Vaccine Delivery Innovation Initiative

Project Summary

Disclaimer: All visual elements shared from the research within the document as well as separately may not be used for advertising products or services, brand endorsements or for public propaganda.

CKS

CKS Consulting Pvt. Ltd.

Vaccine Delivery Innovation Initiative
Copyright © 2009-10 Bill & Melinda Gates Foundation

BILL & MELINDA GATES *foundation*

Contents

Executive Summary

This report presents the results of a research and innovation project called the Vaccine Delivery Innovation Initiative (VDII). It is an outcome of a research and design collaboration between CKS Consulting Pvt. Ltd. (hereafter 'CKS'), and Dr. John Sherry of Intel Corporation, with support from the Bill & Melinda Gates Foundation and in partnership with the Government of Bihar.

The purpose of the project was to apply the methodology of ethnographic research to better understand barriers to routine immunization from the unique perspective of users- namely, frontline health workers and recipient families- and identify innovative solutions that account for user-preferences and helps them overcome everyday challenges to increase immunization coverage. Members of CKS spent several weeks in five locations across the northern Indian state of Bihar shadowing frontline health workers, interviewing families, and observing community life. We came away with a deep understanding of the dynamics of routine immunization: How frontline health workers think about their work; how communities view the public health system; how various incentives motivate action – or fail to do so; how a lack of resources or environmental conditions constrain the ability of workers to reach certain areas.

We organized our numerous, diverse insights about such barriers into a framework that focuses on six key areas. Each of these areas will be discussed in the pages that follow:
- Identifying, registering and locating children for immunization
- Immunization session planning and management
- Immunization session execution and logistics
- Tracking children and work activities
- Accountability and training
- Awareness and demand

The aim of the project is to go beyond merely identifying barriers, and to drive innovation that can be used to significantly increase routine immunization coverage. Some of the solutions explored by the CKS team have already generated interest among firms or organizations who have expressed their willingness in further developing these ideas into products or services.

I. Introduction

## Routine immunization in the state of Bihar

As noted by the World Health Organization, delivering safe and effective vaccines through an efficient delivery system is one of the most cost effective public health interventions. Routine immunization (RI) is a process for protecting newborns and young children from a variety of diseases, including polio, tetanus, diphtheria, pertussis, tuberculosis, measles, and others. It involves a series of injections and oral doses given at regular intervals throughout the first year of life. Immunization is not considered complete unless the full course of immunizations is given.

India is home to one of the largest RI efforts in the world – based on the number of fully immunized children[1], the volume of vaccines delivered, and the geographical spread of the communities served.

This project focused on the northern Indian state of Bihar. Over a fifteen year period ending in 2005, Bihar's neonatal health care indicators actually declined compared to the rest of the northern Indian states. In the last three years, however, Bihar has seen substantial improvement. New health initiatives by the National Rural Health Mission (NRHM) such as *Muskaan* in 2007, have contributed to an increase in routine immunization rates in Bihar from 20.7% to 41.4 %[2] between 2004-07. Bihar has been making significant progress, with immunization coverage increasing even upto 54.6%[3] between 2008-09, with firm commitment from the State Health Society Bihar (SHSB) and technical support from UNICEF and WHO, constantly endeavoring to improve immunization coverage in the state. Local experts point out that merely implementing the current system correctly would continue to increase immunization rates, perhaps even up to the highest levels in north India (~75%). The project attempts to compliment these efforts that are already underway, by providing ideas for innovative solutions to help accelerate and sustain these developments.

Full Immunization coverage (Northern Indian States)
Percentage of children 12-23 months
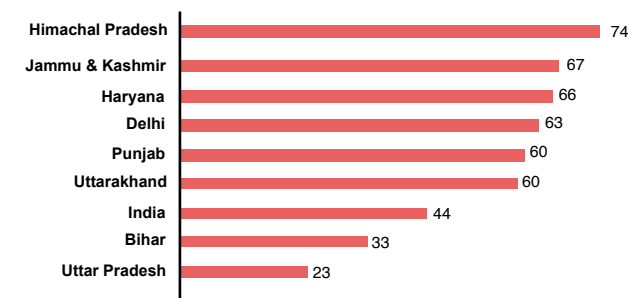
Source: NFHS-3 (National Family Health Survey) 2005-06

Trends in Vaccination Coverage (Bihar)
Percentage of children 12-23 months receiving vaccinations
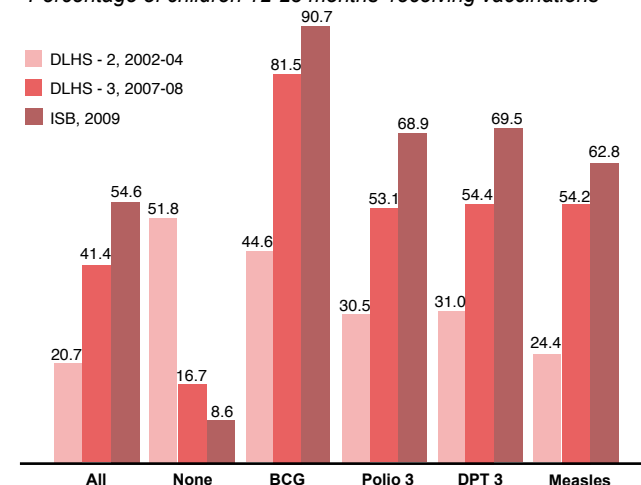
Sources: DLHS-3 (District Level Household Survey) 2007-08 Bihar, ISB 2009

[1] A Fully Immunized Child (FIC) should have received single dose of BCG, three doses each of DPT and OPV, and single dose of measles vaccines before the child reaches one year of age. The coverage figures quoted in the document imply full immunization, unless otherwise noted.

[2] Based on a comparison of data from DLHS-2 (District Level Household Survey, 2002–04) and DLHS-3 (2007-08), Bihar

[3] Based on data from ISB, 2009

Research Locations

Research was conducted in five districts of Bihar. Our focus was mostly on rural locations, where migration rates, lack of access to private services and other factors affect RI success. (One urban location was studied, providing a valuable point of comparison). Our choice of locations offered maximum diversity in terms of key variables, including robustness of the public health infrastructure, caste, cultural and ethnic diversity, socioeconomic status, education, geography, political and administrative factors, and others. Based on these parameters we selected the following districts:

- *Kishanganj* has routine immunization coverage of less than 30% (DLHS-3, 2007-08). It ranks low in terms of health infrastructure and basic socioeconomic factors, with a high Muslim population at 67.5 % (Census of India 2001).
- *Muzaffarpur* also ranks low both in terms of health infrastructure and socioeconomic factors, but has comparatively high complete immunization coverage at 50.1%- 60 (DLHS-3, 2007-08). It is classified as a High Risk zone with some flood-hit areas.
- *Saharsa* is also extremely flood prone, ranks relatively high in terms of health system factors, but lower in terms of endemic socioeconomic factors.
- *Gaya* has a weaker public health system, but ranks higher in terms of endemic socioeconomic factors. It also has a high scheduled caste population at 29.6% (Census of India 2001).
- *Patna*, an urban area in a continuing expansion mode, has many peri-urban areas with lower immunization coverage than rural areas.

In each of these districts, two blocks were selected based on contrasting immunization rates, geographical location and topography, and demographics. On an average about four villages were covered in every block, including many hard-to-reach areas.

Map of India and the state of Bihar

Districts in Bihar

II. Goals, Methods and Approach

Design thinking meets systems thinking

Over the past two decades, an increasing number of organizations have applied the principles of "design thinking" or "design innovation" to solve a wide variety of challenges. While normally associated with the creation of sleek, high technology gadgets or consumer products, design innovation has also been fruitfully applied to problems of global health and development[4]. For this reason, members of the Global Health Group at the Bill & Melinda Gates Foundation sought to employ a design innovation approach to the problem of routine immunization.

"Design thinking" emphasizes a clear, detailed understanding of potential end users of a product or service. Given the goals of this project, however, we knew that a more holistic, systemic understanding of vaccine delivery would be necessary. We needed to understand many different "end users". This included, first and foremost, frontline health workers, including Auxiliary Nurse Midwives (ANMs); Accredited Social Health Activists (ASHAs); and Anganwadi Workers (AWWs). Equally important to us were the mothers, care providers and decision makers in the households of children who would be eligible for immunization. Beyond these, we were committed to learn about others in the public health system: Medical Officers In-charge (MOICs), Lady Health Visitors (LHVs), and others. We also approached rural health care practitioners and other key influencers (e.g. religious heads) to understand the broader challenges from the demand side at the community level. We studied the functioning of private clinics, in order to provide us with points of comparison, for instance on such issues as how record keeping is handled.

---

[4]*The well-known American design firm IDEO, for instance, has partnered with the Rockefeller Foundation and the Bill & Melinda Gates Foundation to develop design tools for the developing world.*

Ethnography as a research method

Ethnography is a research strategy often used in the social sciences, particularly in anthropology and in some branches of sociology, for gathering empirical data on human societies/cultures. The term ethnography may be loosely applied to any qualitative research project where the purpose is to provide a detailed, in-depth description of everyday life and practice. Unlike survey research, ethnography involves the goal of seeing the world, as much as possible, through the eyes of the people we study. Data collection is done through various methods such as interviews, participant observations, and shadowing, often involving lengthier periods of time spent "in the field".

Ethnography complements other research methodologies such as quantitative surveys and field trips. It validates assumptions and other analysis gained from secondary sources, while at the same time uncovering new insights and areas otherwise overlooked. Generating the findings in the form of photographs, videos and audio recordings provide for powerful tools of communication. It provides the necessary base information such as cultural or social sensitivity of the target group to generate suitable design principles against which all future solutions may be tested. The design concepts can be directly tested with the end-users, which help in refining and strengthening the target product profile.

Process flow

Research

14 weeks

Analysis

6 weeks,
2 key workshops

Innovation

8 weeks,
3 key workshops

■ **Secondary research**
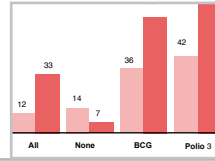
- 6 weeks
- 25 expert interviews, literature review and detailed location selection process

■ **Ethnographic research**

- 8 weeks, 10 team members, 5 locations
- About 4500 hours of interviews, observation, digital photos, videos and audio

■ **Interim analysis**

- 2 weeks, 2 interim workshops, More than 15 participants each
- Presenting data, identifying robust patterns and knowledge gaps, revising research questions

■ **Final analysis**

- 4 weeks, 6-10 members
- Building data models, identifying key challenges, brainstorming on potential solutions

■ **Concept generation**

- 2 weeks, 1 workshop, 5-7 members
- Building on potential concepts, preparing storyboards for a subset of most promising concepts

■ **Concept validation**

- 1 week, 2 locations in Bihar
- 10 experts in New Delhi and Patna, Bihar
- Testing concepts with users and domain experts, documenting feedback

■ **Revising concepts**

- 2 weeks, 5-7 member
- User and expert feedback analysis and revising concepts

■ **Innovation workshops**

- 2 days each, 2 workshops, 30 participants each
- Sharing findings with a larger audience soliciting reactions to initial concepts, brainstorming on additional solutions and prioritizing ideas leveraging multi-disciplinary expertise

(Above) Researcher shadowing an ASHA, (Below) Researcher interacting with key influential people in the community

Research activities

The project began with a comprehensive secondary literature review, and interviews with individuals who have worked extensively in the domain of maternal and child health in the states of Uttar Pradesh and Bihar. These interviews revealed many of the challenges in vaccine delivery and uptake at the ground level. This preliminary work helped us to frame specific research questions targeted at different points in the public health delivery system and in the communities that system is required to serve.

Equipped with this background knowledge, the teams began their research in the selected locations in Bihar. Employing methods such as observing, interviewing and shadowing the various participants, and by extensively documenting the processes through digital photographs, videos and audio recordings, the researchers sought to understand the rural health ecosystem. What is it like to be an ANM or ASHA? Conversely, how do people in the community – young mothers who might be resistant to RI – perceive ANMs or ASHAs? This requires the ability to recognize the perspectives and assumptions that shape people's beliefs and attitudes, and the nature of their interaction with each other. How does an ASHA speak to a mother or grandmother as she tries to convince them of the value of RI? How does the ANM explain (or fail to explain) follow-on care instructions to a young mother with a newly immunized child? How often does an ANM interact with her immediate supervisor, the LHV? What do they discuss? Similarly, what kind of interactions do ANMs or ASHAs have with MOICs? Such observations help us in understanding how information flows through the network of people responsible for RI, and in understanding the scope for improvements. Another key aspect of the research is to look for "pain points". When does a tool not work as designed? When does an incentive fail to motivate the desired action? How might a lack of time, or factors in the environment, limit the ability of a frontline health worker to do her job?

Research participants

Given below are the types and numbers of participants the researchers interacted with during the course of the project.

Frontline Health Workers

- Auxiliary Nurse Midwives (ANMs)   - 20 (4 per district)
- Accredited Social Health Activists (ASHAs) - 20 (4 per district)
- Anganwadi Workers (AWWs)   - 20 (4 per district)

Lady Health Visitors (LHVs)   - 10 (2 per district)

Medical Officers In-charge (MOICs) - 10 (2 per district)

District Immunization Officers (DIOs) - 5 (1 per district)

Rural Health Practitioners   - 10 (2 per district)

Home Visits   - 40 (8 per district)

Alternative Drives[5]

- JE Vaccination Program
- Polio Campaign
- *Dular* Training

[5]*A few alternative campaigns not directly linked to RI were also studied, to gain a better understanding of the holistic rural health system, as well as to understand their independent functioning, and to draw comparisons with respect to RI.*

(Above) Researcher in conversation with a recipient's mother during a home visit, (Below) Researcher interacting with key religious influencers in the community

(Above) Organizing data during the interim workshop, indicating unauthorized participants in the system and identifying knowledge gaps, (Below) Creating multiple data models to represent the enormous ethnographic data collected
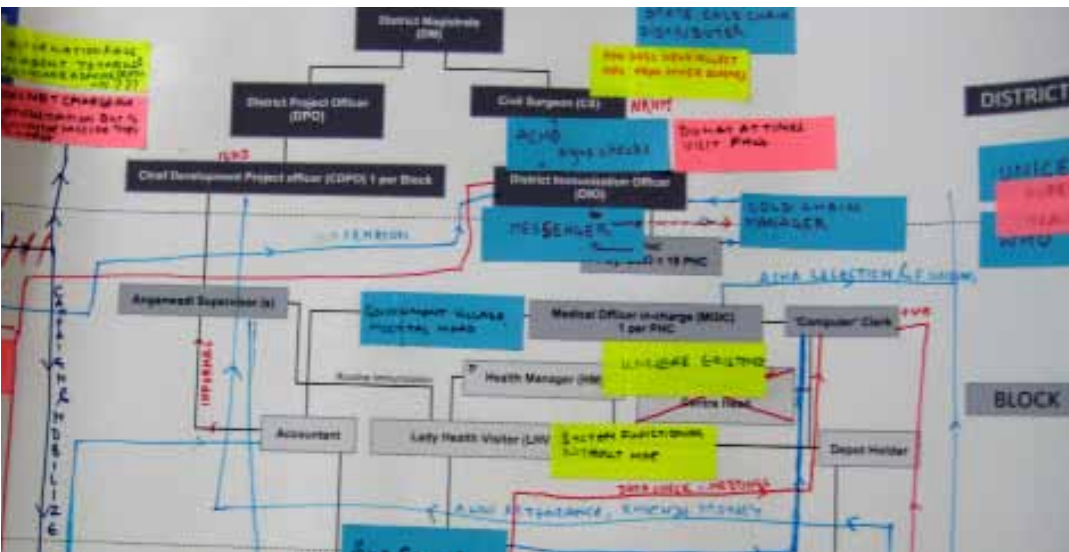
Analyzing the ethnographic data

Two interim workshops were held in Patna, Bihar at key points in between the research phase. The workshops saw the participation of a few experts representing the public health system and related organizations, in addition to the research team. It served as a platform for individual teams to present the data from their respective locations to a larger group. This helped in identifying robust patterns (e.g. lack of proper information exchange between the ANMs and ASHAs was seen to be common across locations), as well as in identifying knowledge gaps. This led to revising and refining research questions and methodology for the subsequent phases of research, substantially contributing to the quality of data thus collected.

An intensive analysis phase followed the culmination of the research phase. The enormous amount of data collected during the research was broken down and represented through various data models. This helped in organizing the insights, making challenges and potential interventions more evident. The various break downs identified were clustered into larger sets of challenge areas, and prioritized by analyzing its gravity and the potential scale of impact on improving RI coverage by solving the given problem. Six key challenge areas emerged out of this exercise. This helped in focussing our brainstorming for solutions around these challenge areas in order to best serve the goal of bringing about radical improvements to RI coverage in Bihar.

From problems to solutions

It is hard not to probe into potential solutions while being constantly engaged with data pointing at breakdowns in the filed. These "seeds" of concepts were recorded by each researcher in their individual design diaries, and documented for future references. While these thoughts may not amount to full fledged concepts, many of them served as a stimulus for further brainstorming.

During the two month long analysis and design phase, these "seeds" served as new starting points. The team explored a variety of concepts, developing a range of solutions that were both high tech and low tech; some exploiting more human resources, while others focussed on utilizing existing resources to their best potential; some that required shorter implementation time, while others that were longer term. The stronger concepts that emerged during the design phase were converted into story boards and taken to two locations in Bihar to test them with the target users. These concepts were also presented to experts in New Delhi and Patna, for validation. The feedback from the users as well as the experts were then analyzed to further refine some of these concepts.

The project culminated in two workshops held in New Delhi, India. The Global Health Delivery team at the Bill & Melinda Gates Foundation worked closely with us to organize and invite participants[6] to these workshops. Each workshop, spanning two days, brought together groups of experts representing the fields of industrial design, engineering, technology, public health and consumer marketing. The research team was able to share our findings and the final concepts with a broader audience, and collectively brainstorm further on new solutions. Several participants expressed, on behalf of their organizations, interest in further pursuing particular solutions. The VDII program will thus continue with deeper design and / or engineering work on some of the concepts described later in this document.

