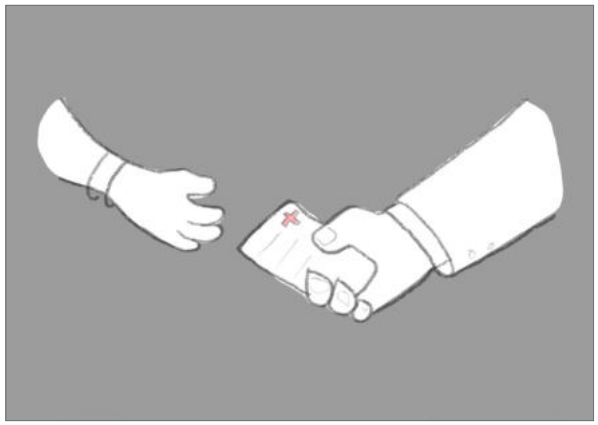
The mother went to the vaccination center with her three kids

On the way to the hospital she misplaced the elder son's card. She forgot the vaccines to be given to the eldest child



The doctor is towards the end of his shift and wants to leave as fast as possible. He did the job hastily.

The doctor administered whatever vaccines the mother told verbatim without evidence.



He creates a new vaccination card for the eldest son and fills it up.

All the children now have a vaccination card. However the eldest son might have missed a few vaccinations in the process.

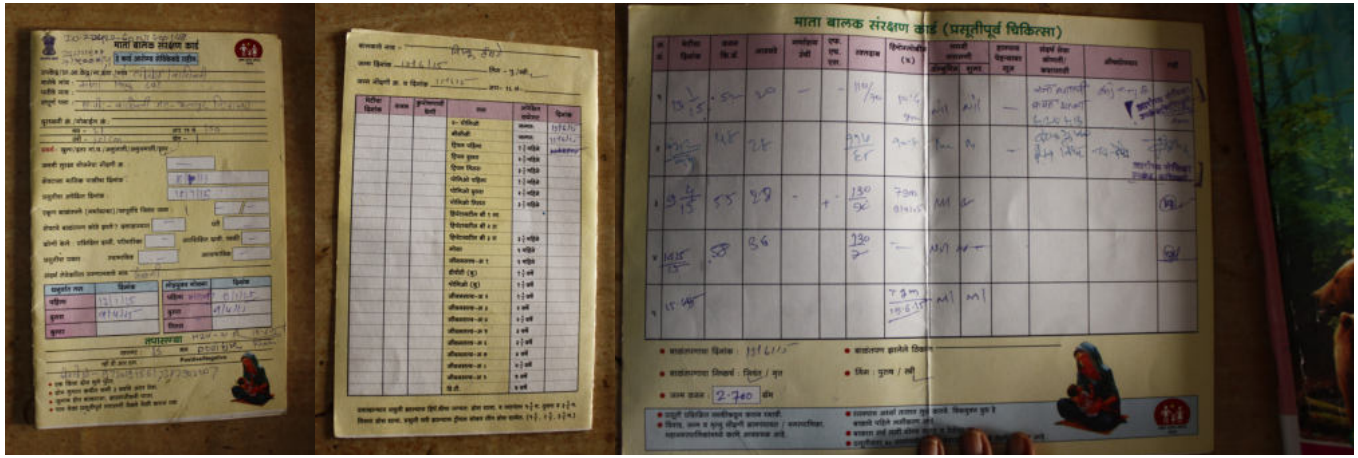


Figure 7. Old Child Immunisation Card maintained by nurses and doctor.

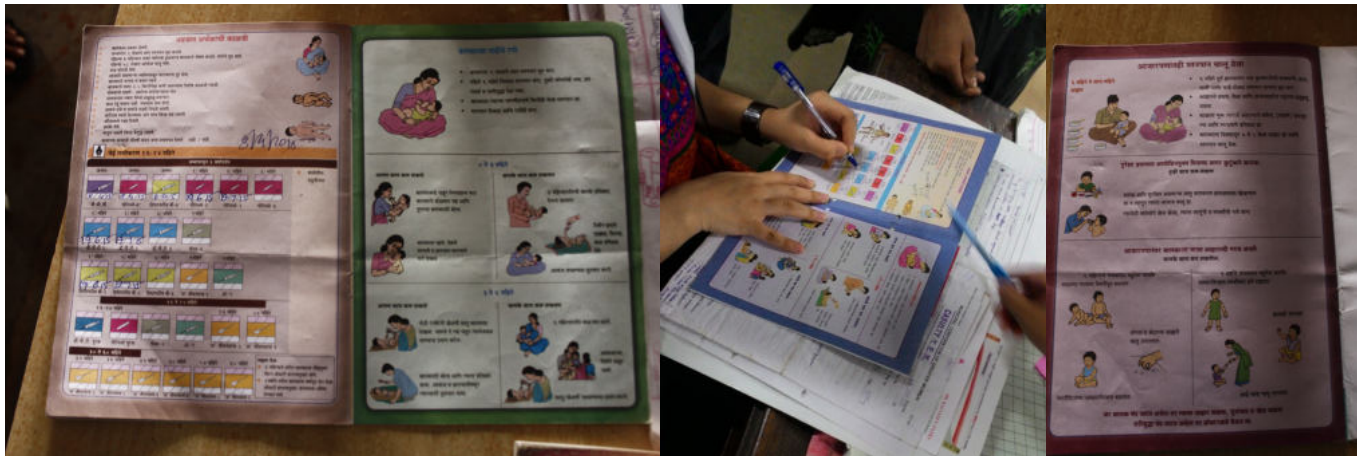


Figure 8. New Child Immunization Card maintained by nurses and doctor. Card itself is very informative.

Data Collection Practices

Findings related to parents:

Most of the data is in a tangible physical format on the form of the child vaccination card.
This card tries to educate parents
All the vaccination dates and weight are written manually by the doctors or nurses.
Vaccination appointments are often marked on calendars in homes.

Figure 9. Every private clinic or hospitals have their own Child Immunization Card and every other doctor keeps record in his own way.

Hospitals related findings :

Hospitals have their nurses and doctors to collect data. In the King Edward Memorial Hospital visited during field study, it was observed that the data is manually entered thrice and then they send the updated master register to F South ward Mumbai. After that master register is digitized in Pune.

Figure 10. The child's immunization card is updated.

Figure 12. After updating the immunization card. The Vaccination information is recorded in the Master register. This master register is also used to search for earlier entries.

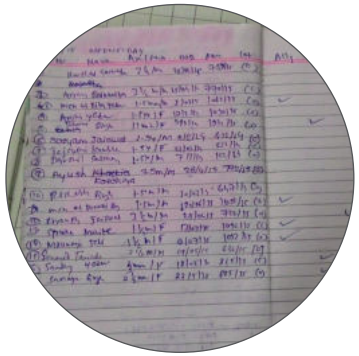


Figure 11. A Duplicate copy of the Master register is created for security of information, easy updating and cross checking. This makes it a long and laborious process.

Problems & Insights

Post the primary data collection, some issues were identified related to the major activities in the system. It also gave insights which could lead to design interventions.

1. After each immunization, doctor/nurse checks both the card and their record according to updated record of the child and gives appointment dates for next scheduled vaccination. Many a times people misplace these cards and lose all the data. Doctors are forced to issue new cards and enter all data again and they have to believe what the parents tell them.

2. Culturally it takes three months in India for a baby to get his/her name.

3. There is a slight apathy towards vaccination as the child grows old. Parents tend to ignore that 5 years long process of vaccination is important for their child.

4. Parents' lack of awareness is a major issue. They are often unaware of additional dosage.

5. If the gap between two vaccination doses is long, parents tend to forget about the next appointment.

6. For improving the situation, efforts should be made to impart information, education, and communication activities, to educate the mother.

7. Vaccination sessions in government hospitals is thought to be a full day affair due to mismanagement of timings. There is no working system for booking appointments for the parents in these hospitals. There is a constant inflow of a large number patients in these hospitals and the vaccination session often turns into a full day affair. Government hospitals find it difficult to give an exact time slot to the parents.

8. Parents do not prefer giving a feedback. Prefers videos over messages or images.

9. There is an information gap with regards to the side effects and curative measures of immunization. Parents hesitate or stop the immunization process altogether if the child encounters any side effects.

10. Parents usually prefer private sector as they are unhappy with the service provided by government hospitals.

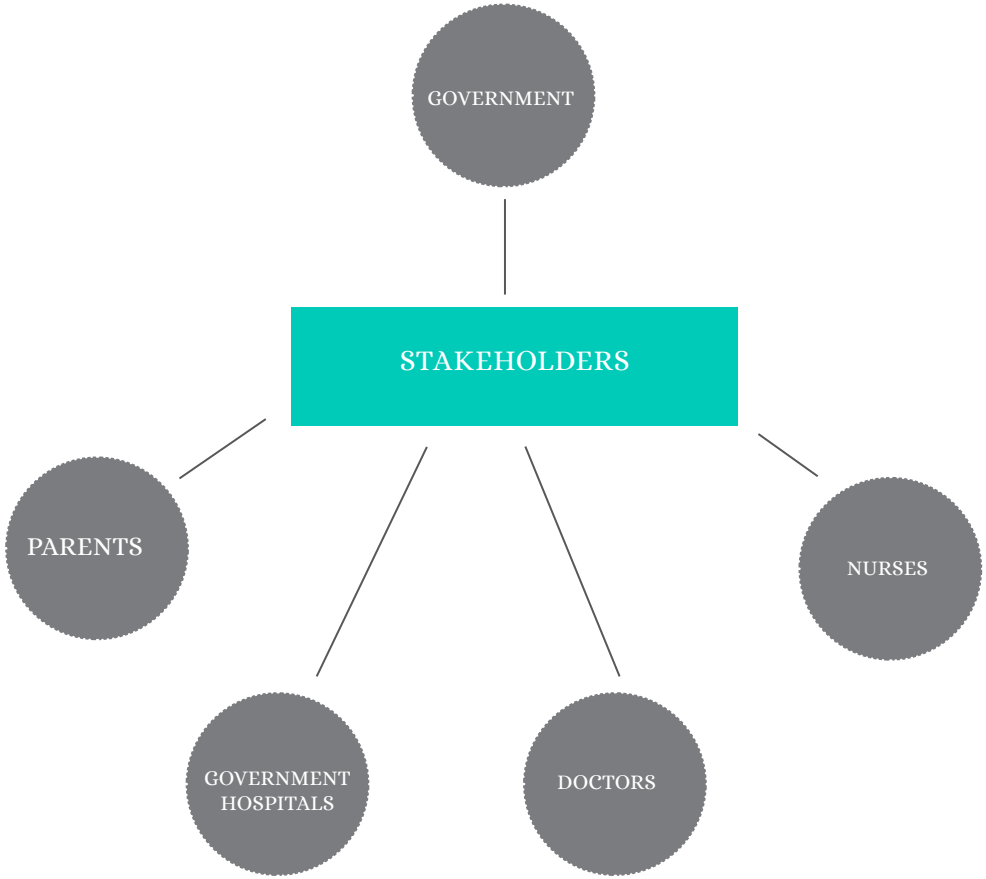
11. Vaccination tips and facts are encouraged by parents.

12. Reminding and motivating parents can reduce the vaccination dropout.

13. It was found during the user studies that some parents feel that the child can explain his health anomaly after the age of 3-5 years and hence there is no need to vaccinate. Vaccination is sometimes thought of as curative rather than a preventive measure.

14. User preference of the medium of communication is an important consideration. A default may not work.

Stakeholders In The System



Parents :

Parents are responsible for getting the child vaccinated timely and maintaining the schedule of the vaccination sessions. They also maintain the vaccination card for their child.

Government :

Government's responsibility is to provide adequate supply of vaccines to its citizen and ensure the availability of any new vaccine.

Hospital:

The hospital maintains the record of the children and their vaccination sessions. It has to ensure that the proper vaccination process is followed.

Doctor :

The doctor administers the vaccination to the child and checks for any anomalies with the child's health.

Nurse :

The nurse helps the parents and the doctor in successful fulfilment of the vaccination process. The nurse also guides the parents about the process further and informs them about any side effects of the vaccination.