[5]*List of workshop participants and their organizations are provided in Appendix 2, page 63.*
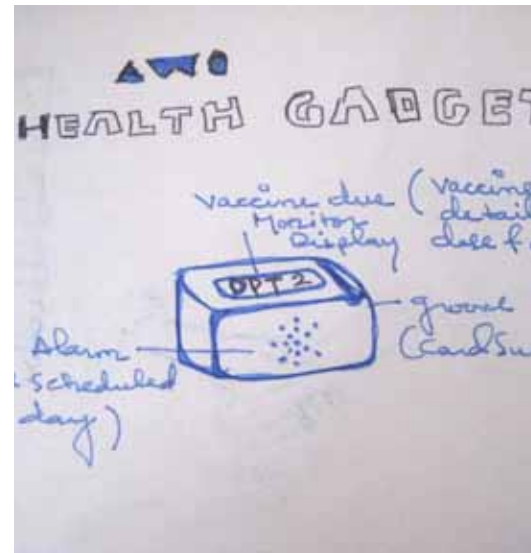
Spatial Navigation Tools
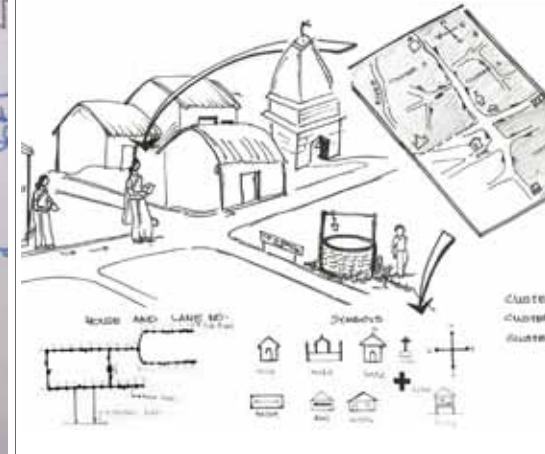
(Clockwise from above) "Concept seeds" recorded in a design diary, Evolution of promising concepts, Participants reworking concepts and brainstorming on new solutions during the innovation workshop

OVERALL OBJ6 (header)

- WE NEED LOCAL MAPS TO TRACK ANM MOVEMENTS
- ASHA/CKS FIELD REPORTS COULD HAVE LOOKED MORE DIFF VIS A VIS
- WE WILL NEED ROBUST REGIONAL AND DEMOGRAPHIC CONCEPTS FOR BIHAR AND ALL DISTRICTS HE HAVE WORKED ON
- STANDARDIZE USE OF VIDEO IN RESEARCH REPORTS
- HOW TO CAPTURE 'IDEAL - THEORETICAL' vs. 'ACTUAL - PRACTICAL' FACTS STRUCTURES

SALARY (header)

- DOES THE ANM DESERVE A BARE SALARY ... E TO VARIETY ... WORK?
- CAN ASHA UNDERSTAND ...

SELECTION CRITERIA (header)

- HOW IS THE ANM'S SELECTED?
- ANM / ASHA / ANM : THE COVERAGE AREA & MICROPLANNING EACH A VERY STRONG NEXUS. HOW DO WE IDENTIFY THE WEAK
- HINDU - MUSLIM X + Y → WHAT IS THE ...
- HOW ARE ASHAS SELECTED? WHY IS THERE NO MARKS CARD?
- ... ASHA ... accountable for ... ASHA ... certificate?
- TO WHAT EXTENT IS THE EDUCATION OF ASHA A CRITERIA IN DECIDING ROLES & RESPONSIBILITIES (IF SHE IS QUALIFIED vs. IF SHE IS A ...)
- ASHA1 ASHA2 ... ACCOUNTABILITIES

TASK AREA (header)
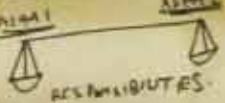
- WHAT ARE THE ... THAT AN ... CENTER ...
- HOW DOES AN ... STRUCTURE HER TIME ... RECIPIENTS
- WHAT INFORMATION do parents ask ASHAS about?
- HOW DOES HER ROLE AS INTERMEDIARY FOR INITIATIVES ... LEADEN
- IS THE ... BEING GIVEN TOO MANY NON-RI RESPONSIBILITIES?
- IS THE ... REQUIRED TO PRODUCE A COVERAGE MAP ... DO IT VOLUNTARY TO ASSIST HER EFFORTS
- Question: What role could AN ... play to support RI work by ANM? - mobilize - injection safety - educate
- WHAT KIND OF TOOL/TECHNIQUE/ KNOWLEDGE AN ASHA USE TO MOBILIZE RECIPIENT
- IS THERE TECHNICAL HANDOFF BTW ANM TO NEXT?
- Are ASHAs more effective mobilizing/educating 1:1 vs. group?
- DOES ORGIN GIVE ANMs A CHANCE TO COMPARE PRACTICE ACROSS REGIONS?
- DURING AN RI SESSION, HOW FREQUENTLY IS THE ANM DISTRACTED ... OR REQUIRED TO ATTEND TO NON-RI ISSUES?

LHV PERFORMANCE (header)

- SHOULD THE OLD HVS WHO LACK THE ENERGY BE REPLACED BY ANMS WHO ... TER PERFORM?
- IN MOST CASES, THE LHVs ARE NOT SEEN AT THE PHC (OR AT THE RI CENTERS). SHOULD THERE BE AN EFFECTIVE POSITION REPLACING LHV
- WHAT DOES LHV DO EXACTLY?
- LHVs DUTY IS TO SUPERVISE, BUT SHE NEVER DOES IT - SENIORITY CREATES AN ATTITUDE THAT STOPS THEM FROM ...
- IS THE LHV REDUNDANT IN EXISTING SYSTEM?
- LHV SEEMS TO BE CURTEOS POSITION LIKE MANY OTHER ...

III. Analysis: A Framework for Understanding Barriers and Potential Solutions

In order to organize the tremendous amount of data collected from the ethnographic research, we created various data models to represent and highlight the key aspects of vaccine delivery. These models helped us to view the process of RI from the perspective of individual participants in the system, as well as that of the system as a whole. A few of these data models are discussed here.

A day in the life of each of the key research participants were recorded in the form of diurnal maps, plotting significant activities they are engaged in during the day, and the approximate time slots. An analysis of the diurnal maps of the various participants on RI day helped in identifying misalignments, such as lack of coordination between the activities of the ANM and ASHA. For e.g. in some scenarios the ASHA was already in the field mobilizing recipients before ANM's arrival, resulting in recipients having to wait for longer hours at the session site.

Diurnal Map of ANM-RI Day

Diurnal Map of ASHA - RI Day
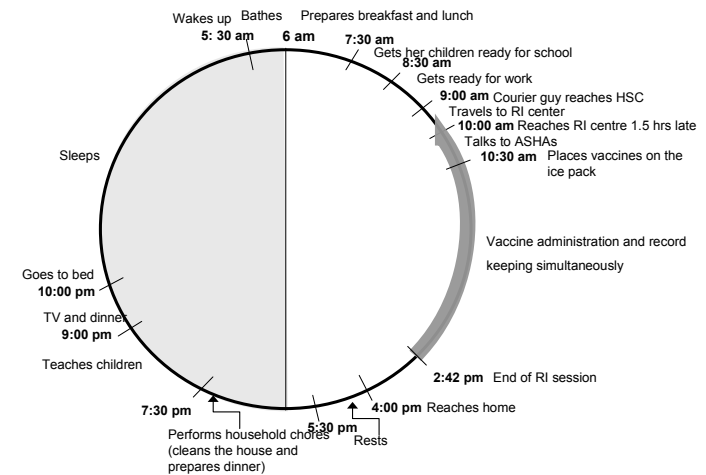
Diurnal Map of Recipient's Mother

Experience Flow Diagram - Routine Immunization Day

Courier boy
- Courier man comes to the session site
- Leaves from session site
- Stays back at the session site
- Helps with searching recipients name in ANM records

AWW
- Set up the RI site
- Goes to mobilize recipients
- Collects the cards from all recipient families

ASHA
- ASHA goes to her coverage zone to mobilize recipients
- ASHA comes to the site
- ASHA might help in setting up the site
- ASHA consults the ANM for list of due recipients and goes for mobilizing
- If the ASHA has the RI health card, she comes with it to the site
- ASHA has the RI health card but forgets to get it to the site
- ASHA goes back to get the RI card
- ASHA does not go to get the RI card
- Convinces the ANM to administer the vaccine

ANM
- ANM arrives at the RI site
- Takes the vaccine carrier, opens vials and places them on the icepacks
- All the cards are submitted to the ANM
- Refers the RI health card
- RI health card not present with recipient family
- ANM checks the register to locate the child
- Cannot find the recipient's name, so sends back the recipient
- Finds the child's name in the register
- Cannot find the child's name so makes a new RI card
- ANM does not administer the dose
- ANM administers the dose
- Disposes syringes on the floor

Recipient
- Goes to the session site
- Reluctant to go to RI site
- Recipient not found at home
- Recipient families reaches the RI site with the RI health card
- Recipient family comes to session site without RI health card
- Recipient families become impatient waiting for their turn and demand that their child should be administered first
- Recipient family goes back to get the RI health card
- Child gets vaccinated

Key Players

Issues boxes

Advance Preparation
- Preparation of the site usually done an hour before and not done in advance leading to chaotic worldspace
- ANM does not ensure if ice pack is frozen according to storage norms

ANMs arrival at the RI site
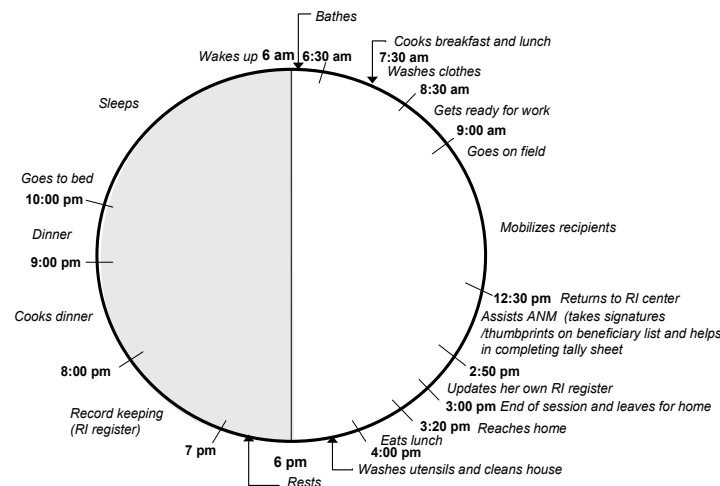- ANM may arrive late after the vaccine carrier is delivered
- ANM not arriving or arriving late leads to recipients waiting for a long time

Mobilization
- ASHA during mobilization does not specify about carrying the RI card to site
- Recipients are unaware of the location of RI site
- ASHA is unable to overcome reluctance and does not always inform the ANM about the reluctant cases

Mobilization
- Going back to get RI card is found to be burdensome by the recipients families

Tracking
- ANM is not able to rely on RI card for tracking information about recipients in her records
- ANM at times, when not able to find recipients information in her records administers vaccine without consulting her records
- The chances of loosing records are higher as child grows older

Administration Process
- ANM follows unhygenic practices while administering vaccines (e.g. does not always use cotton swabs at the administration site, Vit A spoon not cleaned and is used)
- ANM skips filling all the required columns in the register in a hurry leading to administration of spoilt vaccines

Key
- Coordination
- Alternate scenario
- Issues

Pre Vaccine Administration | Vaccine Administration

Comes back to collect the tally sheet and vaccine carrier box

Helps ANM in updating her records

Assists ANM in giving oral vaccine

Informs recipient families to come back next month

Provies after care information to the recipient families

Helps ANM fill tally sheet

Disposes used syringes

Assists ANM in giving oral vaccines

Assists the ANM in taking signature of recipients families on the beneficiary list

Informs recipients to come back next month

Provies after care information to the recipients

Helps ANM fill tally sheet

ASHA goes to get more recipients

ANM updates her records and RI health card

Informs recipient family to come back next month

Provides after care information to the recipient family

Completes MCH register & tally sheet updation

Leaves from the RI site

Recipient family gives signature/thumbprint on benificiary list

Recipient family leaves the site

| Record Updation	Administration Process	After Care Instructions	Record Completion	Session End	Disposal
- Beneficiary list is being fudged by FHWs - After achieving the minimum slab of incentives, the ASHA does not go for further mobilizing of recipients - ANM make recipients families wait for long periods because they first update all the records before adminstering vaccine	- ANM does not often carry cotton and swabs using her fingers - Filled syringes are left unattended while the ANM updates her records - Spoons are not cleaned and are reused for Vit A doses	- FHWs do not always provide proper after care instructions to recipient families - FHWs not always find time to complete all reecords - AWWis husband or Courier man sometimes help in record keeping - Record not updated simultaneously after vaccine administration	- Duelist is not prepared and passed on to ASHA - FHWs usually do not inform mother about due vaccination date	- ANM often leaves the RI site earlier - Courier boy does not always came back immediatly after the the session to collect vaccine carrier box and tally sheet - When ANM has conduct two sessions in a day, she is not able to reach the second site owing to logistical challenges	- FHWs do not dispose vaccine and syringes properly which leads to serious problems (e.g. environmental hazard and syringes falling into the hands of children)

Post Vaccine Administration

Experience flow diagram maps the key activities on an RI day, by mapping work activities of frontline health workers (ANM, ASHA, AWW) and their interactions with each other, courier men, and recipient families plotted in three sequential stages (pre vaccine administration, vaccine administration, and post vaccine administration). The model helped in identifying breakdowns and existing gaps in service delivery, which require design intervention. Other problems, such as misalignments and coordination issues, between various players were also highlighted through the process. For instance, many ASHAs do not always coordinate with ANMs before the beginning of the session on the immunization day and go to mobilize in the field without any information about the due recipients.

In order to understand the dynamics and frequency of interactions between the various participants in the system, we generated two charts, with estimations around the frequency of interactions and the nature of influence one participant may have over another. The frontline health workers and the mother were chosen as the central players as they are in the forefront of the RI delivery mechanism. In place of the recipient itself, the mother was chosen to represent the recipient as she was observed to be the first touch point and decision maker for the recipient. The other players include formal participants such as the MOIC and Health Manager at the back end of RI delivery mechanism as well as informal players such as the head of the household or religious leaders who were observed to be capable of influencing behaviors and decisions.

Relationship Dynamics

In the relationship dynamics map we sought to plot the degree of influence one participant exerted over another. While some of these were formal exercising of power under a reporting line format, for instance the MOIC's power over the ASHA and ANM, or the CDPO's power over the AWW, some others were based on the social structure and interpersonal dynamics. For e.g. the village head, though not a formal part of the RI system commands a great influence over the ASHA owing to his social standing and his role in the ASHA selection process. The ASHA's incentives are distributed by the accountant at the PHC, and due to the monetary nature of this interaction, the accountant was perceived as being more influential over the ASHA. Though the AWW and ASHA are considered as peers with respect to RI, the AWW was observed to hold a slightly higher standing over the ASHA as the AWW is a salaried government employee and has been part of the system longer than the ASHAs. Similarly, a few players like the BMC and the lady supervisor, who are involved in monitoring the frontline health workers in areas outside RI (e.g. polio campaigns and teaching activities) could be leveraged to establish better feedback mechanisms for RI.
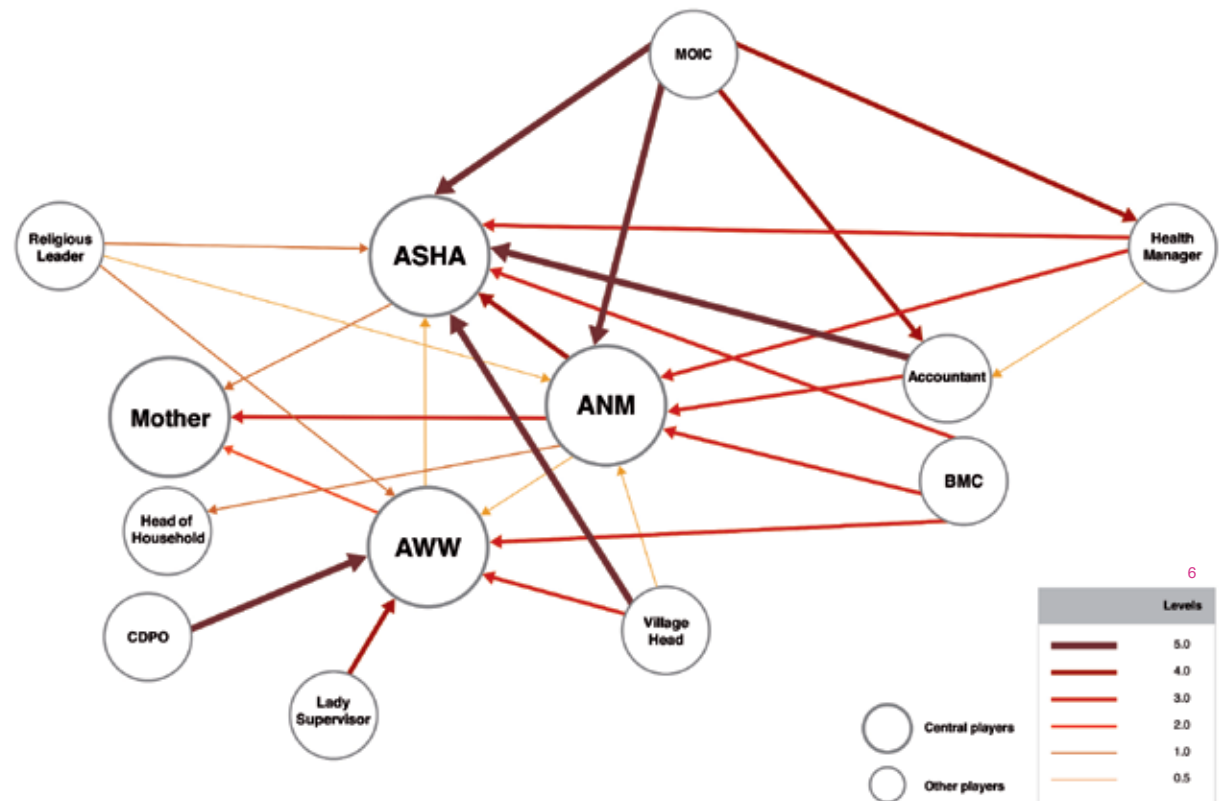

[6]Influence/ power is marked on a scale of 0.5 to 5, with 0.5 approximately defining an informal, yet slightly more respectable standing of one participant over another, and 5 denoting an authority that can influence behavioral changes.

[6,7]These are estimates drawn from a comprehensive understanding of interactions observed in various locations, and are only suggestive in nature.

The social interaction map plots the frequency of interaction between the various participants. It takes into account both formal and informal interactions. For instance, the frequency of interaction between the ASHA and AWW is noted to be very high as they reside in the same village and were very often part of the same social circle. However, the interaction did not largely benefit RI. The interactions between the village head and ASHA were more frequent than between the ANM and ASHA, as the ANM does not belong to the same village, limiting the interaction to only the RI day. The ASHAs also often met other ASHAs from the neighboring villages, and these peer interactions can be potentially utilized to share information to improve their task areas.

Social Interaction Map
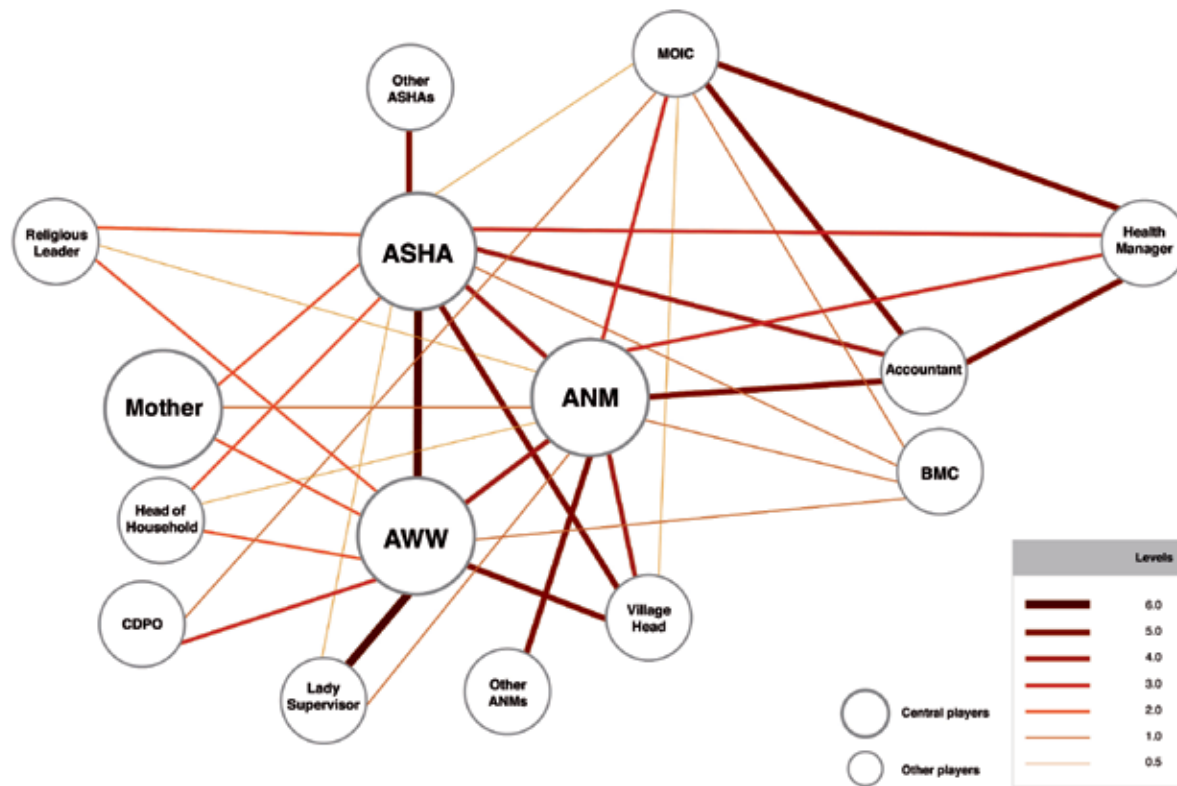
A comparative study of the two models revealed some under utilized resources who could be employed for specific key performance areas. For instance, the MOIC commands a great deal of power over the ASHA, but has very less interaction opportunities that is insufficient for effective monitoring and feedback. On the other hand, the village head has sufficient power over the ASHA and greater frequency of interaction, providing scope for building a feedback mechanism within the community. The interaction between mother and ASHA/ AWW is observed to be less in spite of their geographical proximity. The ANM who is seen to exercise better influence over the mother in comparison to the ASHA or AWW, has lesser opportunities of interaction. However, the ANM could use these opportunities to get feedback about the ASHA's performance from the mother, and motivate and assist the ASHA to perform her tasks better. The ANM exerts an informal power over the AWW due to her higher professional standing, but has no direct command on AWW in a reporting line format. The lady supervisor, who monitors the AWW's prescribed tasks under ICDS, has considerable power over the AWW and fairly frequent interactions during meetings and AWC visits. This can be utilized to provide effective feedback.

[7] The strength of interactions are plotted on the basis of frequency and length of interactions and the nature of these interactions, whether interpersonal or group meetings. 0.5 denotes infrequent and brief interactions happening once in a month mostly during meetings (e.g. MOIC presides over the monthly ASHA meetings at the PHC, but do not share any interpersonal discussion with ASHAs). 6.0 denotes interpersonal interactions more than once almost every day, and 1.0-5.0 denote varying degrees of interaction in between (e.g. between the ASHA and ANM 4.0 denotes interpersonal interaction once in every month during the course of RI session, while between the mother and ANM 1.0 denotes monthly interactions during the RI session which lasts for only a few brief moments and do not yield any interpersonal rapport between the two.
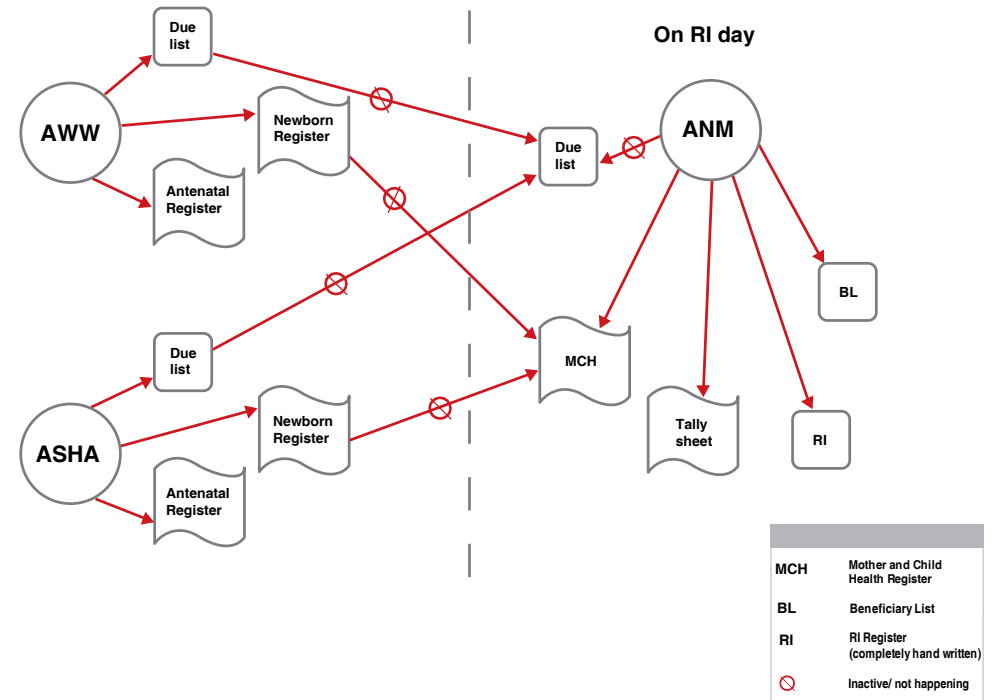
Potential Communication Channels

Note: Each concentric circle represents different entities within the community, namely the family and the mother
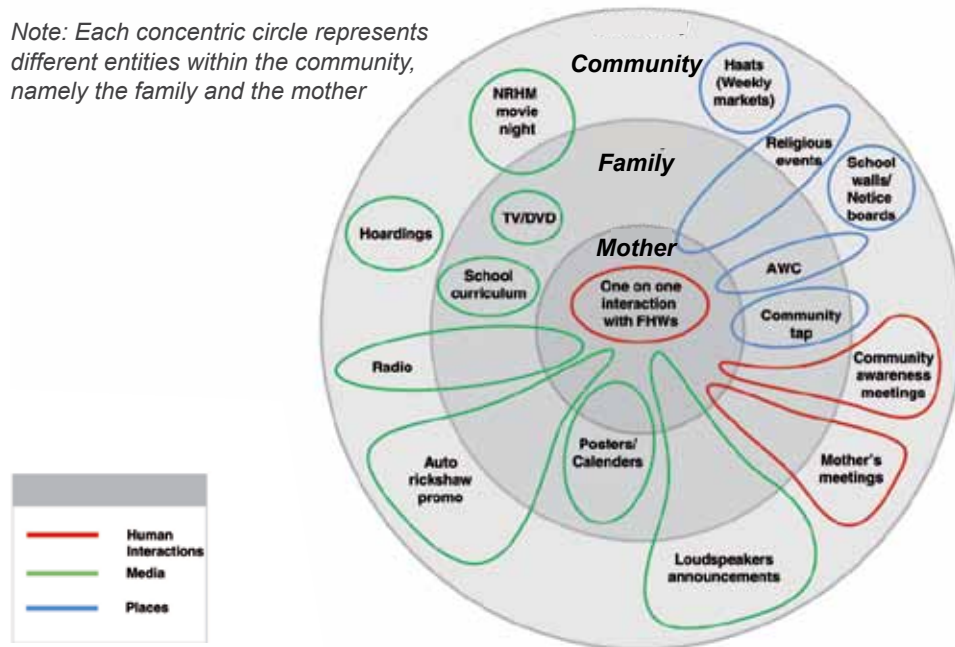
In the communication model, the reach of existing and potential media to different agents, such as mother, family, and community, was analyzed. The places that could be tapped into as well as the human resources that could be utilized towards creating demand were also explored. This communication model provided an essential framework for concept generation. For instance, as the frontline health workers are able to reach out the most to mothers, many concepts were focused on enabling them to create demand and tackle reluctance.

On RI day

MCH	Mother and Child Health Register
BL	Beneficiary List
RI	RI Register (completely hand written)
⊘	Inactive/ not happening

Information workflow between frontline health workers (ANM, AWW, ASHA) was modeled. The records maintained by them as well as the information shared was analyzed that revealed duplicated efforts and missing links of information flow. Similar flow diagrams were also plotted to analyze existing challenges around feedback or supervision for both ANM and ASHA. In the process, the existing gaps in feedback loops as well as possible areas of intervention were identified. For instance, Tuesday meetings could be designed in a better way to work as a more effective platform for feedback.

To best identify the problems that we might solve with innovative design solutions, we asked ourselves a series of questions:

What are the key functions the system should deliver?

Who contributes to each of these functions?

What are the key things participants do to contribute?

What resources are in place, and what resources seem to be lacking?

How are key activities aligned to ensure sustained performance?

The first question, in particular, provided a basic framework that helped us to organize our thinking. We identified six key functions that any RI system should be able to deliver. These were as follows:

The process of RI starts with **identifying, registering and locating children** for immunization. Only when public health workers know about such children, and know where they live, can they begin to plan for the resources they will need to serve them.

Data driven **immunization session planning and management** follows. Based on knowing how many children there are to be served, health workers can allocate resources, plan delivery schedules, and assign coverage zones.

Ensuring complete immunization through organized **session execution and logistics** supply is the next necessary function. Considerable logistical management and other efforts are required to ensure due children, health workers, and all equipment required for immunization are present on the session site.

Tracking children and work activities on immunization day is, of course, the central activity of RI. Effective RI requires an organization of time and materials while the session is in progress. As mentioned, an immunization cycle is not complete until roughly the end of the first year of life. Children need to be tracked to ensure they return to RI sessions to receive the right doses at the right time. This includes diligent record keeping and information management at various levels.

As with any organization, building **accountability and training** workers to develop and improve their skills, and respond to changing conditions is essential to proper functioning. Since they work in many diverse environments under diverse conditions, frontline health workers need to be given appropriate training so that they can acquire requisite knowledge and skills to pursue correct practices.

Finally, RI delivery depends at least in part on the willingness of beneficiaries. Creating **awareness and demand** for RI in the community is, thus, an essential function. Currently, it depends largely on the ability of frontline health workers to engage mothers and the community, to communicate the benefits of immunization.

PROBLEMS

1. MAPPING –
- ASHAs don't ~~have know~~ have concrete knowledge of their coverage area – Both boundaries and itit's.

x 2. ~~Mobilization~~ Mapping
- ASHAs don't cover their zones thoroughly on RI day. Too BIG, and they don't go into some tolas.

3. ~~Mobilizing~~ TRAINING
- ASHAs not trained well enough to over– come reluctance
- ANMs improperly administering vaccin and poorly maintaining site

4. Tracking –
- Due lists not understood, accurate or used as intended.

[...] ssible for ANM to accurately track who's due, who's been give who's overdue, etc. because regis are too hard to use.
- WORKERS HAVE TO MAKE THEIR OWN REGISTERS

b. Tracking –
- Registers ~~are only good~~ only exist at one location. (you can only find your data in one regist)

[Partial text visible at right margin:]
7. [...]
8. No [...]
10. Logis[...]
- Sit[...]
- Sch[...]
- C[...]
11. Apath[...]

[Sticky notes with labels: ABS, JS, EO, JS & RAHUL, Sumit, SS, COMMS, Logist, Supervision, RAHUL, M, INCHA]

ASHA, ANM First meets ~~Entry~~, Prenatal mom

ANM, ASHA First meets ~~Entry~~, Newborn

First encounter
Institutional Delivery

[Right column:]
1ST RI Day
ANM Record Set UP: treatment info

[Sticky notes:]
Mom's "permanent" later nature [...] etc.
Mom's vitals
~~[...]~~
~~Baby due date [...]~~
~~Iron tablets Iron~~

Unique ID (Mom [...])
Mom's pers info
Baby due date (Will be calculated)
treatment info
Thumb Scan (Mom)

[Second group sticky notes:]
Mom : Baby permanent info
Date of Birth

Unique KID AND Unique ID Mom
Date of Birth
Baby pers info
Which vaccines given (what [...])
Thumb Scan (kid)

↓
POST - ADMIN
Come back on for reminder to bring card
reminder to tell about
DPT - fever!

* AUTO GENERATE REMINDER

[Bottom sticky notes:]
Unique ID (Mom)
Mom pers info Baby's info
Baby [...] date [...]
~~[...]~~
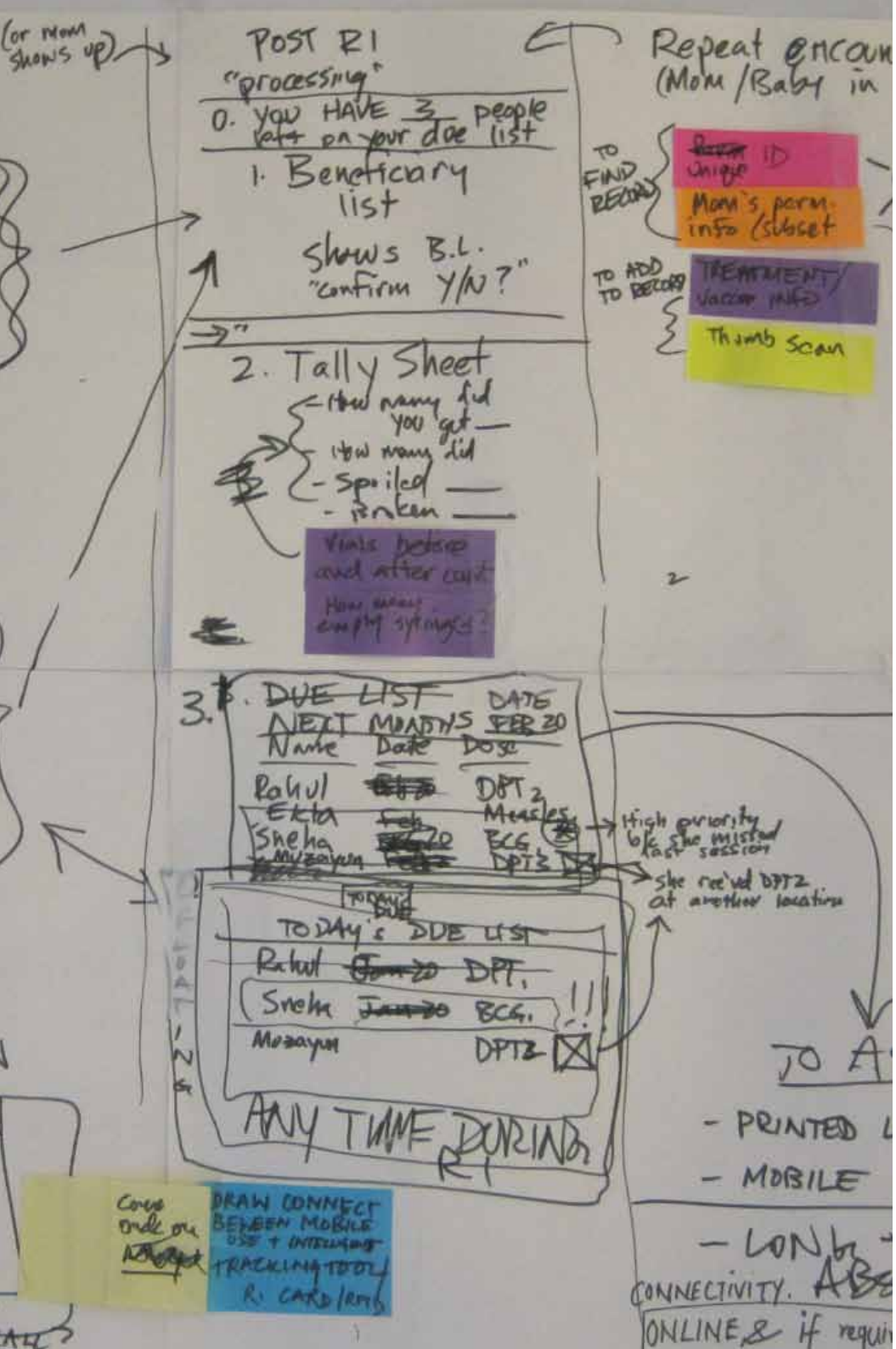
IV. Challenge Areas

For each of the six key functions, using the various analysis models mentioned previously, we identified key points of break downs. Systematizing the challenges according to key function areas helped us in identifying six key "challenge areas". These separate functions are, however, interconnected in multiple ways. For instance, logistical challenges encountered by ANMs on RI day hinder their ability to efficiently maintain records, thus preventing effective tracking of children for further doses of immunization.

The following section focuses on each of these six challenge areas, providing details both on the types of problems observed, as well as identifying possibilities for finding solutions. Following this, we will identify underlying design principles for solutions, and discuss specific solution options in further detail.