Current Service Encounters

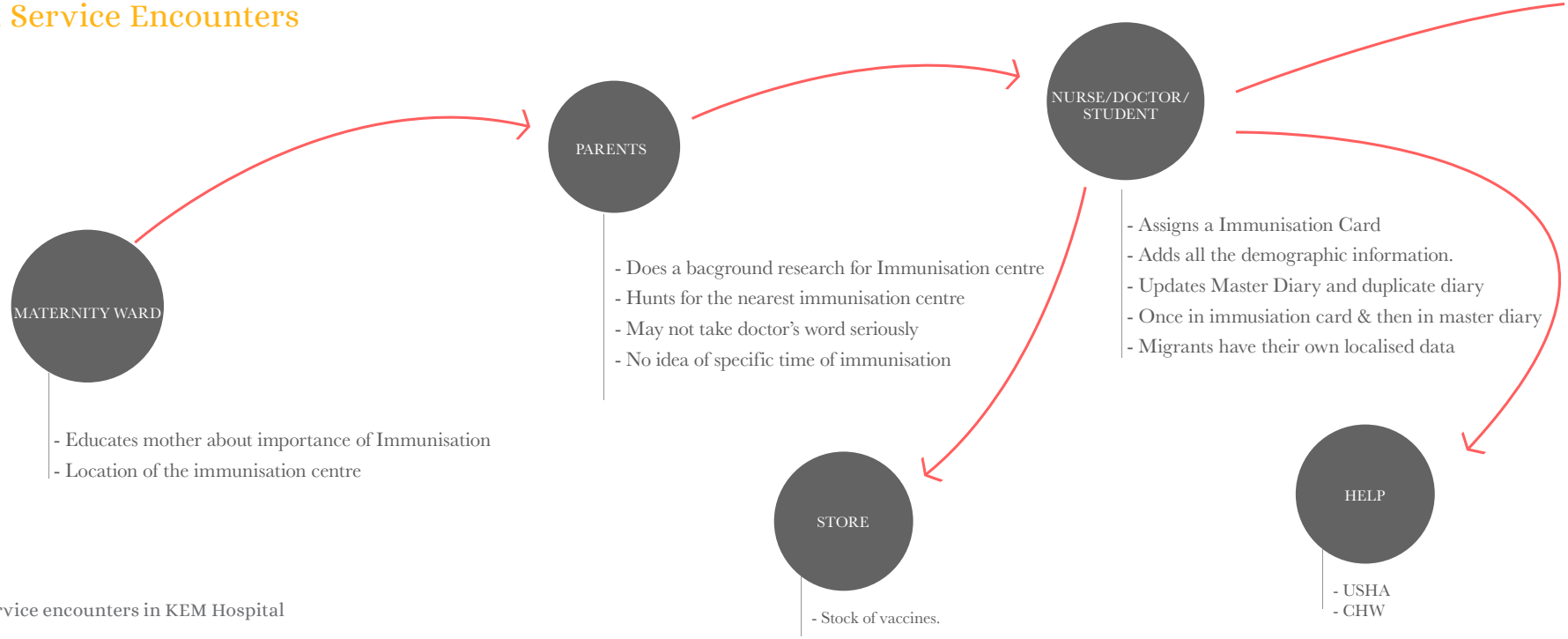
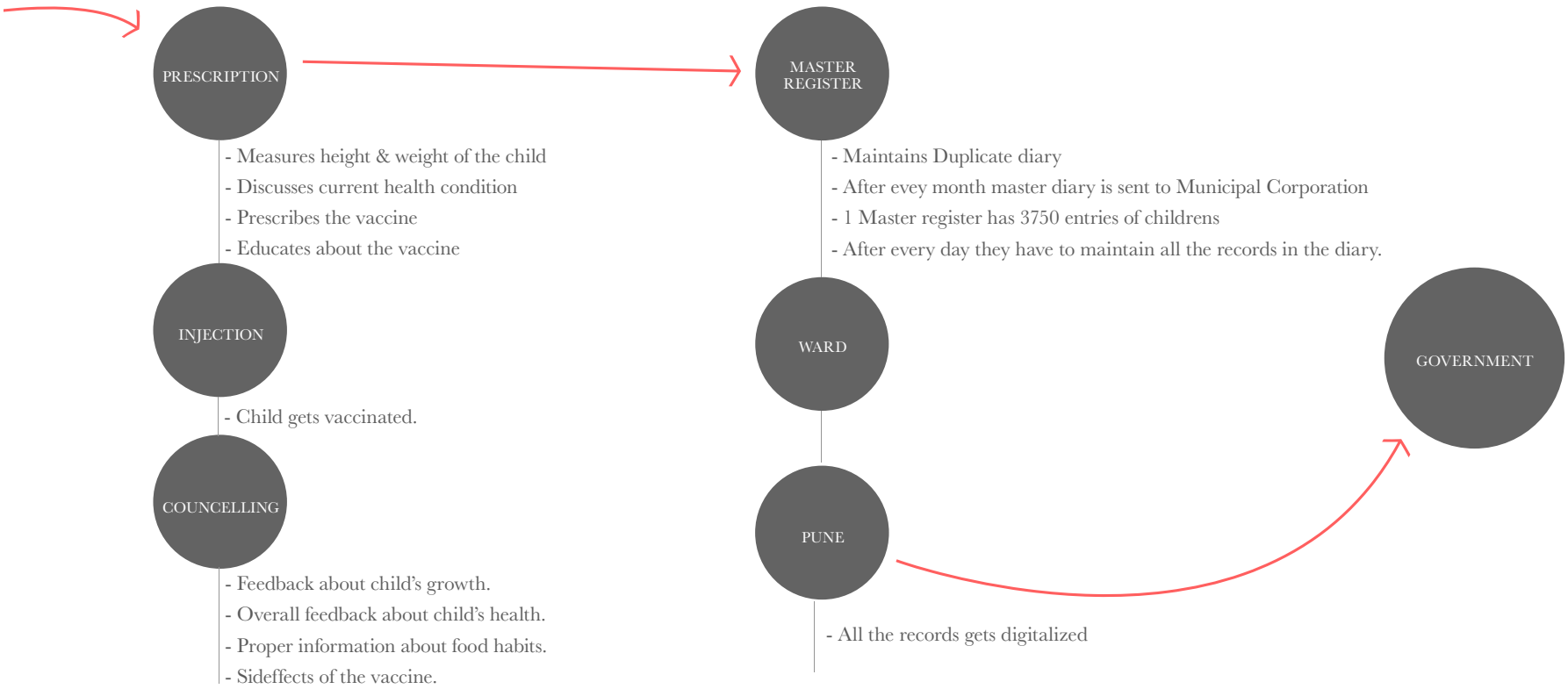


Figure 13. Service encounters in KEM Hospital

When a child is born at a government maternity ward, the mother is given information about the importance of immunization and the location of the nearest immunization center. The parents of the child do a background check of the immunization centers and find the nearest or the most conveniently located center. There is a tendency in parents to cross check the doctor's advise through a second opinion. The parents are often unaware of the vaccination sessions and their time line.

At the clinic, the nurse creates an immunization card for the child. All the child's demographic information is inserted in a Master diary and a duplicate diary. Currently there are different immunization cards for different states and migrants will have their own localized data. In case the card is lost, a new card is made depending on the information given by the parents'. The nurse directs the parents to a USHA or a Community Health Worker in case of help needed.



The nurse is also responsible for the management of the vaccination inventory. At the clinic after the immunization card is created, the nurse or the doctor measures the height and weight of the child and discuss the current health condition with the parents. The vaccination session plan is explained and important notes about the child's health are take down. The child then gets vaccinated. Feedback is given about the child's growth and side effects about the vaccine are told to the parents. The parents are informed about the next vaccination date at the end of the session.

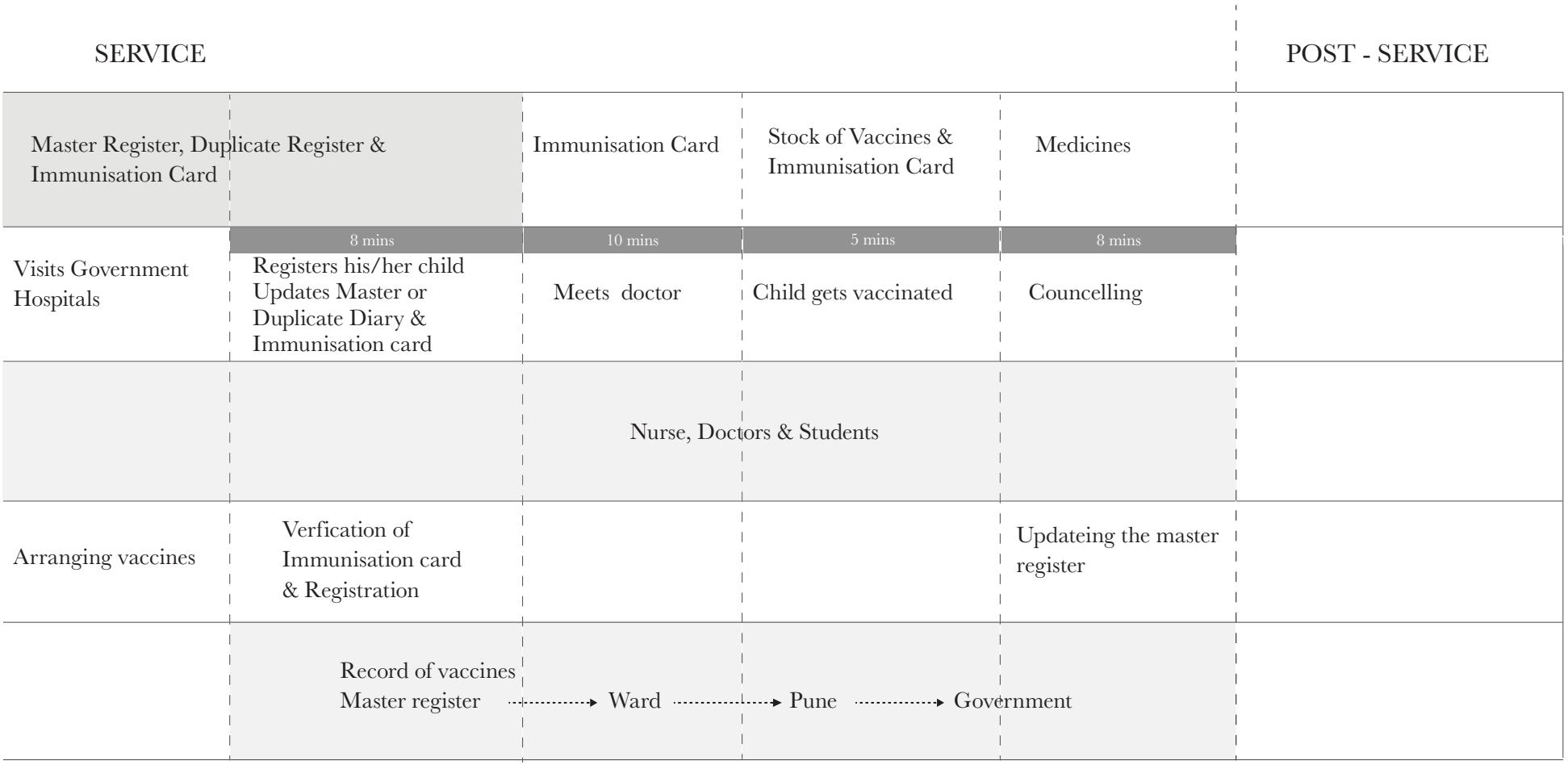
The master register maintained by the nurse has a duplicate copy made for the health center's reference. Every month this master register with 3750 child details is sent to the Municipal Corporation's Ward office. This diary is further sent to Pune where the data gets digitized for use by the Government and other authorities.

Current Blueprint Of The Service

If we see the current service nothing starts till the parents come to the hospital. One can see that the major interactions are between parents and nurses. There is no existing post service evident.

	PRE - SERVICE	
PHYSICAL EVIDENCE		
USER ACTIONS	Hospital, Posters, Television, Newspaper,Social Media, Website, Social Circle, Finding the hospital	
FRONT STAGE CONTACT	Nurse, Doctors, Relatives & Friends	
BACKSTAGE	Scheduling Vaccination & Allotment of vaccination team	
SUPPORT & PROCESS	Getting vaccines	

Figure 14. Blue print of the existing service in KEM Hospital


SERVICE
POST - SERVICE
Master Register, Duplicate Register & Immunisation Card
Immunisation Card
Stock of Vaccines & Immunisation Card
Medicines
8 mins
10 mins
5 mins
8 mins
Visits Government Hospitals
Registers his/her child Updates Master or Duplicate Diary & Immunisation card
Meets doctor
Child gets vaccinated
Councelling
Nurse, Doctors & Students
Arranging vaccines
Verfication of Immunisation card & Registration
Updateing the master register
Record of vaccines Master register
Ward
Pune
Government

Objectives

The overall objective of the project is to reduce the dropout in the rate of immunization in Urban India. The user studies identified a few need gaps with the present system :

It was found that the parents of the child often forget the date of appointment after the first few sessions of vaccination.
There is also a feeling of slight negligence from the parents' towards their child after the child grows older. This leads to a lack of urgency in attending the succeeding sessions. Parents are under the impression that after the first few sessions, the later vaccine doses have a lesser significance.
Hospitals and Government bodies responsible for the vaccination programs in urban areas need information about the drop outs in order to resolve the problem of dropouts. The number and the partial identity of the child may be needed to do this.
Although the earlier gaps are commonsensical in nature, the problems they pose are substantial. This need gap may be solved through a systemic change. Technology can play a major role. The objective of the project can be broken down into three parts:

Remind parents to take their child for vaccination at an appropriate time and location.
Educate parents about the importance of vaccination sessions and individual doses.
Enable the government and hospitals to track the data of the child's health records.

Initial Design Ideas

Design Idea 01

There can be a message delivering system through which hospitals can directly send text messages to parents. The prime objective will be to send crisp and short messages regarding the upcoming vaccination in a periodic interval of time. The proposed service can easily educate people about vaccination and its importance. Parents will have a proper idea about the upcoming process of vaccination and remind them about the next dosage.

The following protocol for the message was derived from the user study.

A. Information about the upcoming vaccine.
1. Why it is important ?
2. Oral or Injected which part of the body
3. Effect on the body.

B. Reminder about the date of vaccination.
1. Periodic reminders.
2. One month prior reminder starts.

C. Post vaccination message.
1. Follow up messages after vaccination

Figure 15. Awareness And Reminder Service Through Text Messages

Limitations :

There is a possibility that users may ignore any or all text messages received through the system. This negates the purpose of the idea altogether.

Design Idea 02

Messages through television. Hospitals or the government can send personalized message through the set top box of individual targeted users. The message will be a reminder about the child's due vaccination date, vaccination facts and other information. The proposed solution will always broadcast the message when the user switches on his/her television. The medium could be anything from text, audio, video or sound.

Limitations :

The idea is highly dependent on usage of television. If someone doesn't have a television or have a cable operator then the solution is nowhere useful.

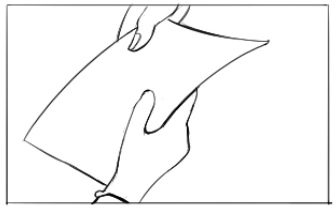


Figure 17. Interactive Pamphlet

Figure 16. Personalized Message Through Set Of Box Id.

Design Idea 03

There can be a interactive pamphlet which will be provided after registration of the baby. Pamphlet will have audio visual messages which will help them educating about the upcoming vaccine and the process doctors are going to follow while vaccinating her/his child. It will give a follow up message regarding the side effects child can have and remind her/him about the next vaccination date. After that she has to return the interactive pamphlet to the nurse.