1. Identifying, Registering and Locating Children

Knowing who and where the children eligible for immunization are drives subsequent immunization, and other broader health service activities.

Historically, the burden for such knowledge has been assigned to both ASHAs and Anganwadi Workers. The rationale behind this is simple: both are local frontline workers who are expected to know their communities well. ASHAs, nominated by the *Panchayat*, are assigned a coverage zone encompassing roughly 1000 people. Unfortunately, contrary to the common perception, our research revealed that ASHAs do not always know their coverage areas well. ASHAs had virtually no formal means of keeping track of new births or pregnancies in their coverage areas. In several instances, we noted that ASHAs would become aware of the recipients, only if their families were sitting outside their house on the immunization day, performing their customary *maalish* (massage) or household chores. Our research teams identified many children over one year of age who had not been immunized, though their caretakers were willing to do so.

> *This is my first child. I do not know when he is due for vaccine. I do not normally step out of the house, and have not been to the PHC. ASHA does not come to my house. I am not aware that ANM 'didi' comes to my village.*

– Recipient mother

ASHA unaware of a new birth in her coverage area until she chances upon the child outside the house during one of her mobilization rounds

> " *I have to walk long distances on foot, crossing fields and rivers, even during the rainy season.* "
> – Accredited Social Health Activist (ASHA)

There are a number of reasons for not reaching out to all recipients:

Geography is one of the key factors. The ASHAs are expected to have a thorough knowledge of their coverage zones since they reside in the village. However, many ASHAs were observed to lack this knowledge. Some of them have been newly married into the village, and do not know areas outside the immediate vicinity of their houses. Among few others, there was a lack of clarity in terms of the border of their coverage zones. This sometimes led to clashes between ASHAs of neighboring areas over overlaps, or omission of households. The ASHA's perception of their coverage zones were also seen to be largely house-centric. As indicated by the maps[8] on the adjacent page, the ASHAs identified their coverage zones on the basis of *tolas* (hamlets) and understood their locations based on the directions with respect to their houses. The *tolas* were perceived as units independent of one another, and the white spaces in between were left unexplained, indicating that the ASHA's understanding of spatial mapping is often incomplete.

Given the emphasis on mobilization, coverage zones at times may simply be too large for ASHAs to cover on any given RI day. In many instances, ASHAs would simply follow main paved roads, never covering houses in interior lanes and on the peripheries of their coverage zones. We observed numerous instances of ASHAs failing to travel to the fields to find women working there, either to mobilize or to inquire about pregnancies or births.
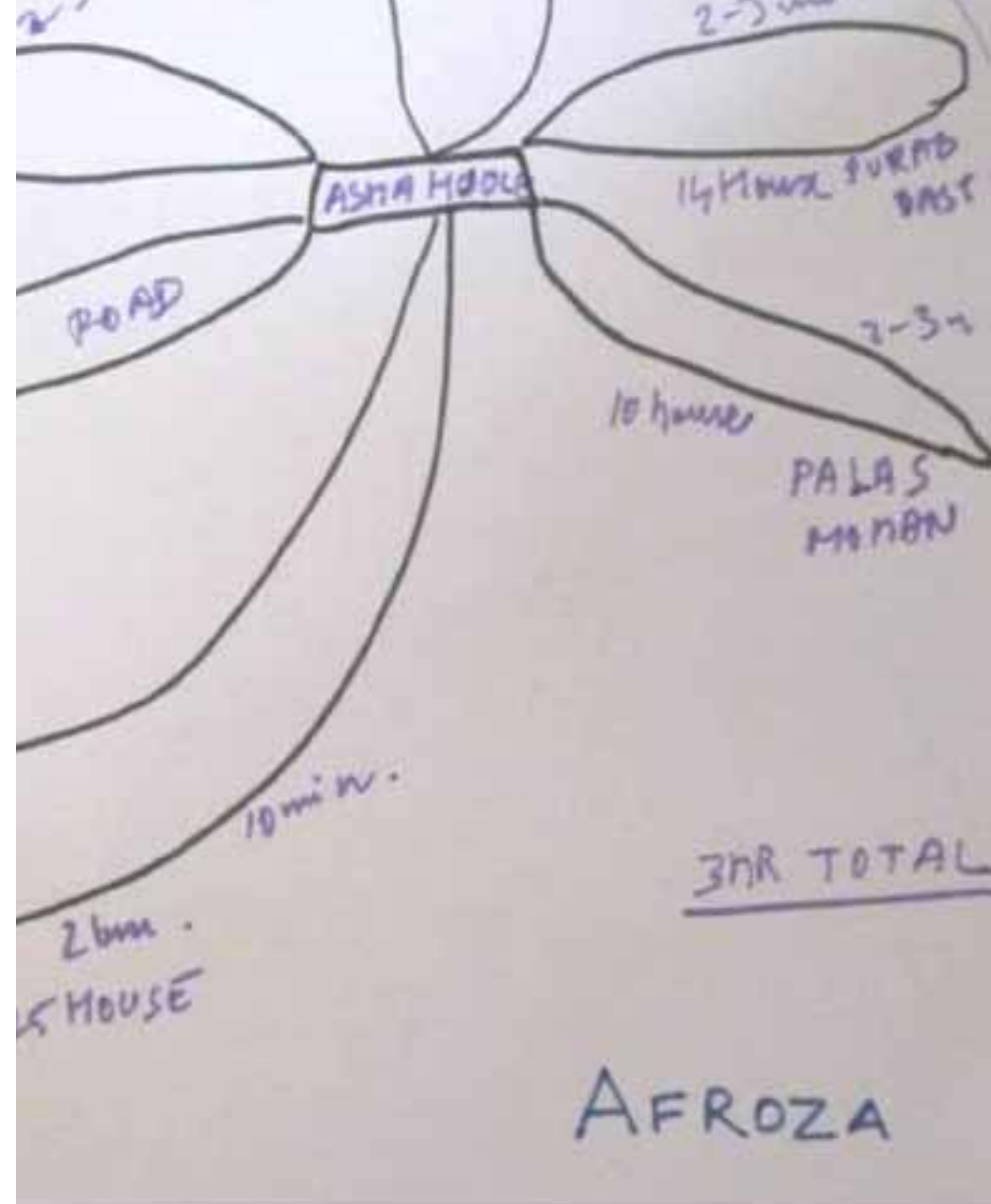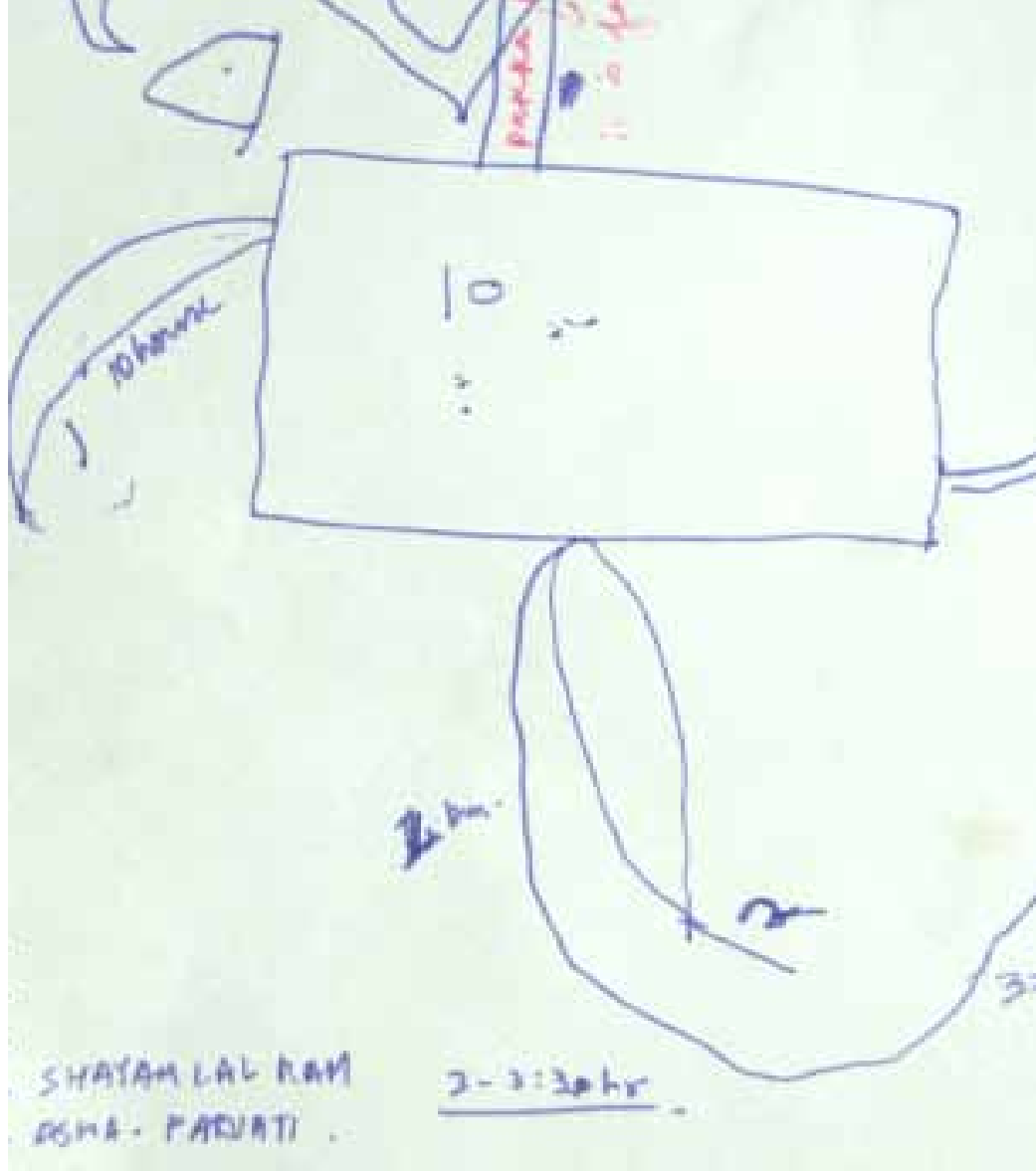
[8]*The maps were sketched by the ASHAs and labelled by the researchers based on the ASHAs' description of their coverage zones.*

ASHA refers to the polio marking on the wall, as she tries to track a recipient

"
When I do not get payments on time, I lose determination. If I do not have money to eat properly how will I find energy to roam around in the field?
"

— Accredited Social Health Activist (ASHA)

Time plays a critical role in limiting ASHAs' knowledge of their coverage zones. ASHAs generally only work one day per month (RI day), and that day is spent primarily conducting a mobilization effort, that is, notifying families of infants that RI is happening. Conducting a careful inventory of households, identifying those where a pregnancy or new birth might have occurred, really plays no role during mobilization.

Incentives are closely related to time. ASHAs are not given incentives to produce any sort of updated records of household pregnancies and births in their coverage zones. They are, however, provided incentives to encourage institutional births, and to mobilize children to attend RI sessions. Not surprisingly, these latter efforts are the focus of ASHAs' attention.

Cultural barriers may combine with geography to limit ASHAs' knowledge of their coverage zones. Although ASHAs are aware of all hamlets (*tolas*), organized on the basis of religion or caste, in their coverage areas they do not always cover them. In one scenario, the ASHA from a Hindu background informed the researchers that she rarely crosses the railway line to reach out to the Muslim community as they often fight with her. Similarly in another location, it was discovered that the ASHA belonging to a higher caste background does not ever visit the low caste *Harijan* community because of cultural differences.

Clarity of roles and responsibilities is also lacking. Many ASHAs feel that their job becomes much harder when AWWs do not share the household survey data of their zones. ASHAs find it harder to identify new births, especially in the case of home deliveries, but AWWs may not always recognize the necessity of, or be willing to, share such information with ASHAs.

Lack of appropriate tools makes their task of identifying and locating recipients even harder. Unlike the frontline health workers involved in Polio programs, most ASHAs are not given maps or other tools to assist them in navigating their coverage areas. Most ASHAs have very limited map-making skills, owing to low educational levels. Even in scenarios where they are provided training about making maps, as in the case of *Dular*, it was observed that they were reluctant to make maps. They mentally map their coverage zones and are usually only able to recollect lanes closer to their house or immunization centers, though they can clearly remember all hamlets (*tolas*) and significant landmarks.

Many of the factors that prevent ASHAs from staying up to date with regards to new pregnancies and births in their coverage zones also affect their ability to mobilize, that is, to notify parents that an RI session is happening and ensure that their children are present. This issue will be discussed below, in the context of RI logistics. Prior to that, it is important to note that identifying and locating children is essential to our next main function, planning.

(Above) ASHA crossing the railway line that separates the Hindu community on the right and the Muslim community on the left. The Mosque in the Muslim area of the coverage zone is visible towards the top left end of the image, (Below) ASHA talking to women in a Muslim household

31% of the ASHAs had their household lists during the session.

20% ASHAs received a due list from the ANM.

Source: PATH, Assessing the Performance of Routine Immunization Systems in Bihar, 2010
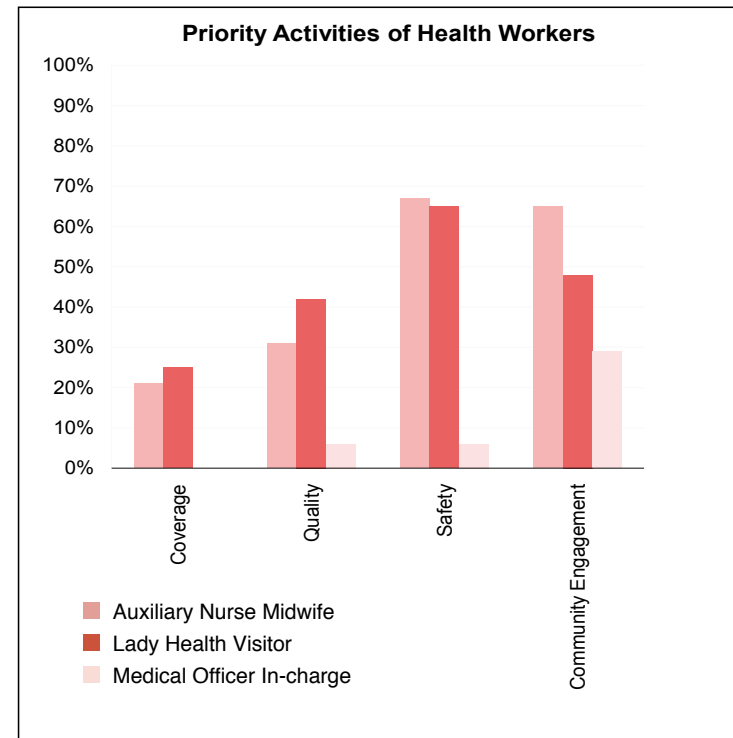
2. Immunization Session Planning and Management

A comprehensive planning process exists for routine immunization, known as the "micro planning process." Micro planning is intended to drive such factors as allocation of coverage areas for both ANMs and ASHAs. It is supposed to provide targets for number of children to be vaccinated. It is also critical for accurate resource planning – for instance, allocation of vaccine quantities and other equipment for RI sessions.

Through interviews and observations, the team acquired an understanding of current micro planning process and its value for frontline health workers. The researchers carefully studied how critical immunization related data is shared between different players in the system at various levels, which illuminated the existing loopholes in the information flow. Officials from private organizations, such as WHO and UNICEF, were also interviewed towards this end.

Ideally, ASHAs performing their mobilization rounds, or yearly household survey data collected by Anganwadi Workers, would provide updated information about new pregnancies or births in their coverage areas, which would then be incorporated as the "true denominator" into the planning process. However, this is not what happens. The estimation of monthly target of beneficiaries in the micro plan is made from population census data (which is updated only once in a decade) and calculated based on such parameters as birth rate, male to female ratio, and total population figures.

Priority Activities of Health Workers

Legend:
- Auxiliary Nurse Midwife
- Lady Health Visitor
- Medical Officer In-charge

Categories: Coverage, Quality, Safety, Community Engagement

Source: PATH, Assessing the Performance of Routine Immunization Systems in Bihar, 2010

Neither ANMs nor ASHAs are heavily involved in the planning process. Interactions between frontline workers and higher level officials are largely "top down". Higher ranking officials, using census data and estimation techniques described above, create targets and typically inform frontline workers – there is little real opportunity for feedback. Consequently, there is little real motivation for frontline workers to identify potential immunization recipients in their zones.

As a result, a number of critical downstream activities are difficult to manage or accurately track. ANMs report high percentage of achieved targets because they are not really aware of the actual recipient numbers. Vaccine shortages can occur, resulting in the turning away of families on an RI day.

In many cases, we noted that critical plan information (e.g. the names of frontline health workers, type of session, total population in a given area) might often be missing, or not updated in a timely manner. Loosely planned schedules of immunization sessions can cause great inconvenience to recipient families, especially when they have to wait for long periods of time due to uncertainty about an ANM's arrival time. The lack of clarity about session timings also results in lack of coordination between ANMs and courier men (who are responsible for delivering vaccines to RI session sites), affecting the quality of service delivery.

> " *We cannot trust the health workers, sometimes they provide immunization services and sometimes they do not.* "
>
> – Recipient family in a hard to reach area

(Above) The courier man arriving late after the ANM has reached the session site, (Below) Recipient families waiting at the Anganwadi Center as the ANM has not arrived at the scheduled time

> " *Because of Polio people expect immunization services to be delivered door-to-door. However, Polio campaign has a very good micro plan and effective ways to cover the hard-to-reach areas, which we should try and adopt for routine immunization.* "
>
> – *Medical Officer In-charge (MOIC)*

This unpredictable nature of services is a bigger problem in hard-to-reach areas. Although immunization sessions are conducted in such areas, many significant details are loosely planned. For instance, in many hard-to-reach areas the researchers discovered that immunization sessions were conducted only once in three to six months, largely because travel to the site was inconvenient for the ANM. Many remote areas had no appointed ASHAs – there was no one to go door-to-door to mobilize families to come to the RI session. Many recipient families pointed out that they were willing to even travel long distances to immunize their children if they would have been informed. Such irregular and inconsistent services contributes to distrust in the public health system and the immunization system more specifically.

Owing to lack of public transport facilities and geographical barriers such as rivers, some remote areas largely go neglected

Thus, planning is crucial to the success of RI in many ways. Real time planning based on dynamic data collection is not only required to ensure that frontline health workers have realistic goals, but is also extremely essential for effective functioning of many logistical aspects, including the transport of correct vaccine quantities, the timing of sessions, and the mobilization of communities. Finally, it is difficult to increase demand for immunization if the system does not provide well-planned, consistent and predictable services.