Limitations :

The idea is not very cost effective. Managing a interactive pamphlet with a baby will be hard for parents.

Design Idea 04

We can design a centralized system for easy access of data across all the stakeholders. The primary objective of this platform would be to provide nurses and doctors easy and fast portal for registration and other processes. The secondary objective of this platform would be to make a database so that government and hospitals can generate insights about the population.
To illustrate, if a parent has registered his/her child in a government hospital A and then the next time whichever government hospitals (say hospital B) she vaccinates that data will be there in the system. Even if he/she misses a vaccine hospital A will put more efforts to get the child vaccinated. Similar in the case of government can easily track in which part identify programmatic areas that are performing well and areas that need strengthening. Once areas that require strengthening have been identified, the issue of improving performance can be addressed easily. Even hospitals can also do it in some extent.

The proposed platform will allow parents to have control over their child's immunization. They can easily share and print their child's immunization plan in any nearest government hospital.

Additionally, system will generate appointment slots based on user's residential address. The patients which stay far away from the hospital will be given higher priority and their names will be on the first slot of the list.

Figure 18. Centralized System

Limitation

Implementing the system in a country like India is a major task. The low rate of literacy and a high number of official languages across different states could be a major hurdle in making the data available digitally.

Design Idea 05

There can be a mobile phone application for parents which allows to create and manage child's vaccination records. It also helps in locating the nearest vaccination center. The application notifies the user about the upcoming vaccinations and due date of the vaccination. The application would calculate and generate a customized vaccination calendar for the child from his birth date. Parents can save the vaccinations data and would be able to send the vaccinations record if needed.

The application will start reminding 30 days prior to the start of the vaccination schedule. The application home consists of a time line interface with periodic videos uploaded on the time line depending on the vaccination stage. The videos would be to educate the parents about the vaccination, its dosage, side effects and other facts. It would also enable management of appointments. The application would show notifications for due appointments, new facts or videos uploaded or any other important broadcast.

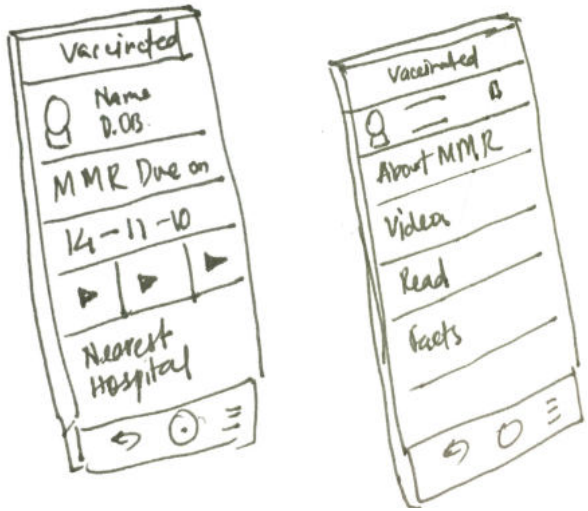


Figure 19. Mobile Phone Application For Parents

Limitations:
Availability of Internet connectivity is of paramount importance for the functioning of the application.

The mobile phone's form factor does not permit detailed information to be shown.
Although growing, smart phone penetration is yet far from reaching all the citizen.

Final Concept

From user studies it was found that a reminding and awareness system is a possible solution to reduce drop out rates in vaccination. The government and other health authorities need to know the number and partial identities of children getting vaccinated in the country to reduce the drop out rate in vaccination. This can be done by means of a centralized system.

A centralized system can be used by government or hospitals to monitor each child born in a government hospital or has been vaccinated in a government hospital. Once they are registered in the centralized system; hospitals or the government authorities can keep a track of their regular vaccines and educate them about the importance of vaccination. Parents can be reminded of upcoming vaccine dates though the medium of a mobile phone. This platform includes an easy and fast portal for registration and other processes for nurses and doctors. It will bring all the government hospitals under one larger network.

In case of the government, it can monitor hospitals and patient data to identify the number of dropouts in different areas in the country. This enables the government to segregate and take action on the areas performing poorly with a large number of dropouts in vaccination. For example if we know that an area in Mumbai has had a large number of dropouts in vaccination for past year, then we know the target are to do the awareness.

Advantages of Centralized System -

Data Integrity

The single greatest benefit of centralizing immunization data is data integrity. The positive points about centralizing the data will be that no redundancy and it will be reliable data. A centralized database means that each member has one primary record, with primary contact information. Thus when there is a change required (like a new phone number or email address), there is only one place to look to make these changes.[11].

Valuable Insights

As all the information gets centralized, it is much easier to develop reports that show a broad range of insights. It will especially help nurses who need to maintain two different diaries and now can automatically generate reports at the end of the day [11].

Efficient service

Parents can easily go to any government hospital to vaccinate his/her child. The vaccination card could be sharable and can

make numerous number of copies. The system will generate appointment slots based on user's residential address. The patients which stay far away from the hospital will be given higher priority and their names will be on the last slot or the preferred slot of the list.

All the information will be available upfront for the stakeholders thereby providing an easy access to the patients' vaccination records.

To reduce the dropout rate, parents should be aware and reminded periodically during the course of immunization. This can be achieved by means of a centralized system with a database through which we can easily have the parents' and the child's demographic information.

The system additionally consists of an application for parents to remind them about the upcoming vaccines.

This application would also work as a medium for educating parents about the medium for educating parents about the immunization process, awareness about vaccines and will also share facts about vaccination. The system tries to connect a whole spectrum of stakeholders starting from parents, hospital managements, doctors, nurses and the government.

The applications starts reminding the parents 30 days prior to the immunization schedule. Parents can be made aware by means of short videos about the vaccination, its dosage and side effects. Periodic session reminders are necessary for parents. This can be done through system generated messages and notifications which would include text message as well as links to the awareness videos. The application also includes a feature for management of appointments and notifications would be pushed whenever a new video is uploaded or an appointment is due.

Proposed Ecosystem

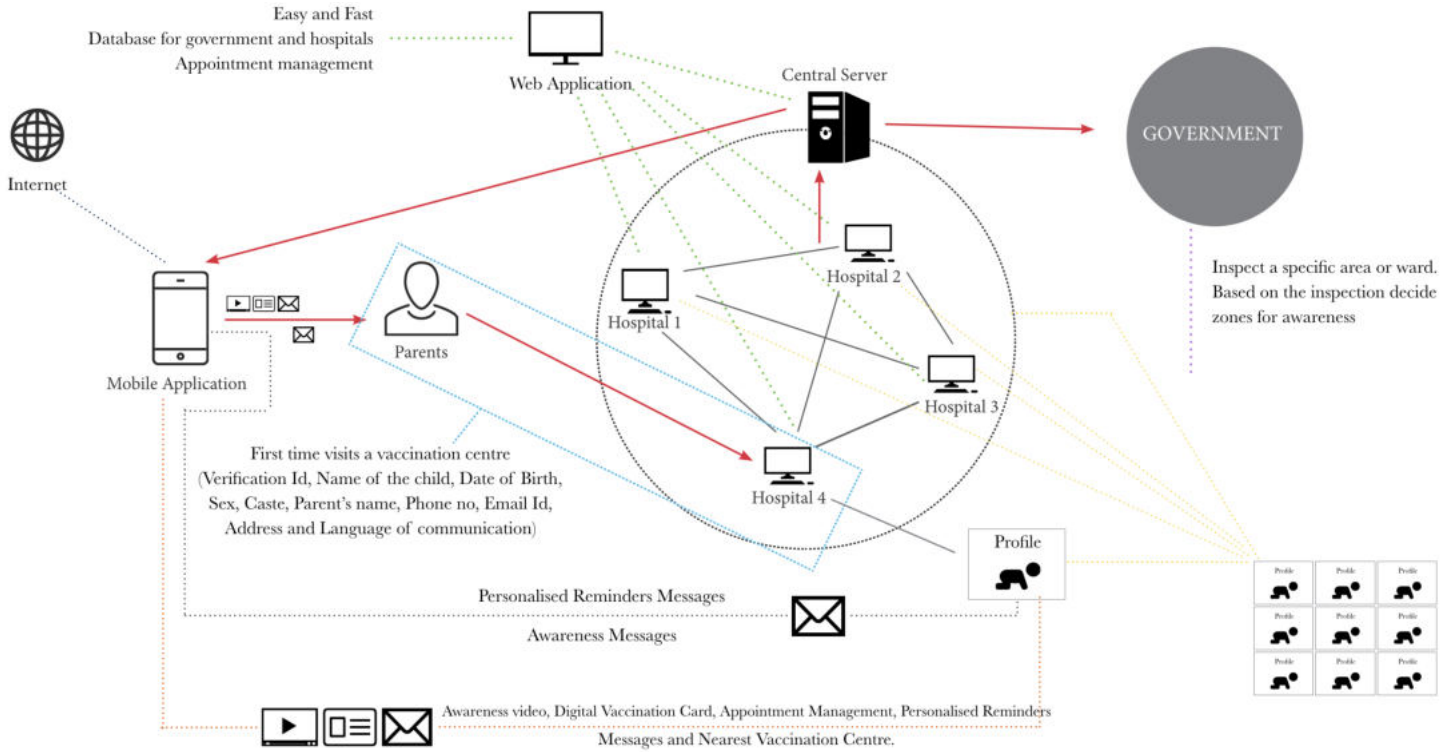
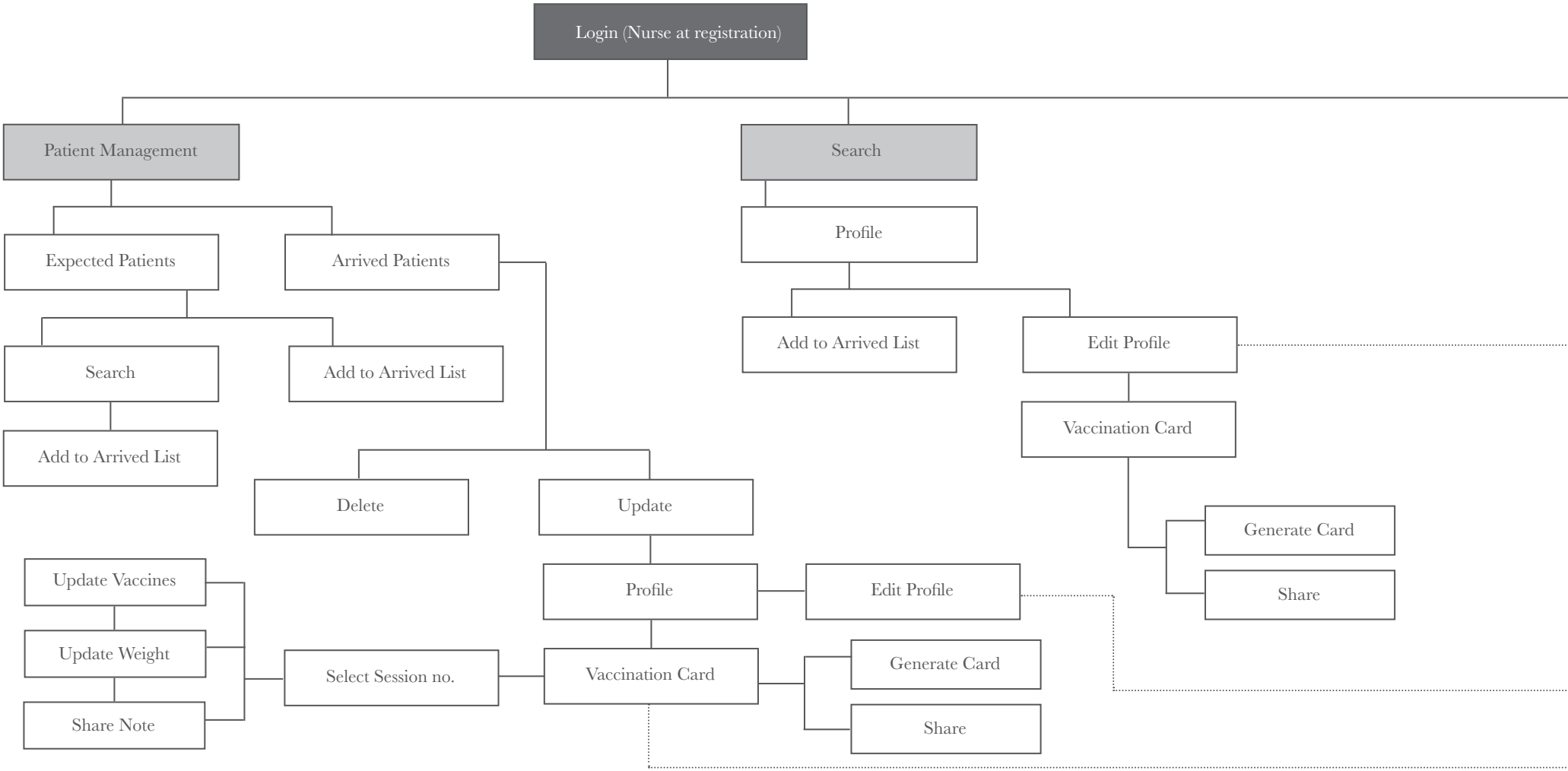
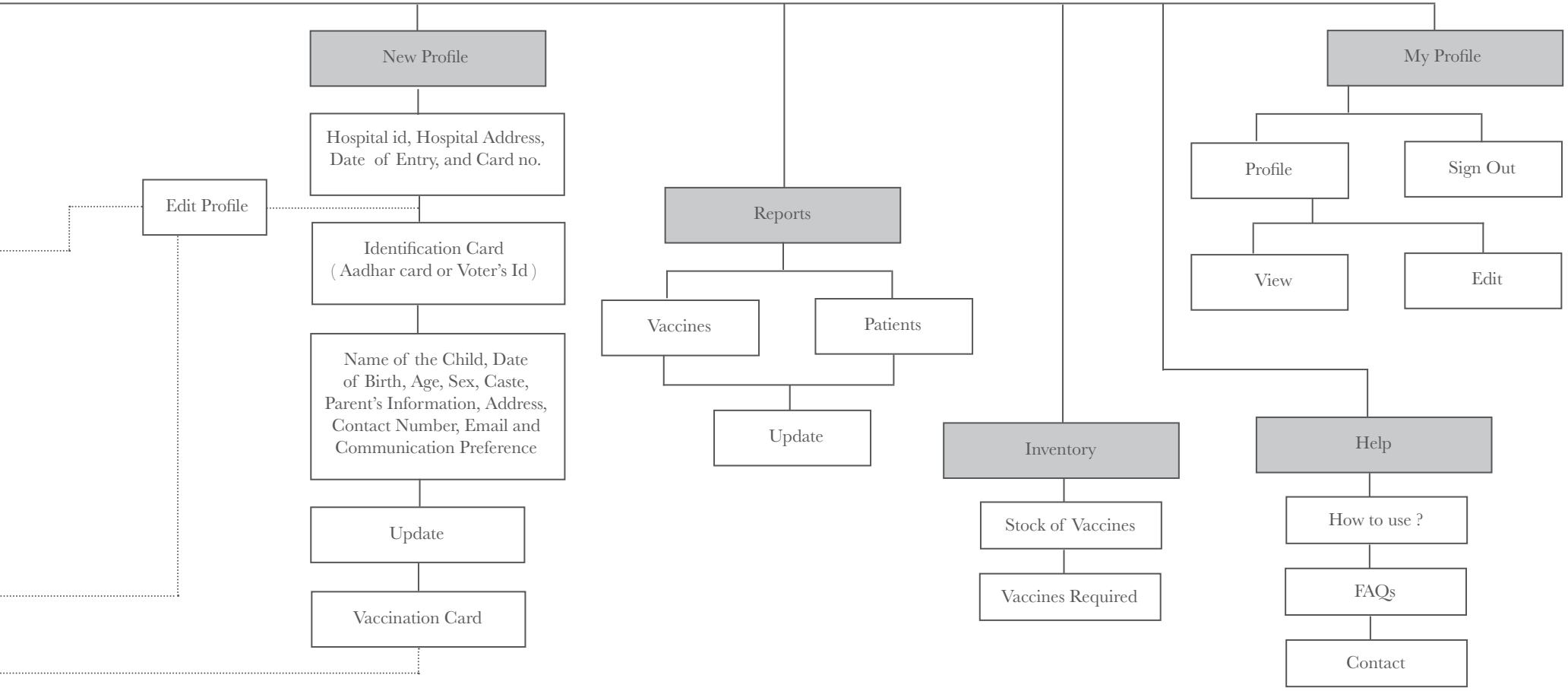