3. Immunization Session Execution and Logistics

At the heart of all of our functional challenge areas lies the basic task of delivering routine immunization. This includes the physical travel and transport of ANMs (who are trained and responsible for immunization), vaccines, and children so that the immunization encounter can actually happen. In addition, this challenge area includes the many, detailed, organizational activities that must happen to ensure the quality delivery of immunization.

In the previous section, we identified some failures of planning that affected the successful delivery of vaccine to the correct children. Other logistical challenges faced by ANMs on the immunization day also prevent them from performing their work tasks effectively.

Traveling and transporting. Many ANMs have to walk long distances to reach session sites. ANMs working out of primary health centers (PHCs) face specific challenges, since they are not allocated the assistance of vaccine delivery men. They are thus required to carry the heavy vaccine box to their session sites themselves. ANMs are also required to carry other tools and equipment, including the MCH registers, medicines for fever, hub cutters (devices to cut and dispose of used syringe needles), and other items. This proliferation of equipment to carry often leads ANMs to make trade-offs, to leave some things behind. Rarely, for instance, did we see an ANM bring hub-cutters to an RI session site. This resulted in improper disposal of syringes and vials, causing environmental hazards or safety issues. At immunization sessions conducted at Anganwadi centers, young children were often found playing with used syringes that were not disposed properly.

Due to lack of basic infrastructure at the session site, the ANM settles on a stack of bricks, leaving all the RI paraphernalia on the floor

Mobilizing. As described above, ASHAs are primarily responsible for mobilizing families to bring their children to the RI session site on a given RI day. As with the task of identifying children, geographic, cultural and other factors prevented ASHAs from mobilizing effectively. Many ASHAs, even those who spent several hours on their rounds on immunization days, were not able to cover all recipient houses. This was not simply a factor of geography (although that contributed), but also because ASHAs were not provided with a list of recipients who were due for immunization, and thus were unclear about where in their coverage area to target.

Most ASHAs do not have good record keeping skills are unable to make this list because they are not trained. ANM or AWW also do not make this list because it is a shared responsibility.

Immunizing. Lack of basic facilities (even tables or chairs) at immunization sites also affects the work quality of frontline health workers. Many immunization sessions are conducted at random locations (e.g. street corners). The absence of proper work surfaces not only prevents effective record keeping but also leads to equipment mismanagement and consequently, unhygienic practices. For instance, many ANMs store the equipment required for vaccine administration at the top of vaccine box. Cotton used after vaccine administration was often exposed to the dirt of the box and, at times, would fall on the ground along with the vials. Even at Anganwadi centers, most sessions were conducted outdoors due to poor interior lighting and ventilation conditions, which exposed the vaccine box to direct sunlight for long hours. In some instances, ice packs melted and ANMs did not bother to check the temperature indicator on vials before vaccine administration.

15% of ANMs used a syringe hub cutter during the session. 75% of the ANMs did not have the polyethylene disposal bags at the sessions. Of those ANMs with disposal bags, 25% used them to correctly dispose of the syringes.

Source: PATH, Assessing the Performance of Routine Immunization Systems in Bihar, 2010

Along with the lack of basic necessities, improper waiting facilities at immunization centers causes inconvenience to recipient families as well as frontline health workers. During peak hours, long lines and a heavy burden of record keeping (see below), resulted in long wait-periods for mothers and infants. Mothers often expressed impatience when forced to wait for periods of one hour or more, especially mothers who work in the fields and earn hourly wages. Crowding of recipient families around frontline health workers hinders their record keeping and vaccine administration tasks. These scenarios create general stress and often led to arguments between ANMs and recipient families. Many families do not come back to immunize their children in the light of these negative experiences.

> " *The ANM makes us wait for two hours at the session site. We get tired of waiting* "

– Recipient mother

> " *Most families forget the name given to the child in the immunization card apart from losing and spoiling it. There are also many mothers with the same names. It becomes very hard for me to find the correct names from these registers.* "

– Auxiliary Nurse Midwife (ANM)

4. Tracking Children and Work Activities

Any organization must maintain an account of its activities in order to measure and improve its performance, and ensure goals and objectives are being met. A key factor in the success of RI is the accurate tracking of infants to ensure they receive all the multiple doses of vaccine that are necessary to ensure immunity. This requires adequate record keeping. Many of the limitations currently facing RI in Bihar can be traced to the reliance on paper registers for record keeping.

Paper registers are not easily searchable. When a mother and infant attend an RI session, it is vital to record this and associate it with other visits. Finding records of prior visits can be time-consuming, difficult and often produce no results, if the records of prior visits are in a different register. The maternal and child health (MCH) register used by ANMs to record the details of immunized recipients has various fields, making it difficult to find entries.

Paper records are easily lost. Owing to these searchability issues, ANMs prefer to consult another type of record: immunization cards. RI cards are created at the time of first vaccination, and given to mothers (the ANM will retain part of the card). Such cards are thus easier to connect with a given infant. However, such cards are easily lost or damaged. During the field research, it was discovered that most of the immunization cards were either damaged (soiled by mustard oil, eaten by rats or destroyed by children) or misplaced by the recipient families. Many families arrive at the immunization site without the card, even if they possess it. Unavailability of the card frustrates ANMs as they find it harder to administer the right vaccine. In such scenarios, either they would send the family back to get the card or, at times, administer vaccines on the basis of verbal information given by recipient family, without consulting any written record.

RI cards found in soiled and tattered conditions

> "I have to make so many records. It takes up most of my time. I do not have ten hands, only two."

— Auxiliary Nurse Midwife (ANM)

Paper-based systems make duplication difficult. During the immunization sessions, ANMs have to maintain multiple records (e.g. MCH register, beneficiary list, tally sheet, due list, immunization card) with many overlapping fields. This burden of replication often leads to incomplete records. For instance, some ANMs just checked the box in the immunization card instead of actually recording the date of vaccine administration. In order to manage their record keeping tasks along with vaccine administration, they would often seek assistance from ASHAs, AWWs, or other resources present on the site, such as courier man, husbands of frontline health workers. This prevented effective record keeping as many errors were found in the records completed by them. ANMs themselves made many errors while record keeping, especially in the tally sheets, because they refer to multiple records to compile information.

Paper medium of registers also makes it easier to fudge data entries. It was observed that some frontline health workers fudged entries in the beneficiary list in order to earn more incentives. Other limitations of the medium, such as wearing out of registers before the completion of immunization cycle or smudged data entries due to dampening of ink, also prevent effective record keeping. Paper-based systems are inconvenient to transport. Because they were required to record information in so many different places, ANMs were left with the difficulty of lugging multiple registers and forms with them. This presents transportation challenges. Many ANMs preferred to buy smaller, generic registers that would fit in their handbags. However, this created a different problem: They then had to structure these registers themselves, creating the fields by hand that would otherwise be found in the MCH register. This resulted in many mistakes in data entry.

Difficulty of transport results in limited availability of records, which makes it impossible for ANMs to track records of recipients who have migrated or shifted locations. ANMs encounter this challenge not only in the case of permanent or temporary migrations, but also more frequently when mothers move between their husband's home and maternal homes. Mothers, who come to their parent's house after delivery, usually do not carry the immunization card. The ASHA or the ANM is thus unable to accurately track whether their child is due for vaccine because their information is not present in their registers.

Tracking of information is critical to ensure that recipients who have been entered into the system are able to complete the immunization cycle. One of the key benefits of good tracking is a mobilization tool known as the "due list." This is simply a list of all children who should be sought out to ensure they are brought to RI day. Children would appear on a due list if they had received an immunization in a prior month (and were thus due for follow-on vaccines) or if they were recently recorded as a new birth. Unless ANMs are able to keep track of recipients who are due for immunization, ASHAs may not be able to successfully identify and locate their houses on the immunization day.

54% of the ANMs correctly recorded vaccines administered during session.
39% of ANMs noted dropouts for follow up via due lists.
On average, PHCs reported 30% higher DPT and BCG coverage for the two months preceding the survey on their computer reports than in their paper registers.

*Source: PATH, Assessing the Performance of Routine Immunization Systems in Bihar, 2010*
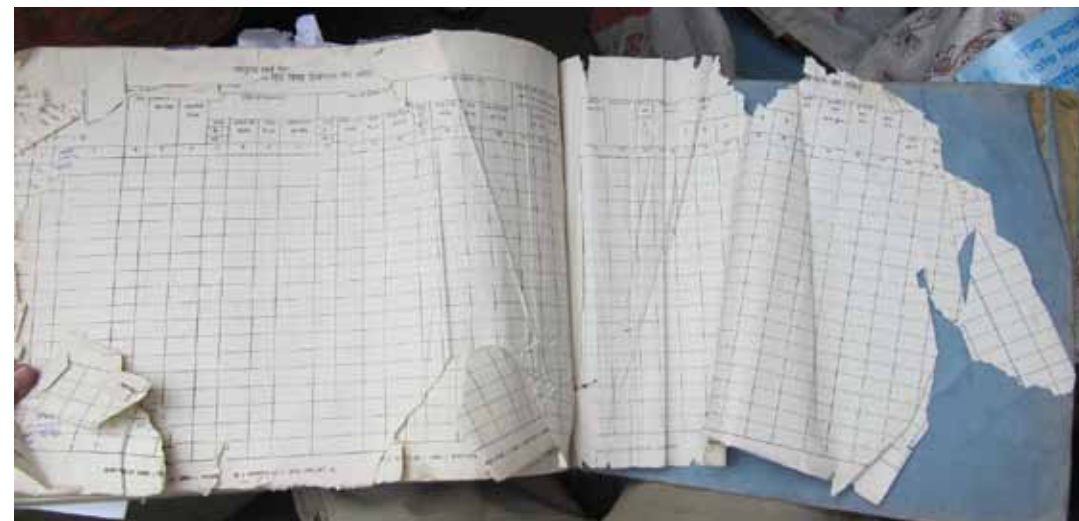
MCH register found with an ANM

5. Accountability and Training

As with many work tasks, "routine" immunization was anything but routine. Numerous conditions make every situation unique. Training is vital to ensure that workers understand the principles and reasons behind the plans and policies, so that they are able to respond to such contingencies and overcome obstacles to delivery. At the most fundamental level, training makes it possible for frontline health workers to pursue correct work practices, and to be sure proper skills and practices are reinforced.

Our research suggests training of frontline health workers is inadequate for the demands of their jobs. ANMs and ASHAs are usually only trained during induction, or if a new health program or scheme is introduced. Infrequent training intervals result in disengagement with the training material over a period of time. For example, frontline health workers forget to provide after care instructions to mothers after vaccine administration, even though they are instructed to do so in training sessions.
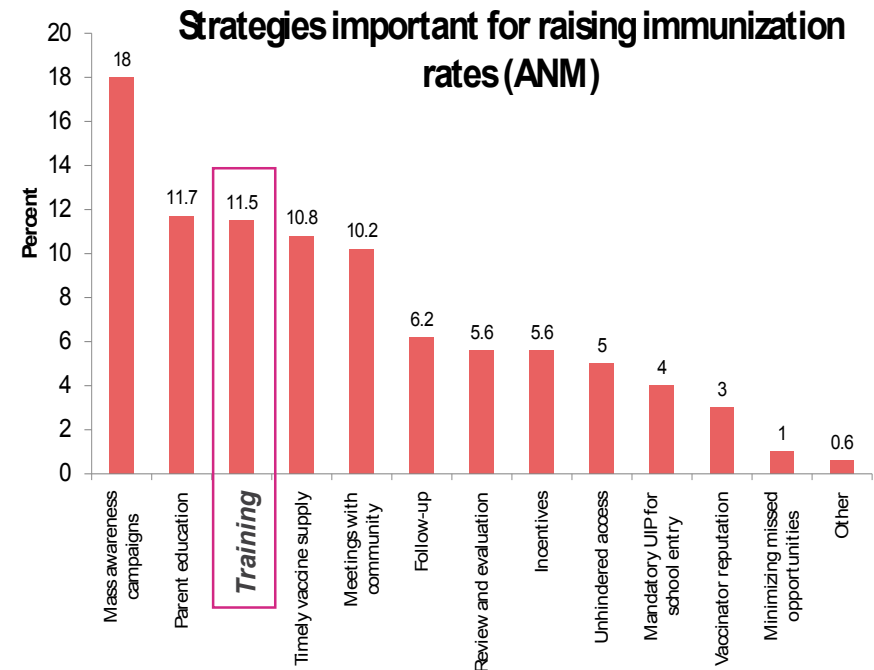
Strategies important for raising immunization rates (ANM)

Source: Emory University, Knowledge, Attitudes, & Practices of Providers Regarding Immunization in India, Uttar Pradesh & Bihar, 2009

"

The frontline health workers need to be trained regularly rather than once. By the time they understand one program, they are introduced to a new program and new set of records. "

– Medical Officer In-charge (MOIC)

> " *Frontline health workers do not understand the logic behind making the due list and are unable to use it for their convenience.* "
>
> *– Medical Officer In-charge (MOIC)*

In other cases, **no training was provided for specific job-related activities.** For instance, ANMs are not trained extensively about proper record keeping techniques. Consequently, they make recurrent mistakes while completing records. In some cases, new information is required to be tracked, new records are introduced, but ANMs and ASHAs were not properly trained in how to perform such tracking. Many ANMs were confused about how to complete beneficiary and due list recently introduced in the system and would often seek assistance from other ANMs. While such peer-to-peer support is valuable, at times, this also leads to incorrect entries. Quite often, ANMs do not understand the significance of record keeping because the value of maintaining proper records is not communicated during their training. They feel that record keeping is important for getting incentives, and are thus motivated to properly complete only few records (e.g. beneficiary list), based on which their incentives are calculated.

Mode of training also plays a crucial role in determining its effectiveness. Many frontline health workers feel that the current mode of classroom training (in often badly over-crowded classrooms) does not provide them any opportunity for discussing or solving specific challenges. Lack of practical skills training clearly inhibited effectiveness in the field. For instance, most ASHAs were unable to problem solve and effectively address the health related concerns of recipient families (e.g. side effects), during mobilization. Put simply, ASHAs were unable to address the concerns of families about vaccine safety, and were thus unable to overcome resistance.

Many such critical function areas of the system, which directly impact immunization coverage, cannot work effectively and efficiently unless the frontline health workers are provided requisite training or enabled with tools that facilitate them to better perform their work tasks.

(Left) ASHA training session in progress at the PHC, (Right) Girl marking her house on a map made on the ground using chalk during the Village Contact Drive as a part of Dular[9] initiative

[9]*The Dular strategy is a unique nutrition initiative initiated by UNICEF India in collaboration with the states of Bihar and Jharkhand. Designed to complement the government's Integrated Child Development Services (ICDS) and build upon its infrastructure, one of the major goals of the Dular program is to capitalize and develop community resources at the grass root level.*

6. Awareness and Demand

Addressing the systemic challenges and enabling front line workers may not significantly improve immunization coverage unless demand for immunization is increased. Many recipient families refuse to immunize their children because they do not understand its significance.

Communicating personal benefit is key: the direct personal benefits for routine immunization are not always as evident to parents or caregivers. While most families know of polio, for instance, fewer have directly witnessed the risks associated with other vaccine preventable diseases. Many recipient families also hold the perception that they do not need to immunize their children because no one in their family has been immunized. The indirect value of immunization – herd immunity, for instance – is a more difficult value concept to communicate.

The research teams observed that people do value child safety and protection. Cultural practices such as applying kohl (*kajal*) in the children's eyes or tying amulet *(taveez*[10]*)* around their neck to ward off evil are common. It is a task of equating RI with these broad values of child protection that remains to be accomplished. This is particularly true with regard to the need to complete the RI cycle. While the care takers go to great lengths with these cultural practices, many recipients drop out from the RI system because of concerns about side effects, and unawareness about the significance of complete immunization.
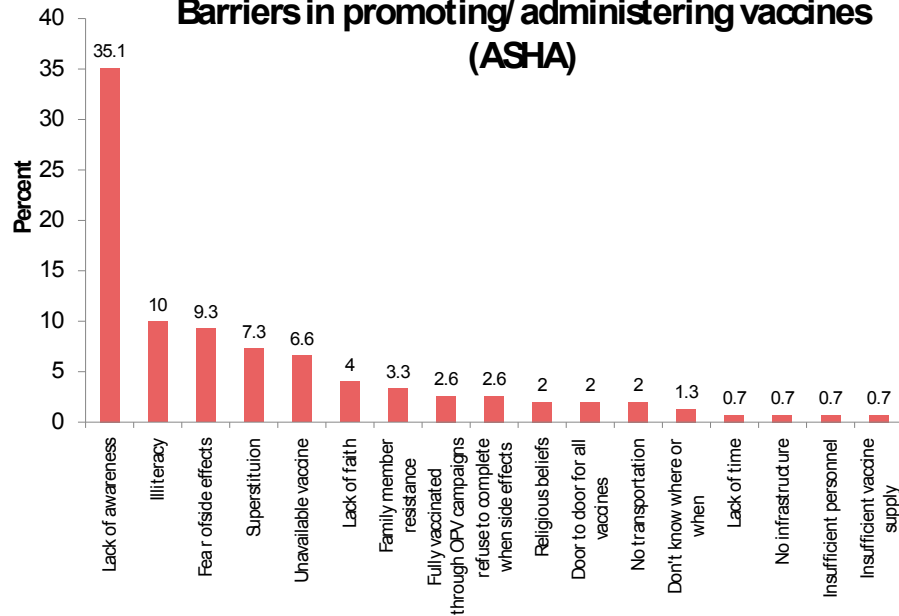
" *We give emphasis to Polio because it is more important that children should be saved from physical disabilities.* **"**

– Medical Officer In-charge (MOIC)

[10]*Alternately spelled as Tawiz or Ta'wiz*

Barriers in promoting/administering vaccines (ASHA)

Category	Percent
Lack of awareness	35.1
Illiteracy	10
Fear of side effects	9.3
Superstituion	7.3
Unavailable vaccine	6.6
Lack of faith	4
Family member resistance	3.3
Fully vaccinated through OPV campaigns	2.6
refuse to complete when side effects	2.6
Religious beliefs	2
Door to door for all vaccines	2
No transportation	2
Don't know where or when	1.3
Lack of time	0.7
No infrastructure	0.7
Insufficient personnel	0.7
Insufficient vaccine supply	0.7

Source: Emory University, Knowledge, Attitudes, & Practices of Providers Regarding Immunization in India, Uttar Pradesh & Bihar, 2009

Recipient mother discussing about a swelling on her child's hand with the ASHA

> *"There is no point in providing any information about immunization. Most recipient families are illiterate and do not understand anything."*
>
> *– Accredited Social Health Activist (ASHA)*

While considerable efforts are made to promote health campaigns (e.g. polio), much less emphasis is given to RI. Posters and billboards promoting health campaigns (e.g. polio, vitamin A) could be found in many strategic locations in the villages we studied, including hard-to-reach areas. Routine immunization is not even promoted at immunization centers in villages or blocks (e.g. Anganwadi Center, Sub Center or PHC).