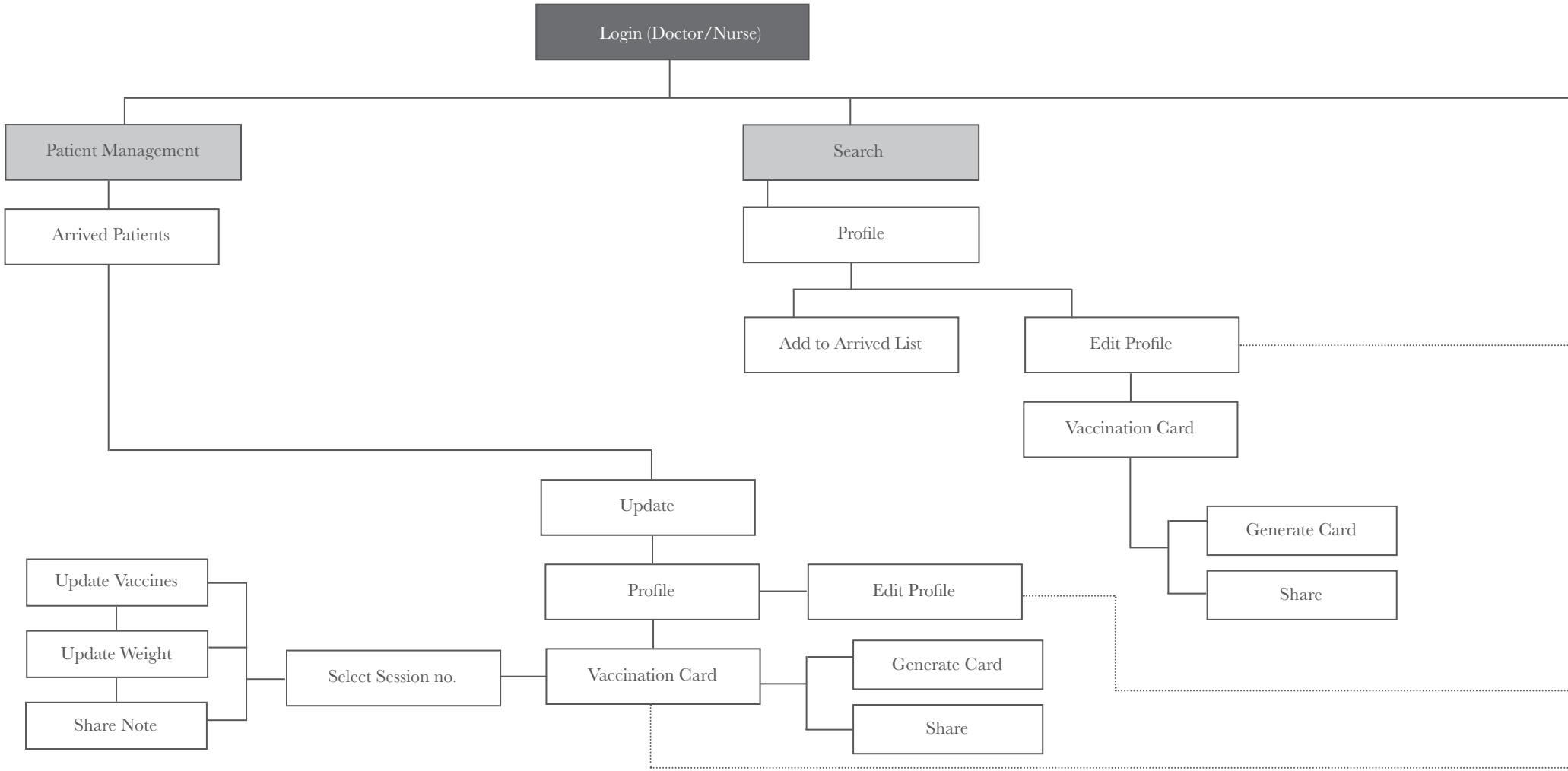
Figure 20. Proposed Ecosystem

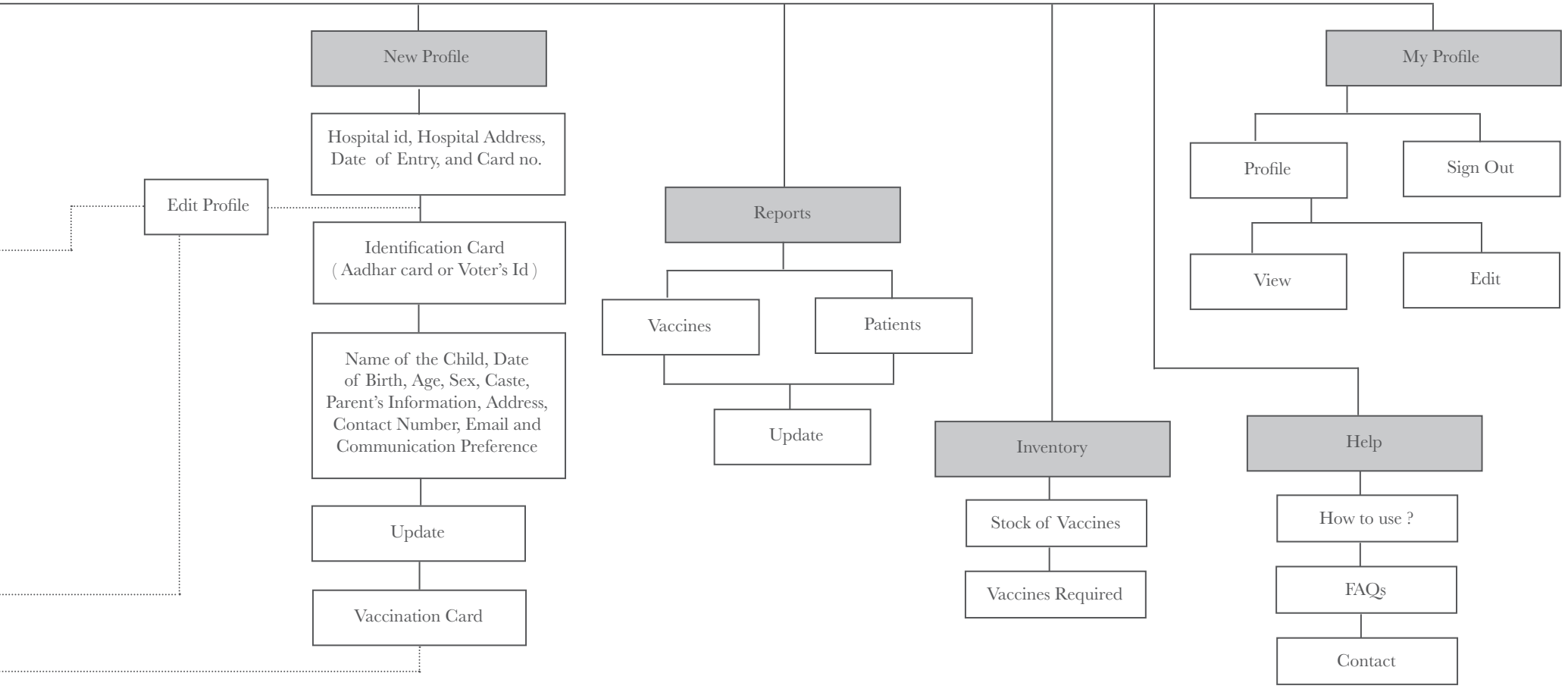
The proposed ecosystem indicates that all government hospital are linked to each other through a centralized system. The parents register from any hospital and their as well as the child's data is uploaded on a central server. All the data in central server is shared with government and among hospitals. Parents receive all reminders, notifications and messages through the application in their phone which system generated.