Current resources might be put to better use to do this. For instance, the immunization card provided to recipient families only has information about the vaccine schedule, it contains no significant educational material or communication of RI benefits. Furthermore, most of the information in the card is textual. It is not easily understood by people with lower literacy skills.

In the absence of effective communication through other media, frontline health workers, especially ASHAs, are the primary source of information for recipient families. They could serve as an important point of communication and persuasion for mothers, especially the ones who do not step out of their homes and do not have easy access to other information channels. These workers, however, are not able to communicate the value of immunization because they are not trained adequately or provided with appropriate tools.

(Left) A mother fighting with the AWW over food ration (Right) ASHA directing a recipient family to the immunization site

Frontline health workers are unable to convince the recipient families who refuse immunization because of side effects and often require assistance from locals (e.g. rural health practitioners). They also find it difficult to mobilize families who refuse immunization because of cultural beliefs. Attitude of these workers also significantly affects demand for immunization. Conflicts about food ration with the AWW, who is authorized to provide ration to only selective families, commonly occur. Many recipient families refuse to immunize their children in the light of these interpersonal differences.

Some families do not take their children for immunization because they lack simple information about schedule and location of immunization sessions. Unlike other drives where information about schedule and location is communicated through various media (e.g. posters, auto rickshaw promotion), in the context of routine immunization such promotion does not happen. They have to rely on frontline health workers for such information as well because even the immunization card also does not serve as an effective reminder of sessions. Recipient families cannot identify immunization sites on their own if they have never visited them before because there is no proper signage. Identification of such sites become much harder if sessions are not conducted at proper Anganwadi centers. Shifting sessions also create confusio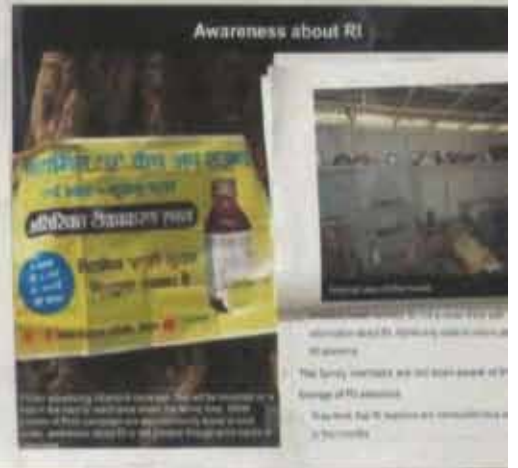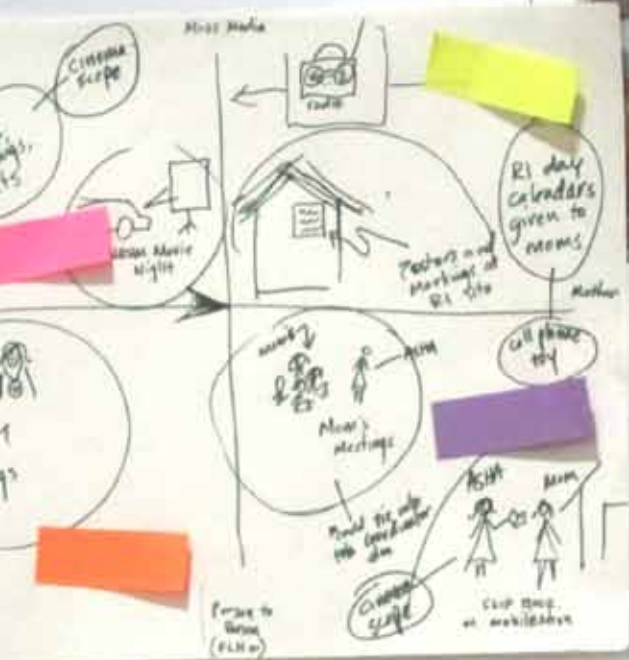n about locations. Scenarios in which recipient families were unable to reach immunization sites because ASHAs or AWWs did not provide proper instructions were not uncommon.

Communicating the value of routine immunization and informing about the logistics of sessions is extremely significant because, unlike other health drives where service is delivered at the doorsteps of recipients, for routine immunization the recipient families are expected to visit a session site. Creating demand for immunization is as crucial as identifying and locating recipients in order to substantially improve immunization coverage. Even if ASHAs are able to successfully reach all recipient families in their zones, they still may not be willing to immunize their children unless they understand its significance. Developing the pull model to create increased demand for immunization would ensure that even the families, who ASHAs are unable to reach on immunization days, are motivated enough to reach the session sites.
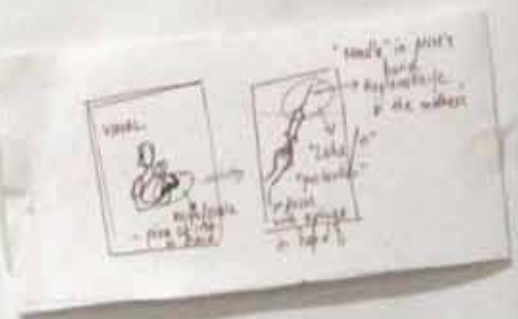
> " *Three injections have already been given. Why do we need more?* "
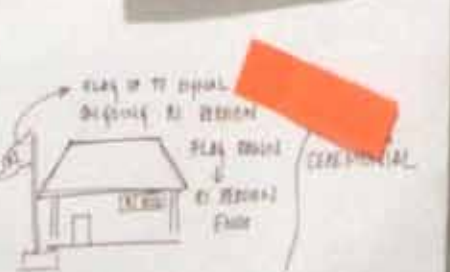>
> *– Recipient family to ASHA*

COMMUNICATION

RI day calendars given to moms

POSTERS AT AGE MAJOR LANDMARKS THAT ILLUSTRATE VARIOUS STAGES OF DEV. OF CHILD & THEIR RELATION TO VACCINE TIMINGS

...e unaware of the ...cause it is not ...community.

Recipient families are unaware of the schedule and location of RI session and have to completely rely on ASHA, who does not provide proper instructions or may not visit their houses at all, on RI day.

Courier Boy Solution

"RI DAY"

Official RI card RFID enabled Indestructible Carries info. Serial # 999-9999

Sticker affixed to redesigned RI card

ANM

RI center

LOGISTICS / DAY OF RI AWARENESS

V. From Problems to Concepts

During an extensive two-month analysis and design phase, the team generated many ideas for each of the challenge areas described above. The "seeds", as mentioned before, helped to trigger new starting points. As we developed these, we identified both general principles that apply regardless of a problem or solution, as well as specific solution ideas.

Design principles

For a specific idea, general principle or the underlying insight was extrapolated in order to generate more ideas. For instance, the principle that cultural practices of child protection should be leveraged, derived from the concept of using cultural props as identifying elements, was employed for developing other solutions. Soon, a small collection of important design principles had emerged. These are principles that would apply to any solution – they would ensure that any such solution could be sustainable and feasible. These design principles include:

Honor and make use of cultural values and practices to encourage RI participation. As mentioned above, families of new infants employed various means to ensure symbolic and practical protection of their children. The equation of routine immunization with such values could be a powerful motivator. Aligning such practices is essential to ensure demand at the community level.

New technologies will be useful, but they must fit with economic and other realities. Many of the problems we saw could clearly benefit from the application of new technologies. However, we also recognize that such technologies must be sustainable, in terms of capital costs, required training, levels of maintenance, durability and many other vectors.

Create more feedback mechanisms. Sustainable systems arise when they generate their own means of self-correction and self-perpetuation. Supervision and feedback of staff, peer support, and feedback from the community are all feedback mechanisms that could contribute to a more robust and adaptive routine immunization program. Thus, many of our recommendations aimed to initiate such feedback loops and mechanisms.

Develop greater ownership and decision-making at the front lines of RI. What appeared to some as a lack of motivation or engagement by frontline workers might better be interpreted as a natural reaction when workers are given little voice or responsibility in shaping their own work activities. Another underlying goal of many of our ideas was to empower frontline workers such that they will be more invested in the success of their efforts.
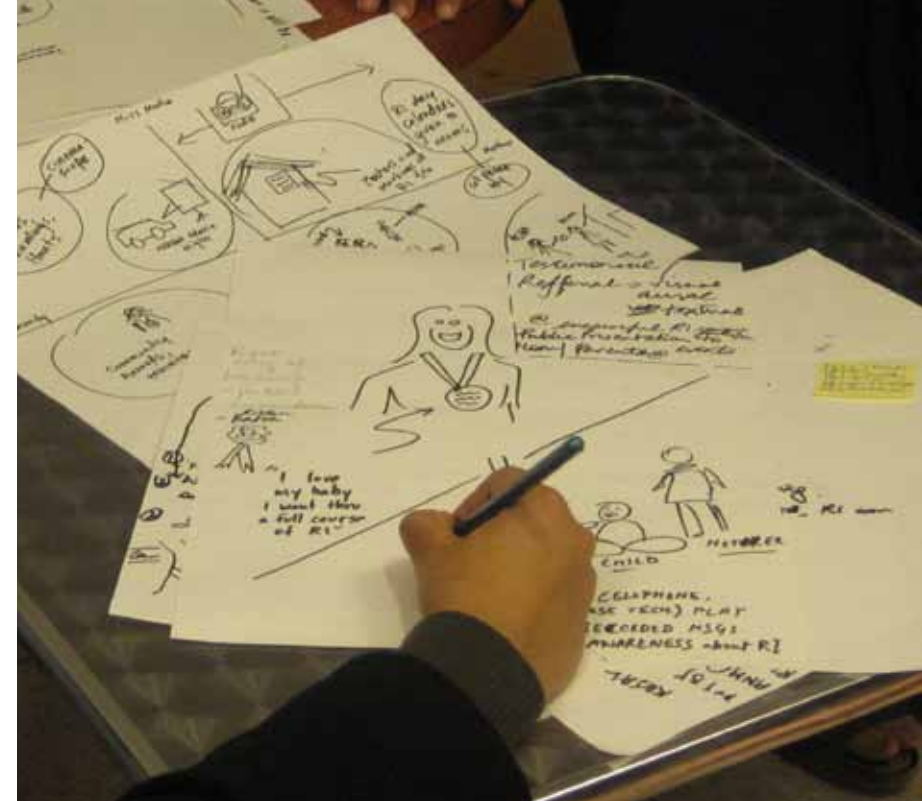
(Above) Story board narrating a concept, (Below) Testing concepts with a research participant in Bihar

Solution concepts

Creating solutions involves an iterative process, which includes both generating an abundance of ideas, then filtering down to the most promising. Once these most promising directions are identified, we iterate again. In this way, we attempt to explore the space of possible solutions as systematically as possible.
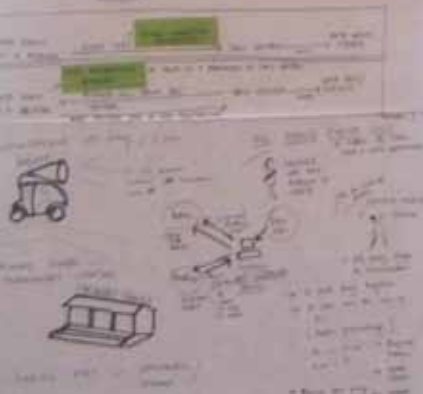
System, service, and product concepts were explored along multiple dimensions depending on the design challenge. In some cases, we attempted to explore both "high tech" and "low tech" solutions, to compare the relative costs and benefits of each. This exercise was also beneficial for identifying implementation challenges that provided inputs for further concept refinement.

Once we had our first group of promising ideas, we developed storyboards, that provided a simple, narrative illustration of how an idea might play out. With these in hand, we returned to the field in Bihar to gather feedback from recipient families, frontline health workers, and higher officials. Such feedback helped us to assess the financial viability, technical feasibility, and human desirability of our ideas. For instance, technology concepts were not only tested for technical know-how and user interface experiences but also for their aspirational value. While all frontline health workers were excited about being empowered with tools of technology, they felt that extensive data entry might be challenging. Currently, most frontline health workers only use their mobile phones for calling and find it hard to text message. The team also approached the key influencers (e.g. *Panchayat*, religious leaders) to understand whether the community would support these concepts. The concept of rewarding mothers was strongly favored by the community because it would inspire mothers to immunize their children.

Domain experts in Patna and Delhi were also consulted for validating the concepts. Most experts strongly favored the technology-based solutions compared to the ones involving more human resources. Some experts pointed out that a market driven triangulation is absolutely necessary for making technological solutions profitable and sustainable, with the service provider, government, and frontline health workers finding them valuable. They also suggested that the interface of mobile devices should be in the form of binomial codes or numbers to allow easy usability by all health workers, considering their different skill sets. Feedback collected from concept testing was found extremely valuable for concept refinement as well as prioritization.
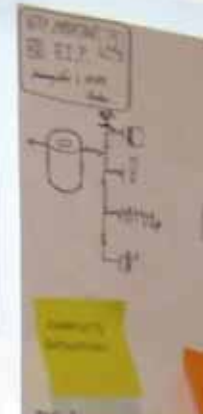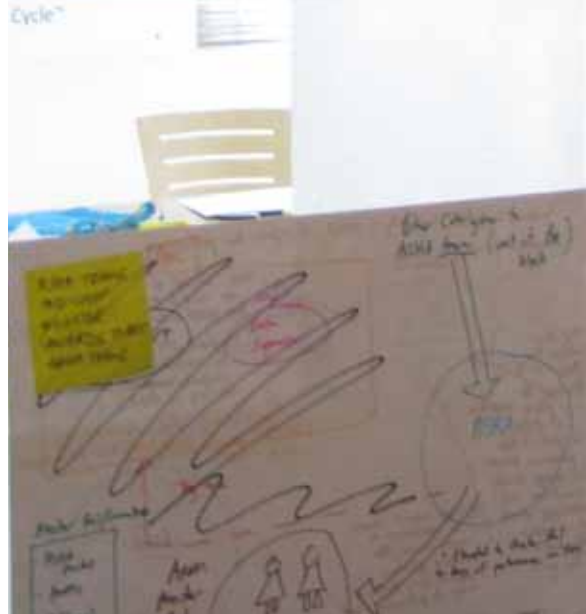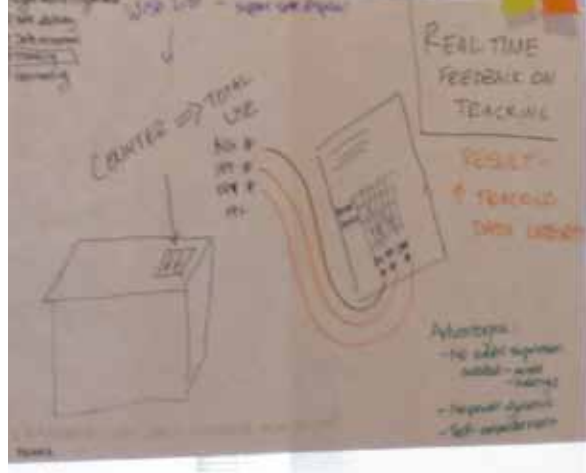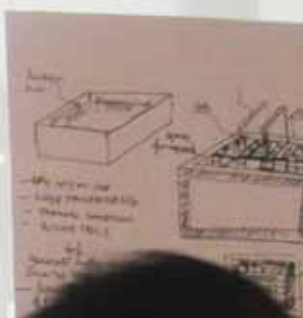
Finally, both our challenge areas and selected concepts were introduced during innovation workshops conducted in New Delhi, sponsored by the Gates Foundation. These workshops served as a platform that brought together expertise from various fields such as public health, industrial design, technology, engineering, consumer marketing and human resource management to collectively brainstorm about immunization challenge in Bihar. The workshop participants were provided knowledge about the existing challenges in vaccine delivery in order to further develop some of the concepts proposed by the internal team as well as explore novel solutions. A range of exciting ideas emerged, with members from different organizations, expressing strong interest in taking them forward.

VALUE
INTRINSIC — PHOTO
EXTRINSIC

READABILITY — POPULAR & CREDIBLE ICONS
— CALENDAR APPROACH

INFO MGT — BARCODE / RFID
ELECTRONIC REMINDER

22 JAN 3 WED
BCG | TB

REAL TIME FEEDBACK ON TRACKING
RESULT + TRACKED DATA

Stakeholders

COUNTER → TOTAL USE

Advantages
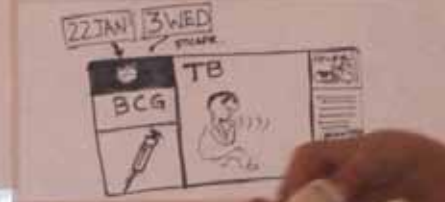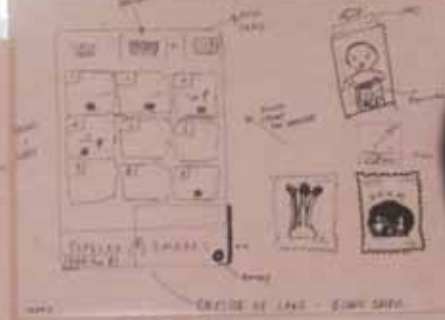
Community ownership
active participation
for immunization

Local groups

VI. Emerging Solutions

Some of the most promising concepts that emerged after the innovation workshops are presented in the following pages.

Each concept concisely describes the characteristics that can be build into the solutions to make them potentially more valuable and help in improving service delivery and access to routine immunization. Each of these are preliminary ideas which require to be further discussed and pursued to improve routine immunization in Bihar, and may also be extended to other related services, such as maternal and child health care, nutrition and family planning.