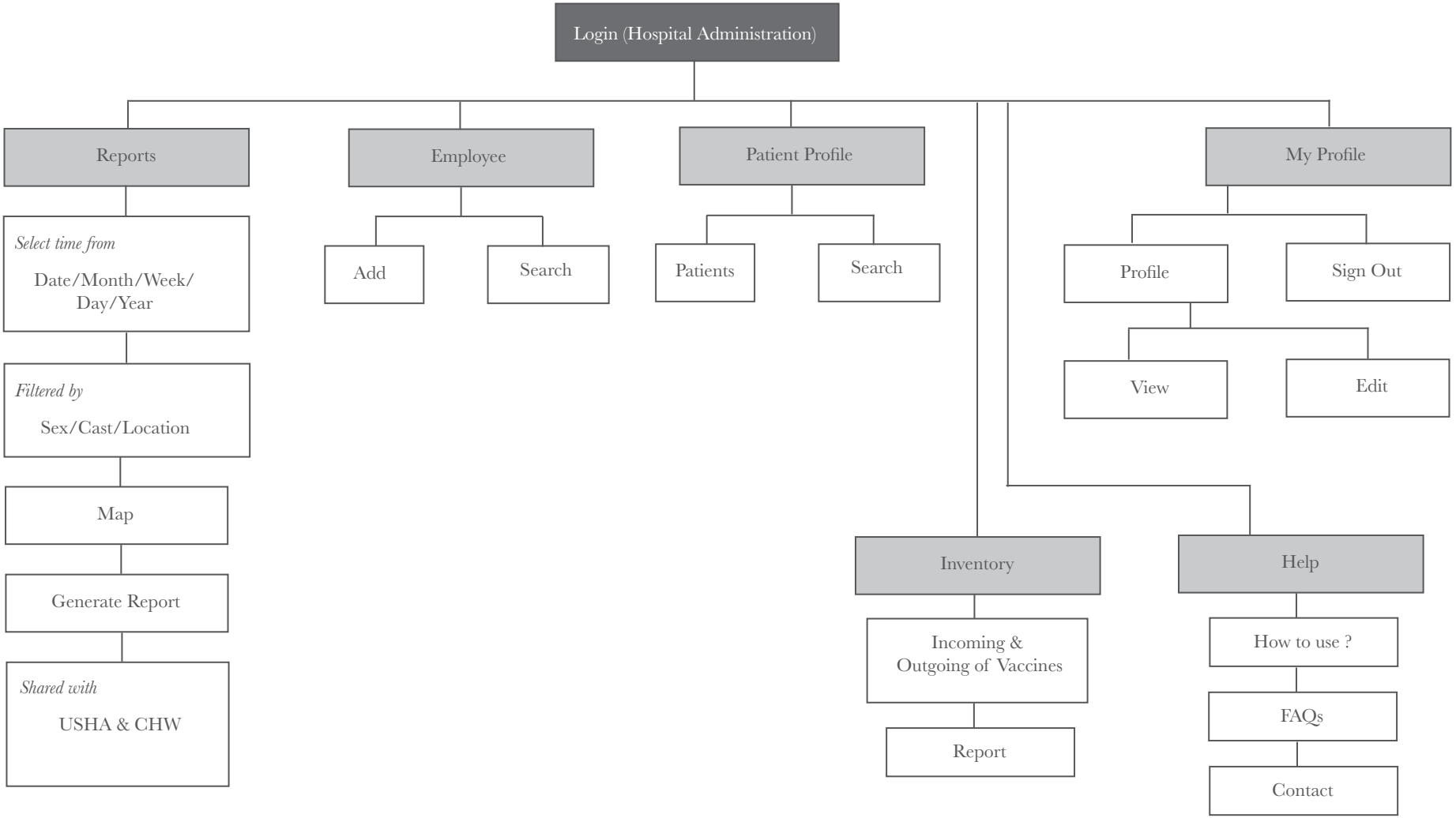
Information Architectures

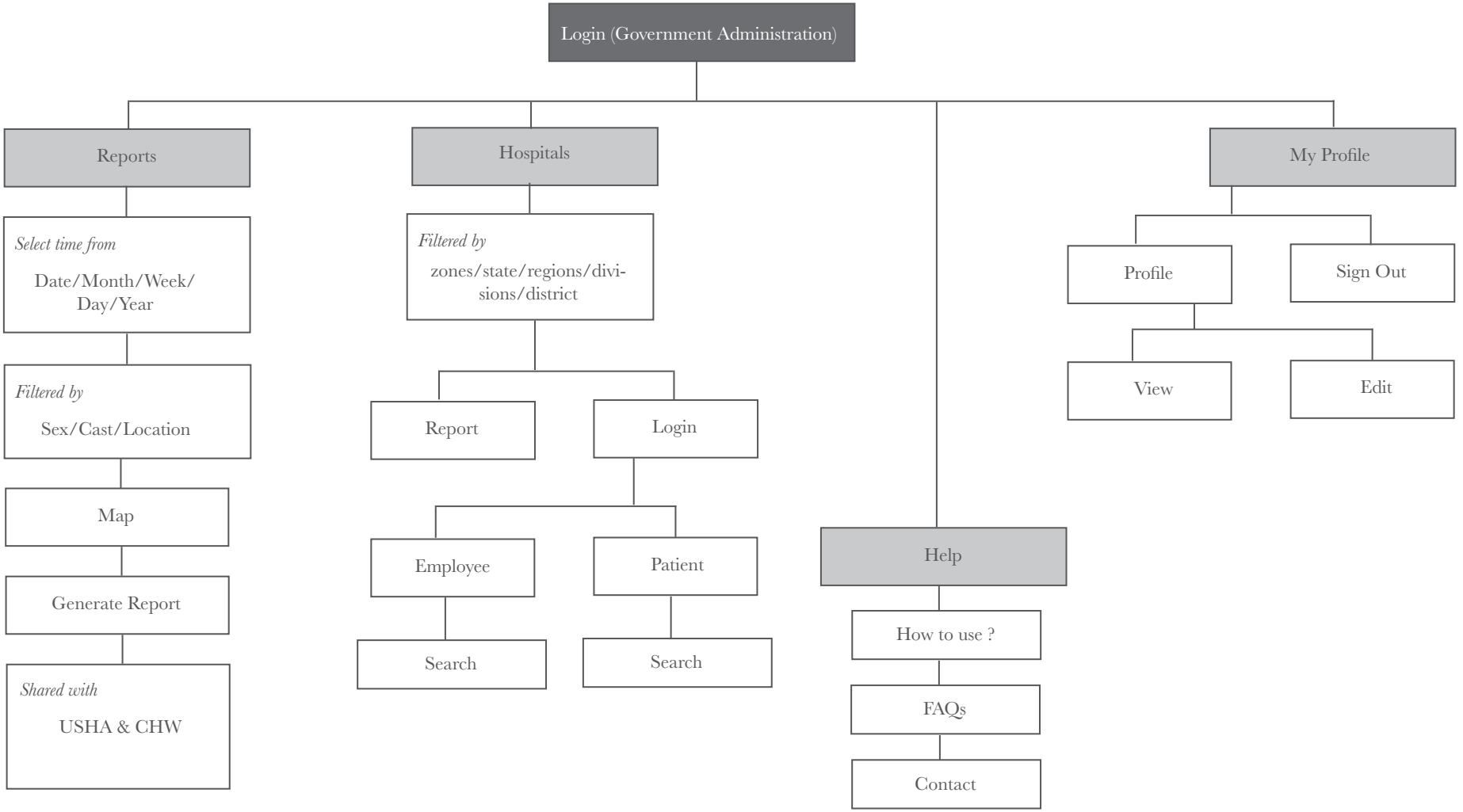



New Profile
Hospital id, Hospital Address, Date of Entry, and Card no.
Identification Card (Aadhar card or Voter's Id)
Name of the Child, Date of Birth, Age, Sex, Caste, Parent's Information, Address, Contact Number, Email and Communication Preference
Update
Vaccination Card
Edit Profile
Reports
Vaccines
Patients
Update
Inventory
Stock of Vaccines
Vaccines Required
My Profile
Profile
Sign Out
View
Edit
Help
How to use ?
FAQs
Contact


Login (Doctor/Nurse)
Patient Management
Search
Arrived Patients
Profile
Add to Arrived List
Edit Profile
Vaccination Card
Update
Generate Card
Share
Update Vaccines
Profile
Edit Profile
Update Weight
Select Session no.
Vaccination Card
Generate Card
Share Note
Share


New Profile
Hospital id, Hospital Address, Date of Entry, and Card no.
Edit Profile
Identification Card (Aadhar card or Voter's Id)
Name of the Child, Date of Birth, Age, Sex, Caste, Parent's Information, Address, Contact Number, Email and Communication Preference
Update
Vaccination Card
Reports
Vaccines
Patients
Update
Inventory
Stock of Vaccines
Vaccines Required
My Profile
Profile
Sign Out
View
Edit
Help
How to use ?
FAQs
Contact


Login (Hospital Administration)
Reports
Employee
Patient Profile
My Profile
Select time from
Date/Month/Week/
Day/Year
Add
Search
Patients
Search
Profile
Sign Out
Filtered by
Sex/Cast/Location
View
Edit
Map
Generate Report
Inventory
Help
Incoming &
Outgoing of Vaccines
How to use ?
Shared with
USHA & CHW
FAQs
Report
Contact


Login (Government Administration)
Reports
Hospitals
My Profile
Help
Select time from
Date/Month/Week/ Day/Year
Filtered by
Sex/Cast/Location
Map
Generate Report
Shared with
USHA & CHW
Filtered by
zones/state/regions/divi-sions/district
Report
Login
Employee
Patient
Search
Search
Profile
Sign Out
View
Edit
How to use ?
FAQs
Contact

Centralized System

Landing page for the nurse after login. The page is populated by the expected patients.
Nurse can directly search on the server and can add a patient on the current list of vaccination.
The nurse can generate a sharable electronic card of the child in any language for parents for reference.

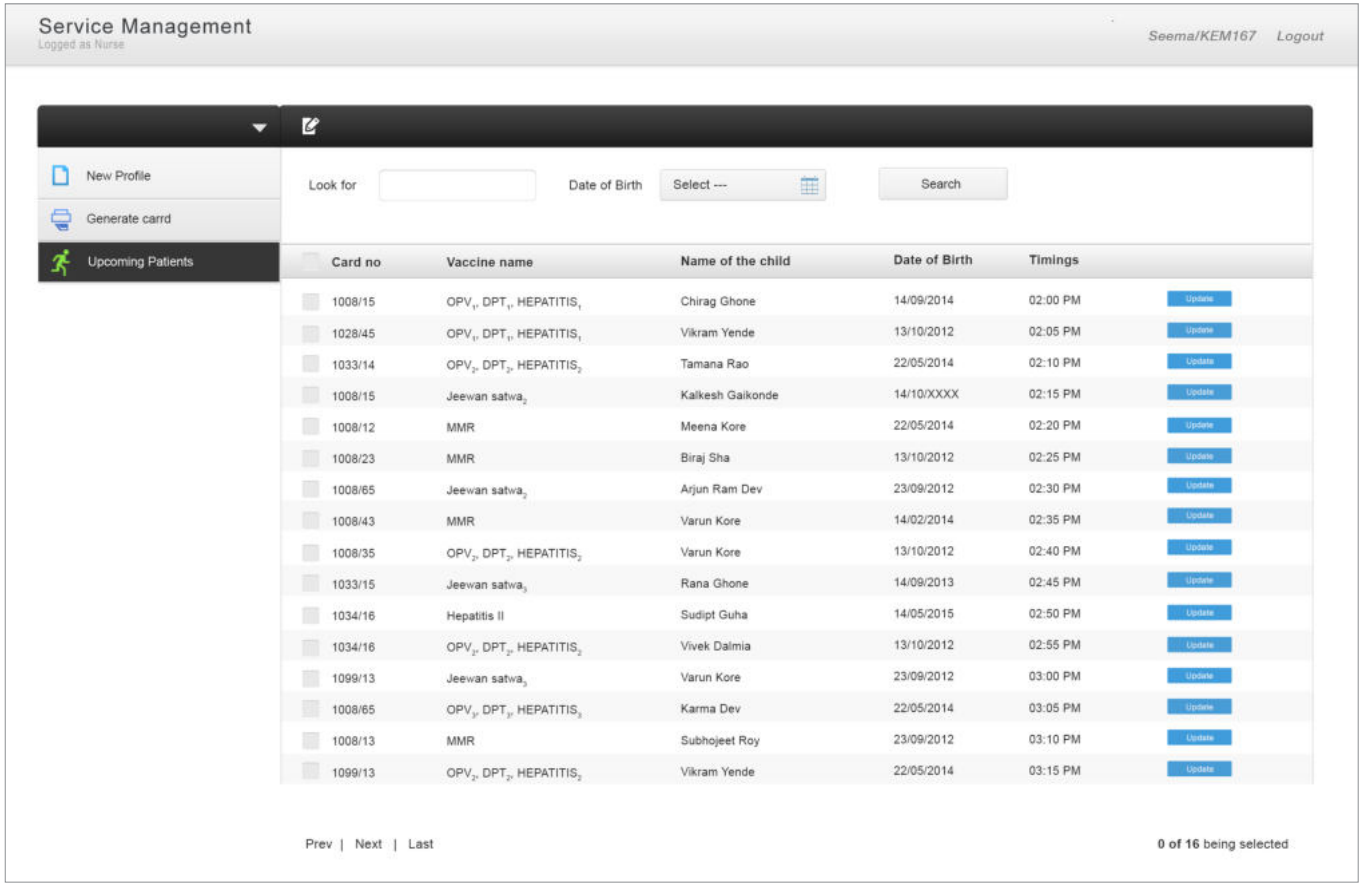


Figure 21. Nurse(Landing Page)

Add a new profile page. All relevant information about the child is noted at this page from parents. To make the identity authentic, reliable and to make the process faster a verification id is asked from parents. Parents need to register through voter's id or aadhar card.
Reminder language preference is kept because through user study it was clear that people have different choices when it comes to selecting a medium of communication.
Once the child is registered in one of the hospitals, his/her information is directly uploaded to the central server. Parents can visit any other hospital and get their child vaccinated by telling the identification number or through their voter id or aadhar card.

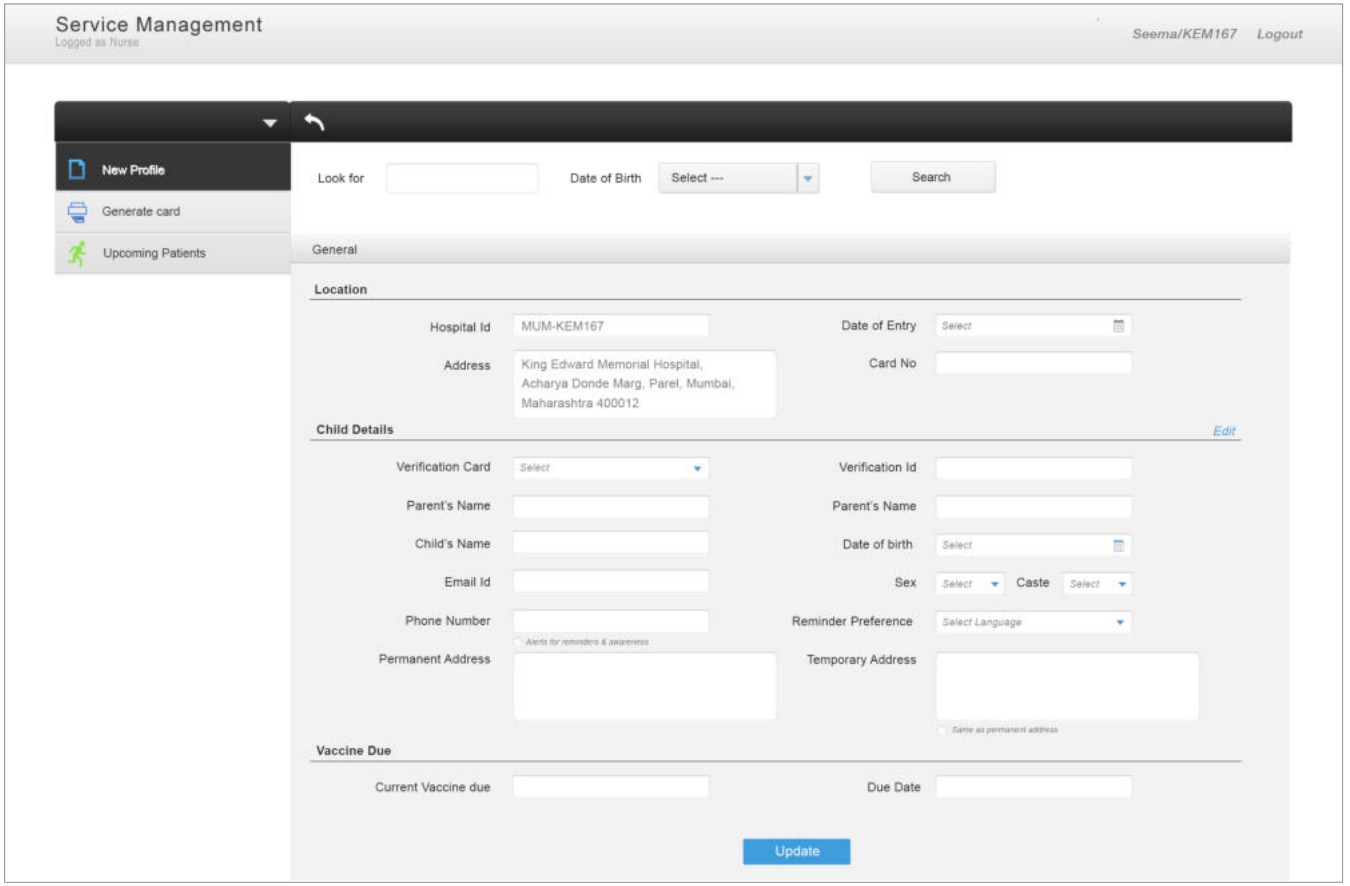


Figure 22. Add new profile.

Updated and Existing page of child's profile.
There is two options of address to locate the parents of a child so that the government can see in which parts there is a major dropout in vaccination.

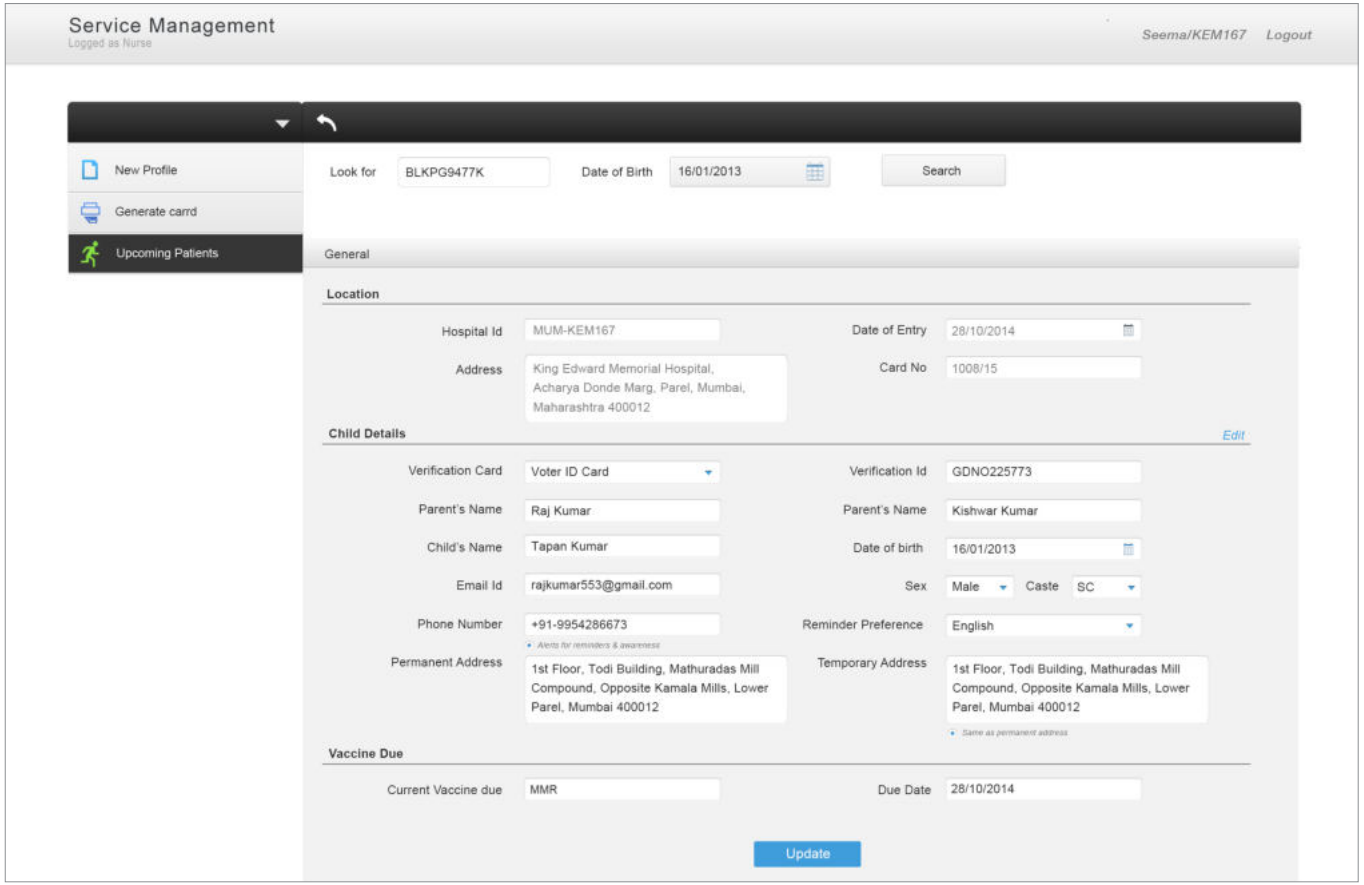


Figure 23. Updated profile.

Vaccination card of the child. All the session of vaccines are made into cards. It highlights the current vaccines that are needed to be given to the child.

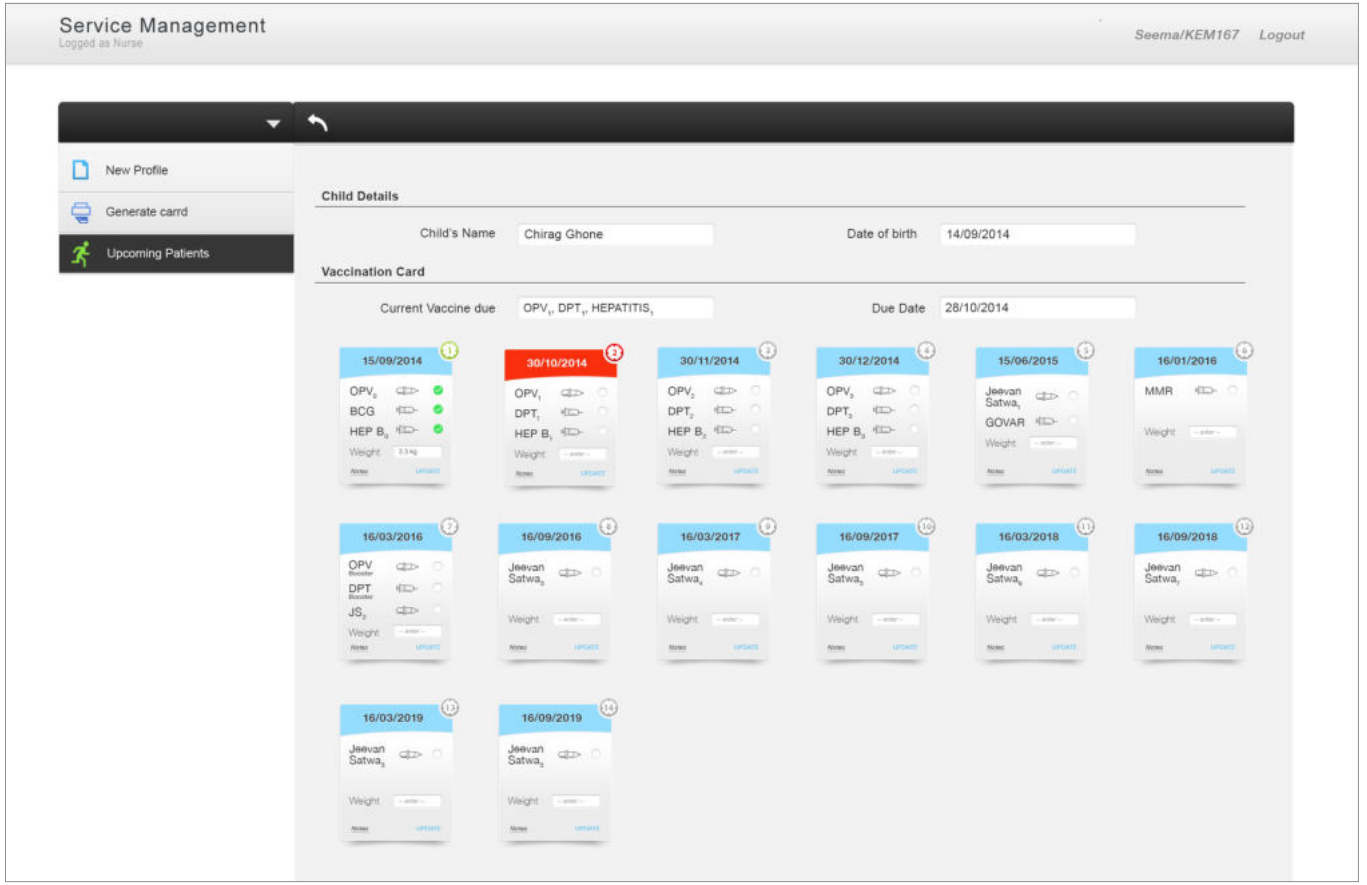


Figure 24. Vaccination registry

Easy selection for updating the vaccine card. Date can only be changed here, once the date has been changed the system will automatically change the other upcoming dates. There is also an option to add a notes which can be directly shared with other cards.

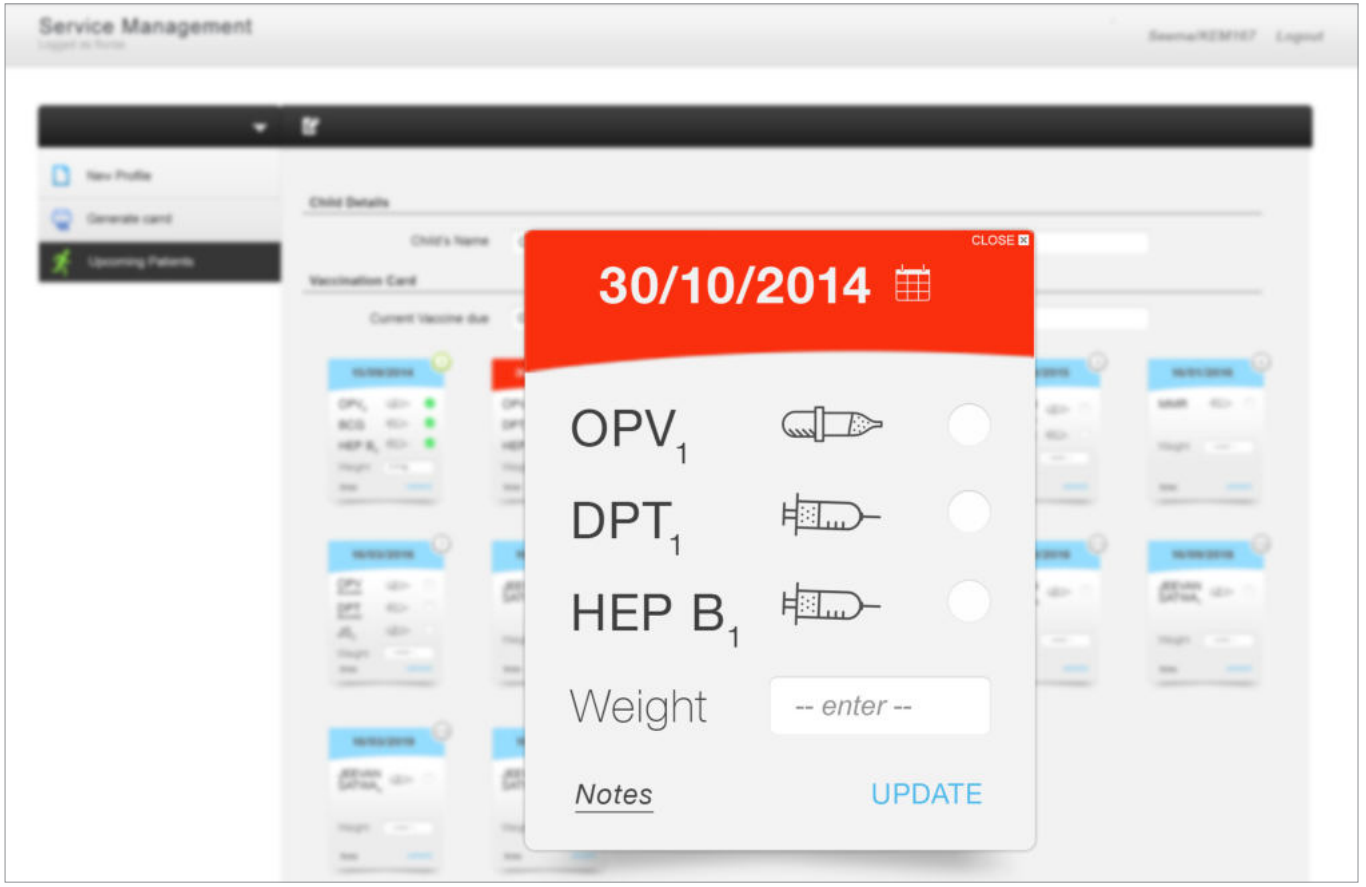


Figure 25. Editable vaccination card

Evaluation Of Initial Concept

Heuristic Evaluation

The screens of the application were shown to a group of nurses and the system and the application was explained. The nurses were asked to evaluate the product based on the verbal explanation and the user flow of the application. This was done to quickly identify apparent flaws with the interface or the system before creating the prototype.

User Feedback

- Nurse liked the work flow about the application but wanted a different page to manage the patients who just have arrived in the hospital.
- Expected list won't work for daily appointments and giving a proper timings will create chaos in the hospital.
- Nurses also expects system should automatically update the daily reports.
- There should be options to search patients on the list.
- Even though user seemed OK with English language.

Final Design

Introducing Vaccinated

It is a system that connects the data from all the hospitals in an easy to use format for the hospital staff and the government. A system that enables fast and efficient updation and management of patient and hospital data like appointments, dropouts and vaccination session information along with patient information. It allows governments and hospitals to monitor the immunization program as a micro level in a hospital department or at the macro level of the nation.