Redesign of Vaccine Carrier Box

Challenge areas addressed by the concept

- Immunization session execution and logistics
- Tracking children and work activities
- Accountability and training

Telescopic handle

Pull out tray, which functions as a work surface

Separate section for storing records

Roller Bag

Briefcase

Back View of Briefcase

40 cms

14 cms

32 cms

Separate section for storing records

Adjustable shoulder strap filled with foam

Top View of Briefcase

Syringes

Medicines
(e.g., paracetemol
folic acid)

Safe birth supplies
(e.g. Clean cord kit, misoprostol)

Cotton

Information screen
(Displays details of
the recipient, including
the due vaccine)

Vitamin A bottle

Vial tray at cold
temperature

Smart card reader

Dual chamber for disposing
needles and syringes

Hub cutter

Inside View of Briefcase

Types of problems addressed

- Unwieldy structure- Very large and heavy vaccine carrier box, making its transportation and handling difficult.
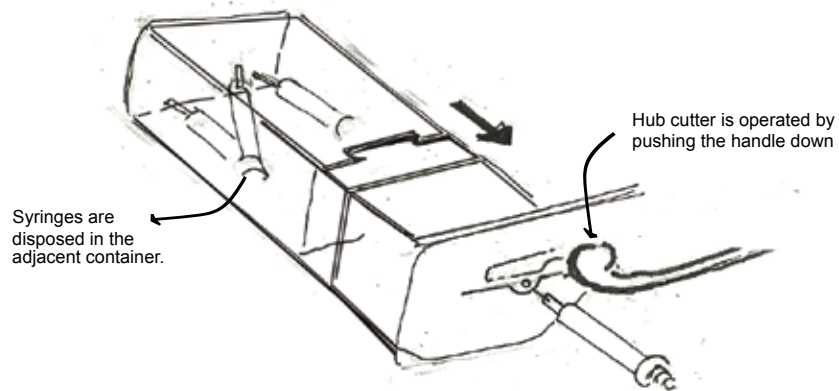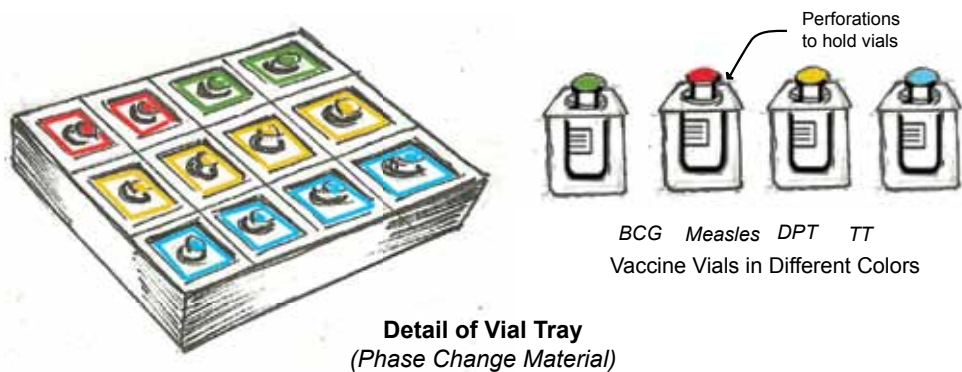- Space and function- Carries only vaccine vials irrespective of its large size, and has no provision for incorporating other components (e.g. syringes, needles, hub cutter) that need to be transported to the immunization session site.
- Safety issues- Difficulty in cleaning and maintenance of pockets provided for ice packs lead to formation of molds. No provision to carry cotton, disposable needles and syringes, leading to unhygienic practices and disposal methods.
- Temperature control- Melting of ice packs owing to improper freezing, large distances of transportation from the cold storage and lack of provision for refilling poses potential threat of spoiling the vaccines. Handling of the vaccine vials using sweaty hands also poses a challenge.
- Potential for institutional branding to build recognition, credibility and empowerment remains unexploited.

Description

The existing vaccine carrier box can be judiciously redesigned to incorporate multiple functions such as storage of RI paraphernalia, easy transportation and collapsible work surface. There is also immense scope for innovation to improvise the box to a "Vaccine-Plus" kit, with value

Perforations to hold vials

Detail of Vial Tray
(Phase Change Material)

BCG   Measles   DPT   TT
Vaccine Vials in Different Colors

Syringes are disposed in the adjacent container.

Hub cutter is operated by pushing the handle down

Detail of the Dual Chamber Hub Cutter

additions serving interrelated functions in other areas of maternal and child health outside the immediate scope of routine immunization. Branding the kit (e.g. NRHM logo) for easier recognition and proud ownership is another aspect of the concept.

The RI kit here is designed in the form of a briefcase, with adjustable straps to provide flexibility to the ANMs to carry it either on their shoulder or back. Alternatively, the RI kit can also be designed in the form of a roller bag, provided with wheels and telescopic handle to allow easy mobility. It also has shoulder straps for the ANMs to carry it on their backs on rough terrains.

Multifunctionality is the highlight of the concept, with storage provision for registers, disposable syringes and needles, cotton, Vitamin A bottle, and medicines, in addition to vaccine vials. The extensible tray acts as a work surface for holding vials and other paraphernalia while in use and as a writing surface support. Incorporating technological features such as an information display screen and smart card reader could help in improved session execution.

Characteristics creating potential value

- The compact form with its smooth rounded edges adhering to the shape of the body, enhances its ergonomics. It would also help in easy stacking, enabling courier men to carry more than one box at a time.
- Accommodating all required paraphernalia for vaccine administration

and record keeping, as well as providing work surface in the same box would improve its functionality. Color-coded vials would allow easier identification of vaccine types. This would help in resolving the challenges around equipment management, enabling smoother work flow.

- Replacing ice packs with materials such as PCM would reduce space wastage as well as help in easy cleaning and maintenance.
- Integrating the hub cutter and compartments for safe and easier disposal of needles, syringes and vials ensure effective waste management.
- Use of innovative materials such as Phase Change Material (PCM) provides insulation to the vials and constantly maintain them at the desired temperature range of 2 to 8 degree Celsius. Provision of an outer case to hold the vials prevents direct contact with person holding the vials, and contributes towards maintaining the temperature intact.
- Additional features such as information screen displaying the names of due recipients and vaccines due could aid in easier tracking of children, and faster vaccine administration. Incorporating smart card reader would make data entry faster and error proof, and also provide an in-built feedback mechanism by tallying due recipients with recipients administered vaccines at the end of every session. This would generate better accountability.
- Branding the RI kit (e.g. NRHM logo) would create improved recognition of the services provided, impart a professional identity to the ANMs and make them feel more empowered.

Further Research

- Ergonomics of the RI kit, including gender specific preferences
- Material options for the RI kit that would make it more durable and cost effective
- The types of materials (e.g. PCM, ice gel, paraffin) available for cold storage[11] and temperature control
- Engineering details of the hub cutter
- New vaccine types to be introduced to the program in the future and the number of vials and syringes that need to be accommodated
- Feasibility of accommodating smart card reader or tracking features in the RI kit, and its implications on factors such as maintenance, durability, weight and cost.
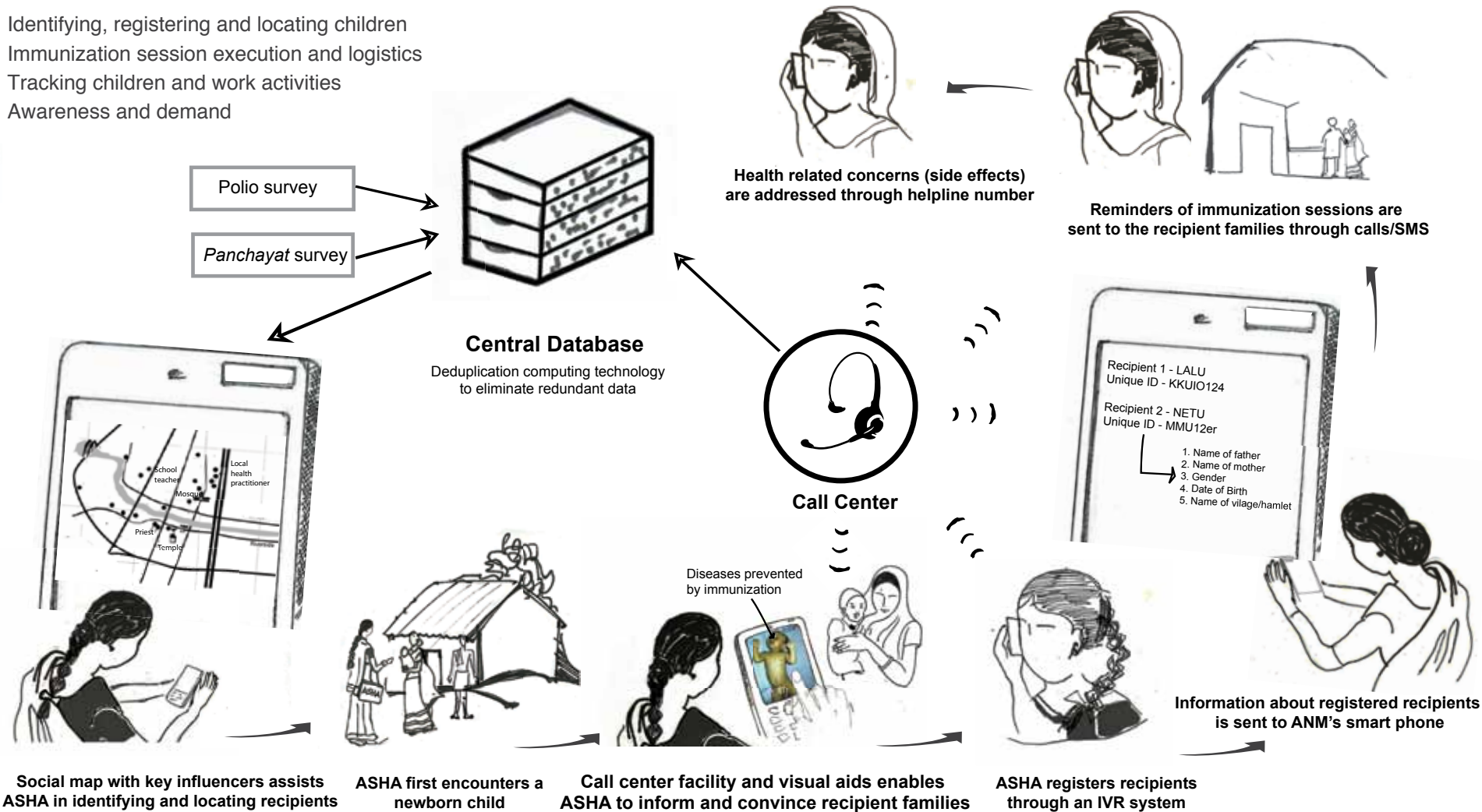
---

[11] *The project team identifies the need for an extensive research on cold storage technologies, in order to be able to develop this solution further*

Interactive Voice Response System for Registration and Assistance

Challenge areas addressed by the concept

- Identifying, registering and locating children
- Immunization session execution and logistics
- Tracking children and work activities
- Awareness and demand

Polio survey

Panchayat survey

Health related concerns (side effects) are addressed through helpline number

Reminders of immunization sessions are sent to the recipient families through calls/SMS

Central Database
Deduplication computing technology to eliminate redundant data

School teacher
Local health practitioner
Mosque
Priest
Temple

Call Center

Recipient 1 - LALU
Unique ID - KKUIO124

Recipient 2 - NETU
Unique ID - MMU12er

1. Name of father
2. Name of mother
3. Gender
4. Date of Birth
5. Name of vilage/hamlet

Diseases prevented by immunization

Information about registered recipients is sent to ANM's smart phone

Social map with key influencers assists ASHA in identifying and locating recipients

ASHA first encounters a newborn child

Call center facility and visual aids enables ASHA to inform and convince recipient families

ASHA registers recipients through an IVR system

Types of problems addressed

- There is no knowledge of the actual up-to-date denominator for RI, and no sources with which the current numbers are cross checked
- ASHAs are not provided with any tools to navigate their coverage area or to assist in identifying new recipients
- ANMs are unaware of new recipients due for immunization session, and ASHAs do not always update the ANMs regarding new pregnancies and births
- ASHAs do not have any tools to educate and convince recipient families for RI, or tackle reluctance
- Recipient families are largely depended on the ASHAs for immunization session schedules, and do not know who to approach for information regarding immunization or other concerns such as side effects

Description

Information collected from the existing resources is stored in a central database. A social map, identifying key members of the community (e.g. *dai-* local midwife, priests, barbers, teachers) and landmarks, is created from this information and send to ASHA's mobile device, along with the list of potential recipients. ASHA would locate recipients and identify pregnant women, newborns, and migrating population with the help of these resources. To register recipients, ASHA would provide minimal data about the new recipients to an IVRS (Interactive Voice Response Service) through a phone-in system using their mobile devices. The information about registered recipients along with their unique IDs would be transmitted to the corresponding ANM's mobile device. The call center facility would help ASHA and recipient families by addressing their concerns and providing suitable assistance.

Characteristics creating potential value

- Leveraging on existing databases (e.g. polio survey, *panchayat* survey) can help in arriving at the actual denominator
- Providing key landmarks and directions would make it easier for ASHAs to navigate through their coverage zones
- Utilizing local resources to assist ASHAs in identifying and locating children can improve registration numbers, especially in case of home deliveries, and amongst large and culturally diverse population
- Call center registration through IVRS would allow simplified data entry using minimum fields, and help in updating ANMs with information regarding new registrations for subsequent immunization sessions
- The visual aid on ASHA's mobile device and help lines would assist in educating recipient families and tackling reluctance
- Call center database can keep track of the immunization history of the child and remind recipient families about due vaccines along with dates. Side effects and other health related concerns could be addressed through the help line number, thus making services more easily accessible
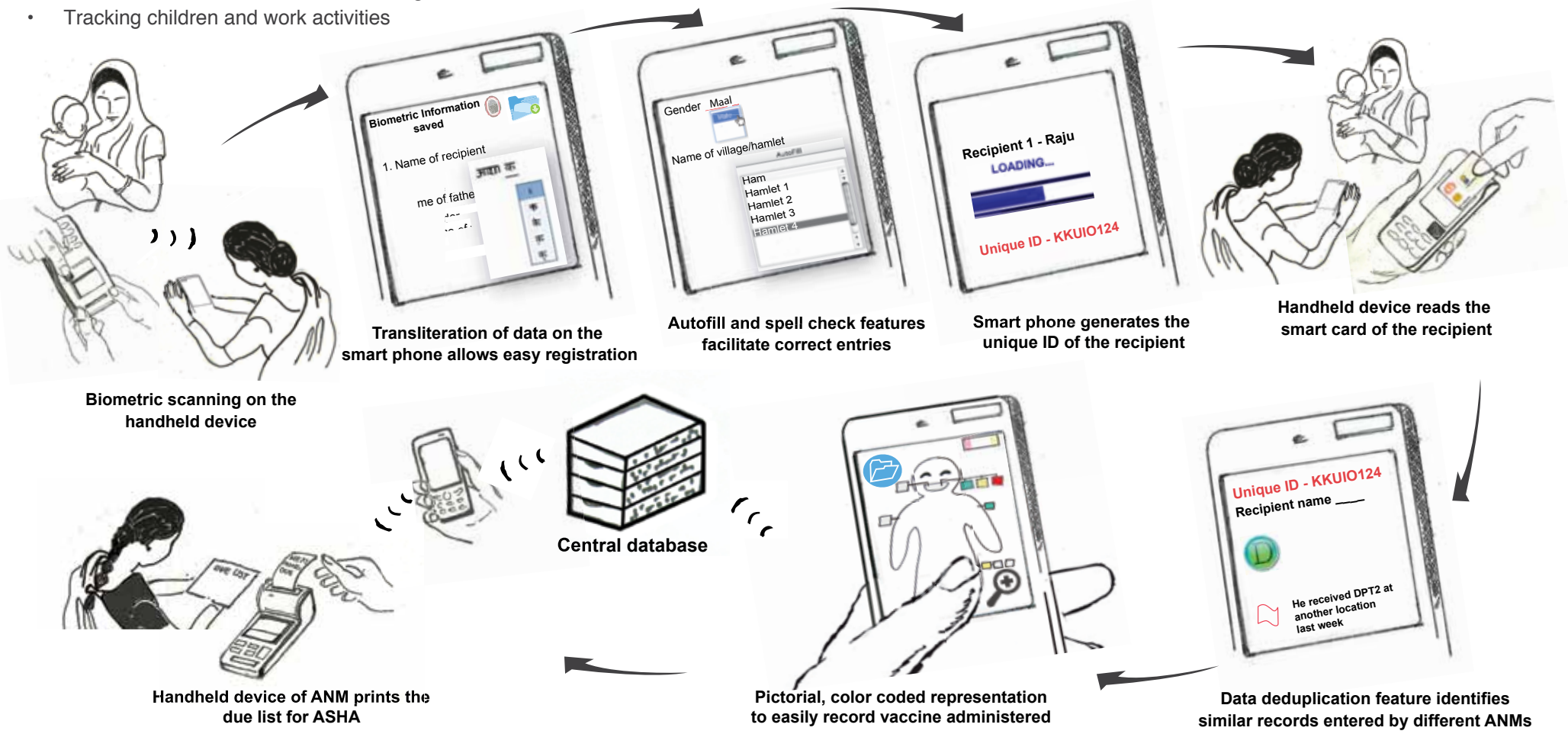
Further Research

- Identification of key members in the community, who would provide information about pregnant women and newborns
- Technology and human resources required to generate social maps and whether they would be considered valuable by ASHAs
- Feasibility of accurate voice recognition and interpretation
- Viability of setting up call centers with knowledgeable operating staff to address health related concerns

Technology Solution for Tracking Recipients

Challenge areas addressed by the concept

- Immunization session planning and management
- Immunization session execution and logistics
- Tracking children and work activities

Biometric scanning on the handheld device

Transliteration of data on the smart phone allows easy registration

Autofill and spell check features facilitate correct entries

Smart phone generates the unique ID of the recipient

Handheld device reads the smart card of the recipient

Handheld device of ANM prints the due list for ASHA

Central database

Pictorial, color coded representation to easily record vaccine administered

Data deduplication feature identifies similar records entered by different ANMs

Types of problems addressed

- Registers are not easily searchable, and overlaps in recipient names create confusion
- Paper based registers limit cross geographical availability of recipient's records, and ANMs are unable to track recipients who have shifted location or migrated
- Maintaining multiple registers and the burden of replication hinders effective record keeping
- ASHAs often go to mobilize without carrying any due list or coordinating with the ANM regarding due recipients

Description

ANMs are provided with smart phones with features such as transliteration, spell check, and auto fill that aid easier and error free data entry. Biometric technology (e.g. thumb scans, face recognition, iris or retina scan) is integrated into these devices. The biometric information is used to generate unique identification numbers for recipients, which is also encrypted in smart cards provided to them. There is also provision of scanners to read these smart cards. The data retrieved from them is transferred to the ANM's phone through wireless transmission. All information recorded on the ANM's phone is transferred to the central database that generates a due list and sends it back to their smart phones. A handheld printer is provided to the ANM to print due lists which is handed over to the ASHA for mobilization.