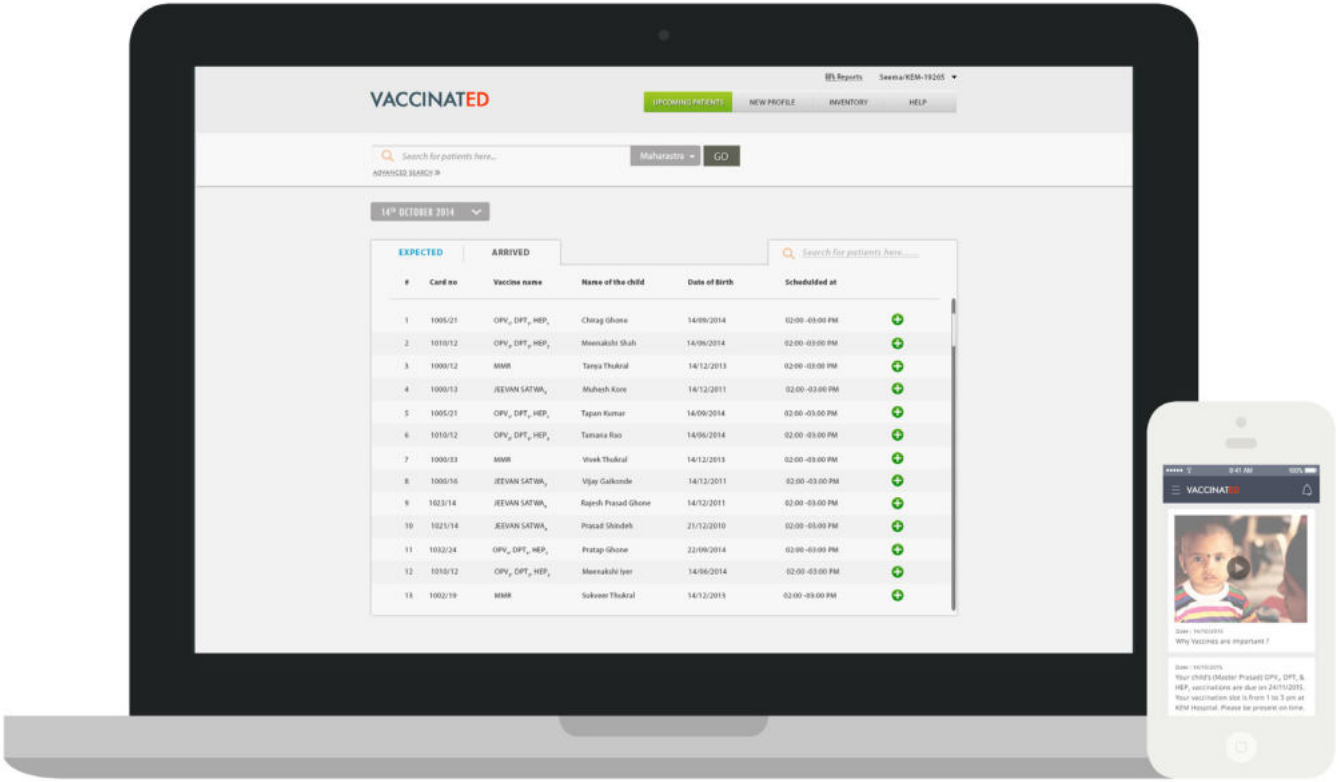


Figure 26. Vaccinated web application and mobile application

Scenario 01

Naveen and Vasundhara are new parents and want to get their child vaccinated. They are unaware of the process and go to a nearby government hospital to inquire about the vaccination sessions. Vasundhara has an idea about a vaccination card.
When they enter the hospital, they are surprised that there is no form to be filled. Instead the nurse asks for their identification and most of the form that is on her computer is already filled up with their information. She asks a few questions about the child like its name, date of birth, preference of language for communication and contact information of the parents. In no time the vaccination card is generated and Naveen and Vasundhara receive a message on their mobile phones regarding the creation of their child's profile and the process further in their preferred language.

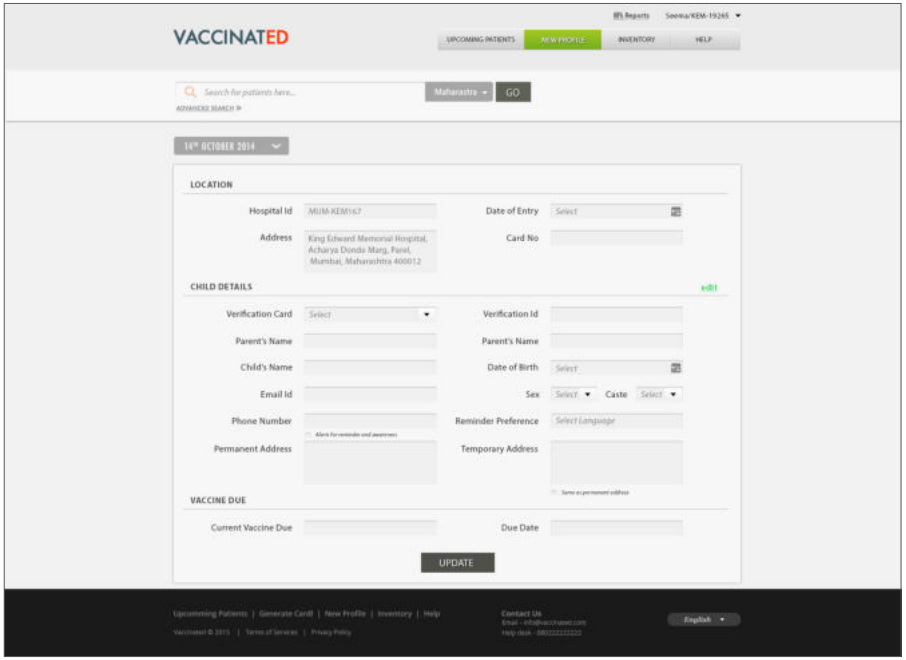


Figure 27. Vaccinated new profile page.

This is the page where first time registration is done. All the demographic information of child is fed here. This form is filled by hospital management. Management need not feed the entire as there is automation to do the same. Most of the demographic data is fed using either Adhar card or Voter's id.

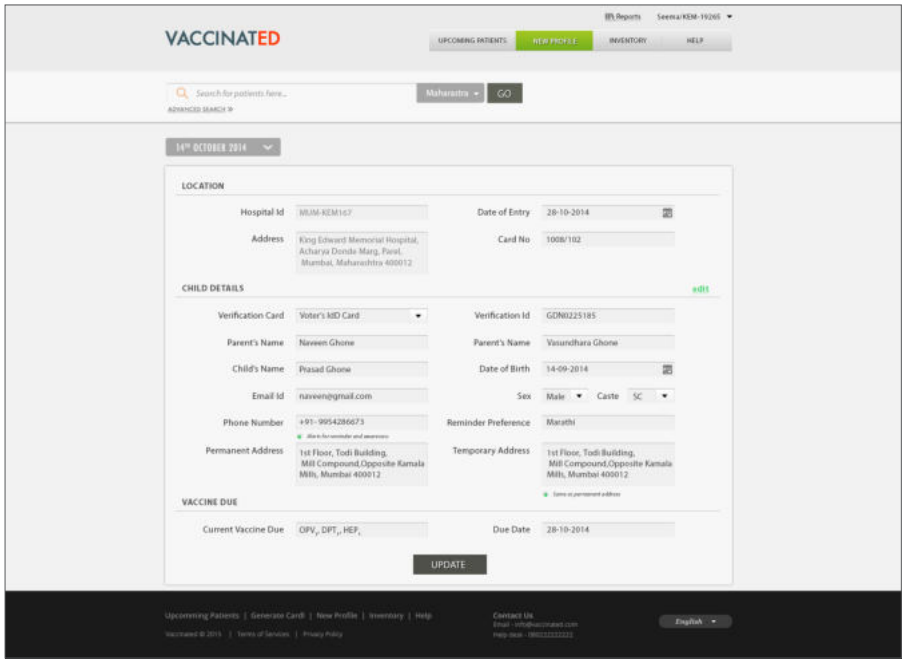


Figure 28. Vaccinated updated profile page.

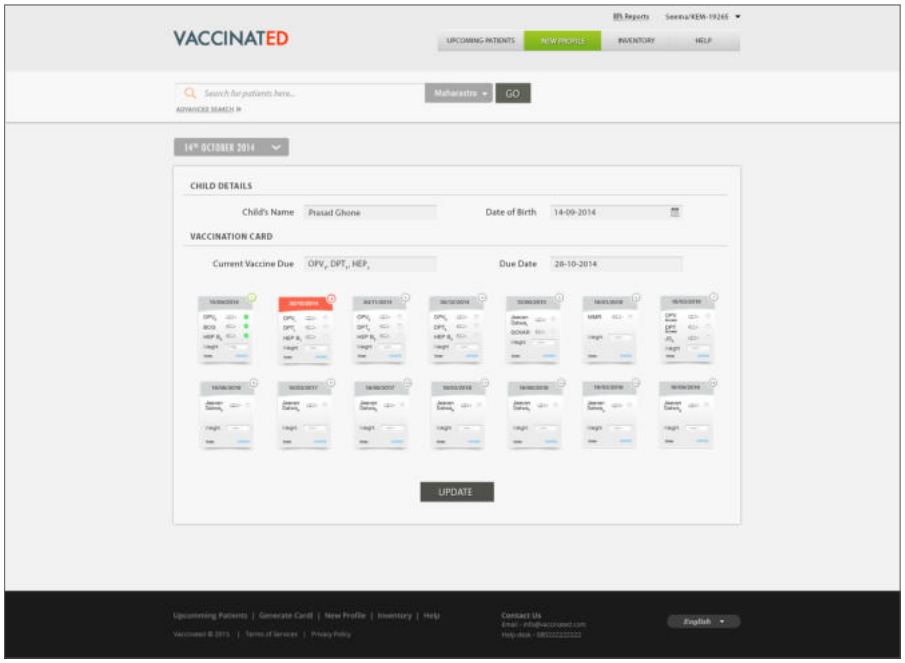


Figure 29. Vaccinated vaccine registry page.

The information like Telephone number of parents, Option to set that telephone number for reminder service, Preference of language for messages, etc is filled in this page.

This is the page which contains all the planned vaccination sessions for the child. The sessions which are done are highlighted with a different color for visual segregation of information.

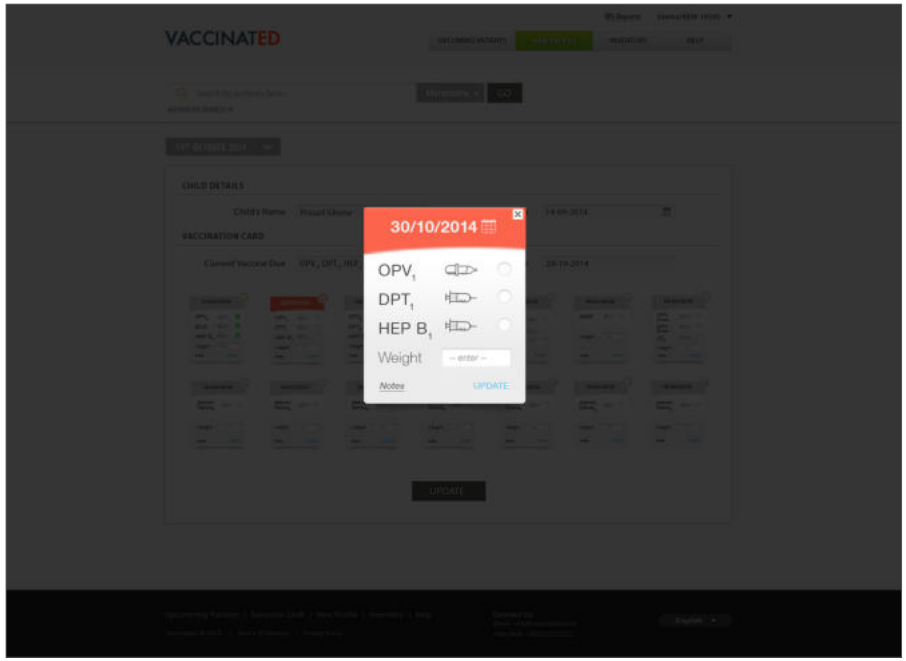


Figure 30. Vaccinated vaccine page.

When a nurse clicks on any session card, this zoomed version of the card is shown. To avoid errors by nurse, radio buttons are provided to mark the vaccines. The nurse can then change the actual date on which child is vaccinated, which then changes all the next vaccine dates adaptively.

Scenario 02

The hospital dean wants to have a look at the vaccination report for the past 6 months. He asks his assistant to create a report of the same in an hour. The assistant opens the dashboard of the hospital administration system from his computer. He selects the months for which the report is to be generated. He clicks on a generate report button of the dashboard. He also finds an option of creating a map of the successful and dropout cases to look at which areas have the most frequency of dropouts. He selects the option to insert the map in the report. The system generates a report of the past 6 months in the form of a PDF document. This document contains detailed information and graphs about the number of patients expected, the number of dropouts, frequency of dropouts, days on which there were the most number of dropouts and many other parameters. He shares this PDF with the dean. The dean is happily surprised to find such a detailed report in less than half an hours time. The dean send the report ahead to the entire

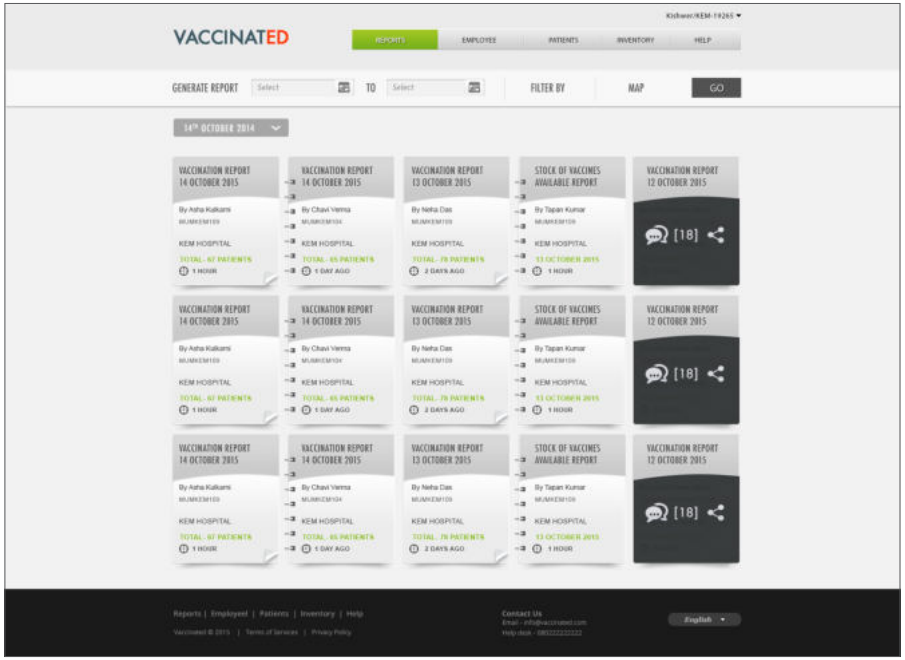


Figure 31. Vaccinated report page.