Characteristics creating potential value

- Enhanced user interface allows easier data entry and provides better searching capabilities. Biometric technology and unique identification numbers help in easier identification and verification of recipients
- Central data base ensures cross geographical access to recipient records, and prevents reregistration of the same recipient in different locations
- Data retrieving reduces workload of ANMs and aids improved information management through easier and accurate data entry
- Printed due lists ensure quicker and effective mobilization by ASHAs
- Automated reports generated from centralized data base ensure better data monitoring and logistical (e.g. vaccine requirement) planning
- The use of unique identification generated can be extended to other public facilities such as BPL card, education, and employment opportunities
- The devices could be used to generate audit and incentive reports, and conduct disease surveillance besides recording and tracking data for RI

Further Research

- Cost effective and technologically feasible devices for ANMs
- Infrastructure challenges (e.g. internet connectivity, electricity) that could hinder effective functioning of these devices
- Suitable user interface and applications for ANMs with different skill sets
- Smart computing technologies to prevent data entry errors and duplication
- Type of biometric technologies (e.g. thumbprints, face recognition, iris or retina scans) relevant for identifying new borns
- Possibility of creating unique identification for newborns in a realistic time frame and type of data to be linked to the UID to prevent data security issues
- Application features that would ensure data privacy and confidentiality
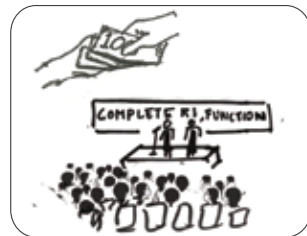- Other non-health care functions to be incorporated to enhance functionality

i-*Taveez* / Immunization Card

Challenge areas addressed by the concept

- Tracking children and work activities
- Awareness and demand

Option 1 - Family Photograph

Option 2 - Cash Incentives

Option 3 - Medal

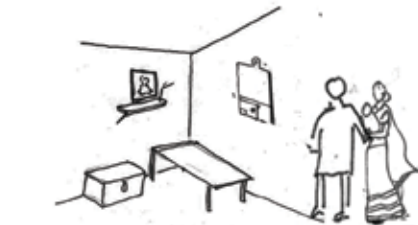ASHA presents taveez and immunization card to the recipient family

Option 1 - Taveez

Option 2 - Immunization card

Option 3 - Smart card

Immunization card is displayed on the wall and visually reminds the recipient family

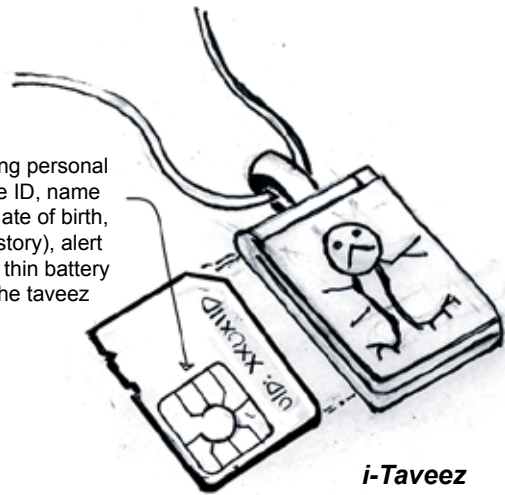Mother visits the immunization site with the smart card or taveez

ANM scans the card and obtains information about the recipient

Incentives are provided to the mothers in a public platform at the completion of immunization cycle

Microchip carrying personal data (e.g. unique ID, name of village/ tola, date of birth, immunization history), alert device and ultra thin battery inserted inside the taveez
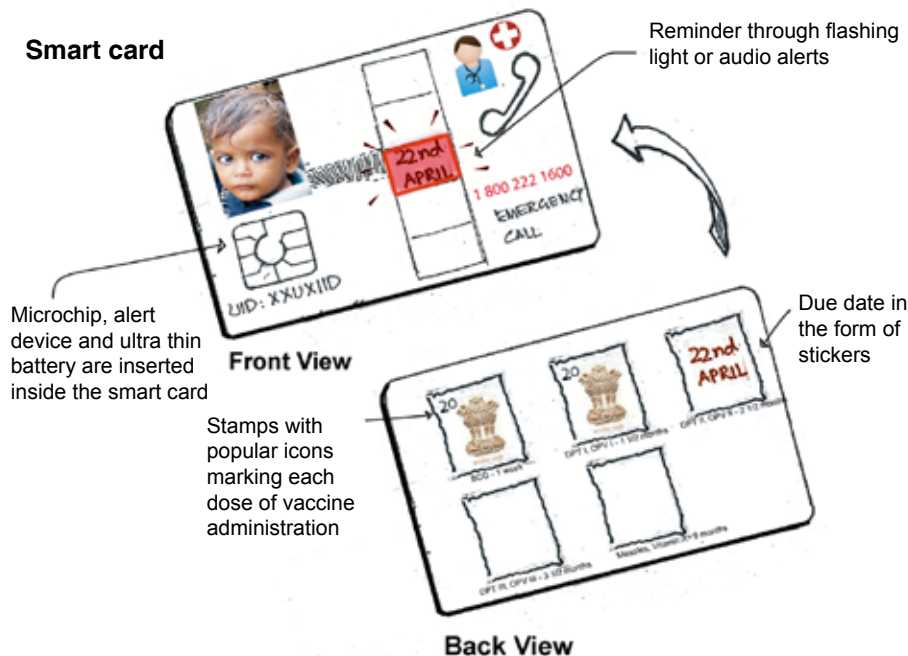
i-Taveez

Smart card

Reminder through flashing light or audio alerts

Microchip, alert device and ultra thin battery are inserted inside the smart card

Front View

Due date in the form of stickers

Stamps with popular icons marking each dose of vaccine administration

Back View

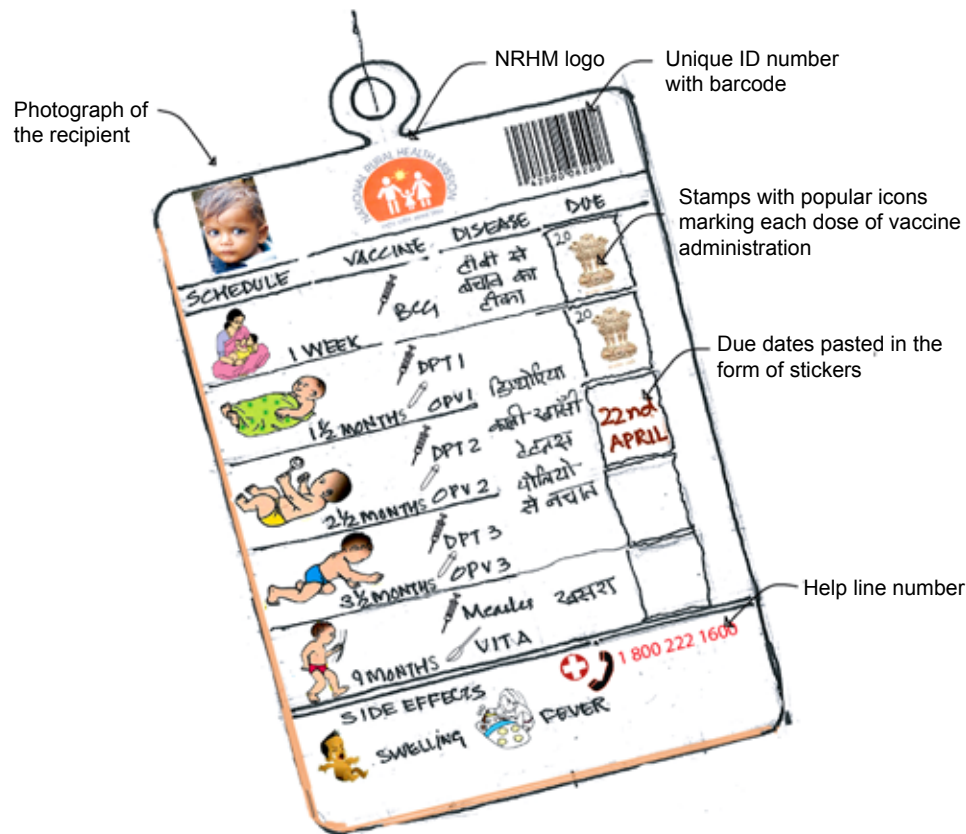## Types of problems addressed

- Tracking recipient data in registers is burdensome for ANMs, leading to vaccine administration without consulting records for due vaccine
- Recipient families do not understand the value of immunization cards, and often misplace it
- The paper based cards are subject to damage owing to improper storage and exposure to factors such as humidity and rodents
- The visual design and information architecture on immunization card is not user friendly. It is difficult for recipient families to comprehend vaccine due dates and vaccine types, thus making them mainly dependent on frontline health workers for receiving information
- Lack of motivation towards completing the immunization cycle

Description

The ASHA would present the *i-Taveez* to the recipient family post child birth, in a religious context (e.g. naming ceremony), or on immunization day. A microchip carrying personal data, encrypted with biometric information, is inserted into this cultural artifact. An ultra thin battery and an alert device could also be inserted inside the *i-Taveez* to remind the recipient families about immunization due dates. Along with the *i-Taveez*, an immunization card made of a durable material is provided that carries all necessary information. It could have provision for inserting photograph of the child. This could serve as an alternative to the current paper based version. Alternatively, a smaller smart card (e.g. RFID, barcode) could be provided. Completion of immunization cycle can, thus, be effectively tracked, and the recipient families could be rewarded for increased motivation.

Improved immunization card

Photograph of the recipient

NRHM logo

Unique ID number with barcode

Stamps with popular icons marking each dose of vaccine administration

Due dates pasted in the form of stickers

Help line number

Characteristics creating potential value

- Smart technology such as RFID or barcode on cards, and biometric features would aid faster and effective tracking of recipients. It would also help in improved information management and easy access to recipient records.
- Using cultural artifacts such as *taveez* could help recipient families in associating significance of immunization for child protection in a culturally appropriate context. *Taveez* provided in the presence of priests on occasions such as the naming ceremony would ensure better preservation. Photograph of the recipient on immunization cards may increase its perceived value.
- Extending use of smart card beyond completion of immunization cycle to other purposes such as health insurance could also increase its value.
- Use of more durable material would help in better preservation of the cards.
- Appropriate iconography on the cards would help families with low literacy levels comprehend information. Visual or audio alerts could also be effective as reminders, decreasing the dependence on frontline health workers.
- Providing suitable incentives (e.g. family photograph, cash incentives, medal) at the end of immunization cycle would motivate recipient families.

Further Research

- Type of cultural artifact acceptable to all recipient families
- Feasibility of incorporating technology in the artifacts (e.g. optimal material from socio-technical viewpoint, easy and safe insertion and lock-in mechanism for the chip)
- Feasible and cost effective technology for smart cards
- More durable and safe material options for immunization card
- User friendly iconography, information design and desirable value additions
- Types of incentives that would motivate families for complete immunization

VII. Prospects and Future Directions

A range of informed and holistic concepts have emerged out of this project, many of which merit further detailing and refinement. As a next step, CKS, with support from the Bill and Melinda Gates Foundation, would work with the Government of Bihar and other partners to discuss opportunities and develop some of these solutions. CKS would focus on creating concept specifications for these emerging solutions, delineating them in ways that maximally reinforce one another, to develop cost effective and viable designs. All solutions proposed would be validated using ethnographic data from the field. They would be thoroughly investigated and evaluated for their benefits and feasibility by constantly engaging with community users as well as domain experts. We would also focus on specific implementation paths for each of these solutions, working closely with the Government of Bihar and other interested organizations.

We invite interested partners to engage in and support the future phases of the project.

For questions related to the project and future work, please contact:

Blair Sachs Hanewall, Bill & Melinda Gates Foundation
blair.hanewall@gatesfoundation.org

Anant Shah, Bill & Melinda Gates Foundation
anant.shah@gatesfoundation.org

John Sherry, PhD, Intel Corporation
john.sherry@intel.com

Aditya Dev Sood, PhD, CEO, CKS
aditya@cks.in

Appendix 1

Acronyms

ANM- Auxiliary Nurse Midwife
ASHA- Accredited Social Health Activist
AWC- Anganwadi Centre
AWW- Anganwadi Worker
BCG- Bacillus Calmette-Guérin
BMC- Block Mobilization Coordinator
BPL- Below Poverty Line
CDPO- Child Development Project Officer
DIO- District Immunization Officer
DLHS- District Level Household Survey
DPT- Diphtheria, Pertussis, Tetanus
ICDS- Integrated Child Development Services
IVR- Interactive Voice Response
LHV- Lady Health Visitor
MCH- Maternal and Child Health
MOIC- Medical Officer In-charge
NFHS- National Family Health Survey
NRHM- National Rural Health Mission
OPV- Oral Polio Vaccine
PCM- Phase Change Material
PHC- Primary Health Centre

RFID- Radio-frequency Identification
RI - Routine Immunization
SHSB - State Health Society Bihar
TT- Tetanus
UNICEF- United Nations International Children's Emergency Fund
WHO- World Health Organization

Appendix 2

Workshop participants

Innovation workshop 1

Name	Company/Organization
Ashok Chandavarkar	Intel Corporation
Narayan Sundararajan	Intel/Grameen
Kazi Huque	Intel/Grameen
Scott Gordon	PATH
Dai Hozumi	PATH
Satish Gokahle	Design Directions Pvt. Ltd.
Saroj Mohanta	MART
Anna Stratis	World Health Partners
Steve Sosler	WHO (CDC secondee)
Dr Arun Gowda	Nokia
Dr. Vishwajeet Kumar	INCLEN
Dr. Satish Gupta	UNICEF
Sujit Kumar	BBDO
Dr. Raj Shankar Ghosh	Institute for One World Health
Urvashi Prasad	Dell
Dr. Balwinder Singh	WHO
Ken Warman	Bill & Melinda Gates Foundation
Andrew Serazin	Bill & Melinda Gates Foundation

Innovation workshop 2

Name	Company/Organization
Dr. Lysander Menezes	PATH
Rajeev Kumar	NeuroSynaptics
Chris Dickey	Healthpoint Services
Prof. Uday Athavankar	Professor Emeritus of IITB
Joris Van Dam	Johnson & Johnson
Abhijit Bansod	Abhijit Bansod Designs
Naveen Kulkarni	Philips Research Asia
Arun Ramanujapuram	IGGI
Nidhi Reddy	HR consultant
Sridhar Srikantiah	Independent Consultant
N. Ramakrishnan	Ideosync
Usha Kiran	Bill & Melinda Gates Foundation
Dr. Karan Singh Sagar	USAID/ Maternal and Child Health Integrated Program

About Bill & Melinda Gates Foundation

Guided by the belief that every life has equal value, the Bill & Melinda Gates Foundation works to help all people lead healthy, productive lives. In developing countries, it focuses on improving people's health and giving them the chance to lift themselves out of hunger and extreme poverty. In the United States, it seeks to ensure that all people—especially those with the fewest resources—have access to the opportunities they need to succeed in school and life. Based in Seattle, Washington, the foundation is led by CEO Jeff Raikes and Co-chair William H. Gates Sr., under the direction of Bill and Melinda Gates and Warren Buffett.

The Foundation supports grantees in more than 100 countries. In the United States, it supports work in all 50 states and the District of Columbia. The Foundation also has a small Charitable Sector Support initiative.

This project was supported under the Global Health Program, one of the three grant making areas of the Foundation. The Global Health Program harnesses advances in science and technology to save lives in poor countries. It focuses on the health problems that have a major impact in developing countries but get too little attention and funding. Their work in infectious diseases focuses on developing ways to fight and prevent enteric and diarrheal diseases, HIV/AIDS, malaria, pneumonia, tuberculosis, and neglected and other infectious diseases. They also work on integrated health solutions for family planning, nutrition, maternal, neonatal and child health, tobacco control and vaccine-preventable diseases.

The other grant making areas at the Foundation are the Global Development Program and the United States Program.

More information on: http://www.gatesfoundation.org

About CKS (Center for Knowledge Societies)

CKS is a research, design and innovation company focusing on emerging economies of the world. CKS conceptualizes and develops innovative products, services and business practices that harness the new possibilities of media, communications and technology. CKS has offices in Bangalore and New Delhi, India, and partnerships with various research organizations in Brazil, China, and other emerging economy environments.

CKS today stands at the cutting edge of design research by creating and using new and effective tools that enable sophisticated user data collection and product design solutions. It employs ethnography, videography, diaries, user trials and other innovative social research tools to gain a rich insight into the aspirations and desires of the users of various product and service categories.

Design at CKS is equally complemented by strong business recommendations and market analysis. It undertakes extensive domain research and market projection in order to ensure that the designs created have a sizable consumer base to cater to. Such consumer analysis grounds its product-service innovations in the actualities of the market allowing clients to better understand their target users. Between 2007-09 alone, CKS has worked with global leaders like Nokia, Nokia-Siemens, Vodafone, Boeing, Herman Miller, Asian Paints, Intel, Google and Dell Corporations among others.

CKS has long standing experience in conceptualizing solutions for social development. Some of CKS's past work includes the Learning Lab initiative founded to promote the creative use of mobile devices for public education in emerging economy environments; recommending gender inclusive ICT access booths; tracking the need for Information and Communications Technologies for children or 'kids' (ICT4K), in association with UNICEF; working in close collaboration with Nokia Siemens Networks' South East Asian division to understand rural outreach best practices and creating new and innovative outreach solutions to make telecom services reach 100% penetration rates; and a multi-country study in India, Sri Lanka, Bangladesh, Pakistan, Thailand and Philippines in order to understand the evolving nature of tele use at the base of the pyramid. CKS authored the widely acclaimed Mobile Development Report, sponsored by Nokia. The report explored the socioeconomic impact of mobile phones in rural areas in emerging economies. In 2008, CKS launched its Emerging Economy Report, which provides essential information for companies creating new products and services for consumers in seven key countries of the world, namely India, China, Indonesia, South Africa, Egypt, Kenya and Brazil.

More information on: http://www.cks.in

Vaccine Delivery Innovation Initiative project examines the key challenges in immunization delivery and uptake in Bihar from the perspective of frontline health workers and recipient families. The findings of extensive ethnographic fieldwork illuminated known and unknown barriers and provided insights into the ways in which they can be effectively addressed. System, service, and product solutions, addressing the identified challenges in improving immunization coverage, are proposed in this report.