This the landing page of hospital administration. The admin can see immunization records on this page. He can also view the comments written on the record. This reports are also sharable. Admin can share these records with USHA and CHW workers.

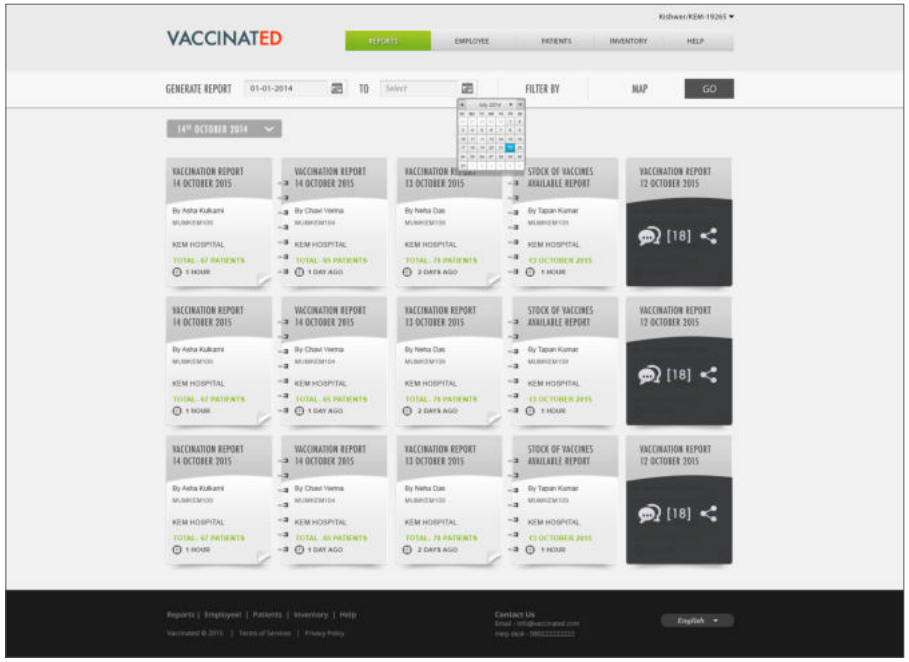


Figure 32. Vaccinated report page.

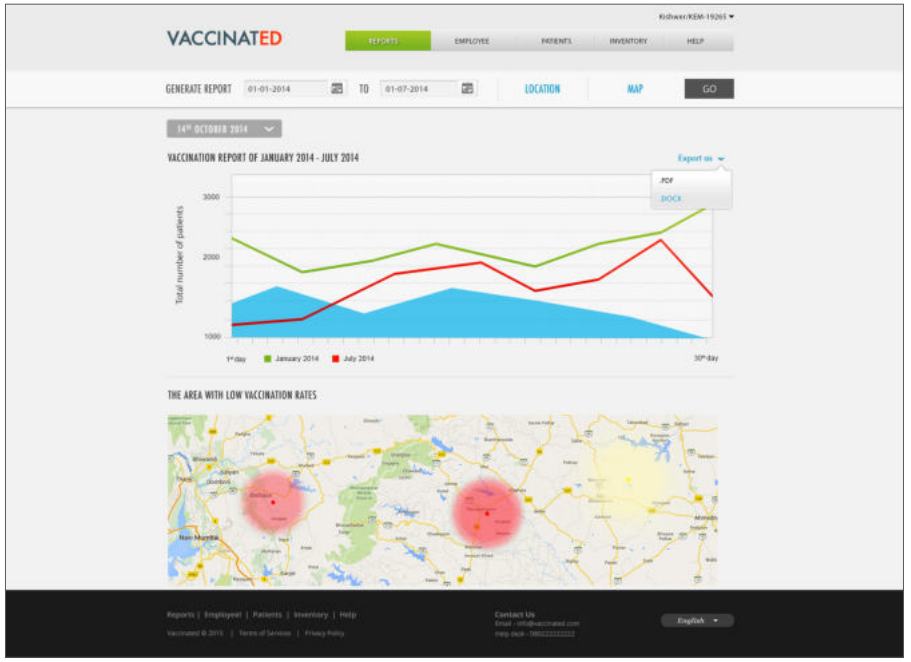


Figure 33. Vaccinated report page.

As the database of all the kids are now present, hospital administrator can look up the data over a period and get meaningful insights from that data. For example, admin selected two dates as the interval, and then filtered the data as per sex and plotted it on a map using 'map' button. Administrator can see the results containing the vaccination during that selected period with that particular sex information and plotted on map.[Fig. 33]

Mobile Application for Parents

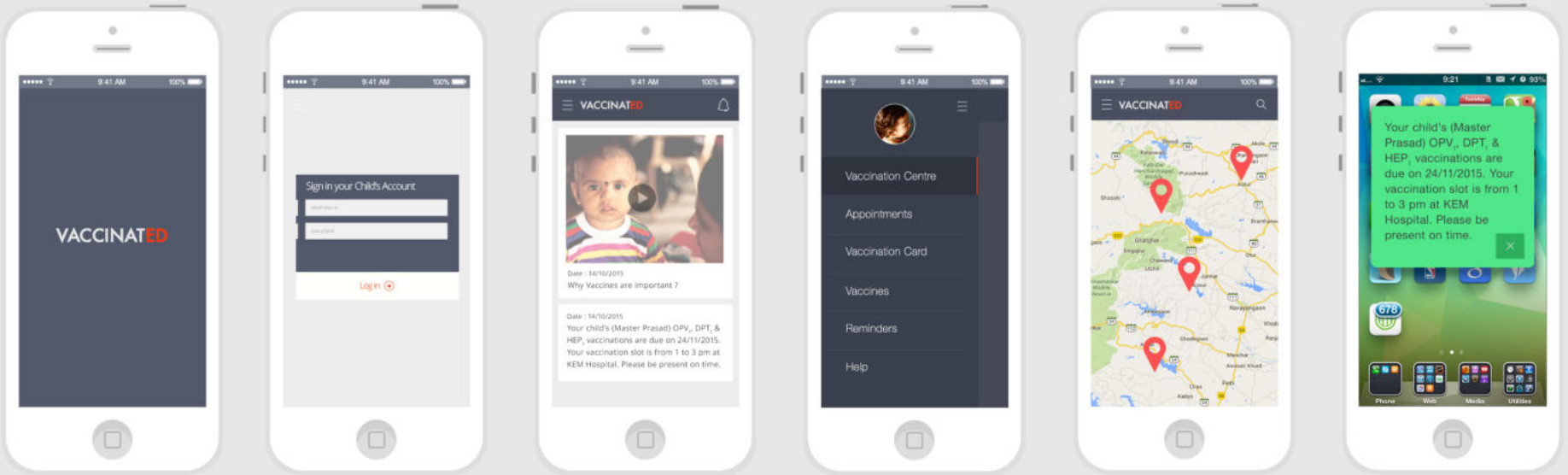


Figure 34. Vaccinated mobile application

Parents can add their verification in the form of their aadhar card number or voter's id or any other approved verification mechanism along with the child's date of birth. The child's profile will be created and information about the vaccination and pending appointments will be notified through the application. The information of only the upcoming vaccination will be pushed to the parents. The parents will be able to reschedule any vaccination appointments through the application. The application also enables parents to find the nearest vaccination centers and pushes messages to the home screen. This application is linked to the centralized system and any update to the data about eh child like the number of vaccinations administered or sessions attended in the centralized system will get reflected in the application.

Message & Reminder Plan

This service is executed for every vaccine. The service starts 30 days prior to the actual vaccination date. 3 messages are sent within a span of this 30 days. The first message is sent 30days prior the vaccine due date, second 20days before and 3rd 10 days before. The structure of the content of message is discussed below.

First message :

The first message is about the awareness of vaccine and vaccination. The message answers these 3 questions:
1. If my child is not vaccinated, what will happen? What it might lead to?
2. Why is it important?
3. How to take the vaccine? Oral or injected? If injection, where to take it?

Second message :

This message tells you about the next due vaccine. This is a personalized message with child's name.

Third message :

This message talks about the post vaccination queries. It talks about the post vaccination symptoms. If in case, vaccine have an adverse effect on child's health. How to identify whether it is within expected limit of that vaccine ore beyond? What to do if such symptoms are identified.

Figure 35. Awareness message, Reminder message and Post vaccination message

Evaluation

The evaluation of the project's aim to reduce the drop outs in vaccination is a longitudinal evaluation and lies outside the scope of the design project. However, the system can be evaluated on two important parameters of reminders and the usability of the centralized system.

Reminder

Research Question : Do the system messages help in reminding parents about the vaccination appointments?
The evaluation is done to check the effectiveness of a text message as a medium sending reminders and the content of the message.

Experiment Design

- 10 Users will be divided in 2 groups of 5 each
- Control group will have 5 users and NO reminder text messages will be sent to them
- Experiment group will have 5 users and reminder text messages will be sent to them
- User turn up from both groups will be recorded
- Conclude based on the observations

Centralized System

The centralized system is checked for its usability. The application is shown to the user group and a think aloud test is to be conducted. The user is asked to do a series of tasks and think aloud while doing those tasks.
Users: Nurses and Medical Students are to be recruited from KEM hospital.

Think aloud test (10users)

- The user is asked to look at the expected and arrived patients on the dashboard.
- The user is asked to move any two patients in the expected patients list to the arrived list. (early success)
- The user is asked to click the register patient button.
- The user is then asked insert the interviewers identification and register the interviewer. He can put the dummy child name as Jayati and the Date of Birth three months from the date of the Think aloud test.

Findings

- Change names of the following options:
    - Vaccination Centre >> Find Vaccination Centre
    - Vaccines >> Vaccine Information
- In the vaccination card option, the dropdown menu options of printing and saving are redundant and should be discarded
- List of vaccination cards should be in a list format rather than a 2 column grid
- The information about the next vaccination should be made explicit
- There should be an option of multi language support
- Contextual notification should be a top priority.
- Know information of the next vaccination should be on top. Notifications should should be last first.
- Important notifications like the next appointment schedule should be highlighted.
- The arrangement of options in the hamburger should be changed to appointments, vaccination card, vaccination centre and vaccines.
- When booking or changing appointments, there should be an option of editing the hospital venue
- In the vaccination centre option, the nearest vaccination centre from the users location should be highlighted

Conclusion

The content and medium has the potential to create awareness among the target audience. The awareness process and the appointment management system can reduce the number of unnecessary visits by the concerned parents. The centralised system has the potential to reduce considerable amount of effort put in by the nurses to maintain the physical registers.

It will take time to adapt and built up a multi lingual centralised system in India but soon it will be there.

Future Work

- Multiple Language Support for the application and website.
- Report generation and visualization of spatial data can give different insights to government to work upon.
- Conducting workshops to get the nurses acquainted with the digital interface.
- Expanding the scope of target audience.

References

1. http://www.newindianexpress.com/nation/Rural-Children-in-India-Have-Better-Immunization-RatesReport/2015/09/15/article3029562.ece

2. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3894018/

3. http://www.dsource.in/case-study/immunization-card/understanding-the-context/index.html

4. http://www.cochrane.org/CD003941/EPOC_does-reminding-people-to-have-vaccinations-increase-the-number-of-people-who-receive-vaccinations

5. reminders work ; http://www.cochrane.org/CD003941/EPOC_does-reminding-people-to-have-vaccinations-increase-the-number-of-people-who-receive-vaccinations

6. http://www.ijmr.org.in/article.asp?issn=0971-5916;year=2014;volume=139;issue=4;spage=491;epage=511;au#ft61

7. https://nrhm-mis.nic.in/PubCoverageEvaluationLibrary/Maharashtra.pdf

8. http://www.iapcoi.com/gp/parents-guide-part1.pdf

9. http://www.cdc.gov/globalhealth/immunization/docs/isb-factsheet.pdf

10. http://www.scopemed.org/?mno=423

11. http://effectivedatabase.com/resources/why-should-you-have-a-centralized-system/

12. http://www.vaccinestoday.eu/vaccines/who-advice-for-vaccination-drop-outs/

13. http://www.who.int/immunization/monitoring_surveillance/routine/en/

14. http://www.gavi.org/support/hss/

15. http://www.gatesfoundation.org/What-We-Do/Global-Development/Vaccine-Delivery

16. http://www.who.int/immunization/global_vaccine_action_plan/GVAP_doc_2011_2020/en/

17. Seven factors for designing successful mHealth.
Author : Atanu Garai
Publications : XRDS: Crossroads, The ACM Magazine for Students - ICT for Development: Bettering our world through technology.
Volume 19 Issue 2, Winter 2012
Pages 16-19

18. http://www.immunizeindia.org/