Child Immunization Health Card Redesign: an Iterative, User-Centered Approach

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ABSTRACT

This paper highlights some of the challenges associated with the current paper-based immunization health card being used in the Punjab province of Pakistan, and further discusses an iterative approach to redesign this card to be more informative for parents in general with a special focus on a low-literate audience. The discussion builds upon user discussion and resulting need analysis for the redesign of the card. The paper details the technical and design aspects of three iterations of the card and their respective feedback. It also highlights some of the challenges associated with designing a solution for multiple stakeholders in a constrained environment.

Categories and Subject Descriptors

• Human-centered computing~Human computer interaction (HCI) • Human-centered computing~Field studies • Human-centered computing~HCI design and evaluation methods

1. INTRODUCTION

Pakistan, with a population of 182.1 million, is the 6th most populous country in the world and has an annual growth rate of 23.19 births per 1000 people [1]. However, 8.6% of its new-born children die before their 5th birthday [2]. Majority of these deaths are caused by Vaccine-Preventable Diseases (VPD), which means these deaths could be can be avoided by timely administration of requisite vaccines to the children. Pakistan missed the MDG-4 goal of reducing child mortality by two third between 1990 and 2015. As per the UNDP 2013 report [9], Pakistan had achieved immunization coverage targets in only 21 from a total of 119 districts (18%). Furthermore, there is a sharp disparity in immunization coverage between provinces and inter-districts that remain to be addressed [9].

Early childhood immunization is critical in increasing life expectancy of children as well as in saving extra health expenditure incurred on vaccine preventable diseases in the future [3]. Expanded Program on Immunization (EPI), a government funded program, is responsible for immunization coverage all across Pakistan. As part of the EPI, vaccinators (government employees assigned to administered schedule vaccines to kids and pregnant mothers) distribute immunization health cards to the parents as an information tool that contains the vaccination status of their child, date of next visit, and information about the importance of immunization [4]. Hence these home-based vaccination cards play a key role in the overall information of parents as well as in the improvement of vaccination coverage rates [4][5][6].

However, there are some well-known limitations with these paper-based cards. These cards are often not durable, text heavy, outdated and over complex for illiterate or semi-literate population to understand [7]. Furthermore, beneficiaries also do not recognize the importance of such paper-based cards.

ICTD '16, June 03-06, 2016, Ann Arbor, MI, USA
ACM 978-1-4503-4306-0/16/06.
http://dx.doi.org/10.1145/2909609.2909634

In Pakistan, the current immunization card is a single page document, relatively smaller in size, with an overall informal look, which undermines its significance in the mind of users. The card uses small size font for text in order to contain all information fields on the one-page limit and contains time intensive formatting. The data from these cards is then manually transferred to paper based registers, which does not allow the provincial management to view granular level vaccination card. The card is also prone to loss, damage due to extraneous wear and tear in outdoor conditions, thus data safety and integrity is easily compromised. Retention of single page vaccination cards has also been a significant issue [5][6][8].

A better-designed immunization card can significantly improve the uptake of vaccination services, a concept that has been recently tested in both rural and urban settings [5][6]. This paper explains the issues highlighted in semi-structured interviews with parents and vaccinators regarding child immunization system in Pakistan. Based on the findings from these interviews, this paper explains the iterative process to design a user-centered immunization card that can overcome user-cited issues arose during interviews. Section 2 discusses the methodology to conduct field survey, and the major findings from initial qualitative field research are highlighted in section 3. Section 4 details the multiple iterations of the card and the feedback received on various prototypes. Section 5 concludes with discussion and future work.

2. METHODOLOGY

In order to learn about the usability of child immunization card by parents and vaccinators, we conducted semi-structured interviews with 69 parents as well as 5 vaccinators. The interviews were mainly focused on: the usability of current child immunization card both by parents and by vaccinators, the challenges they are facing while using the card and what they perceived as the improvements that can be done in order to enhance the usability of current card. On the basis of problems identified in our interviews, we iteratively designed 3 versions of immunization card and gathered feedback from parents and vaccinators after each iteration. All interviews were conducted in Urdu and responses were recorded on paper.

2.1 Interviews with parents

Semi-structured interviews of sixty-nine (69) parents were conducted at vaccination centers in different locations of the Punjab province of Pakistan (Lahore, Murree, Sargodha, Nankana Sahib, Sheikhupura, and Sahiwal).

The purpose of these interviews was to evaluate the usefulness of the existing card for parents. The survey focused on the knowledge of four areas of information that can be of particular significance to parents' usage and retention of the card, namely: the instructions written on card; the next due date; the immunization schedule, and the perceived importance of immunization process and immunization cards.

All of these interviews were conducted over the period of two months and each interview took between 15 to 20 minutes.

2.2 Interviews with vaccinators

In order to know about the administrative issues while filling up the vaccination cards after administrating vaccines to children, we conducted semi structure interviews with 5 state-appointed vaccinators at 5 different Basic Health Units (BHUs) in Punjab. The purpose of conducting these interviews was to learn about the problems vaccinators face while filling the immunization card and registers. Interviews were conducted over the period of two months and each interview took between 20 to 30 minutes.

3. FINDINGS

Apart from reporting findings gathered from parents regarding their understanding level with respect to the current immunization card and its importance for them, our interviews with parents and vaccinators brought to the fore some major issues that the new immunization card tries to address.

3.1 Finding from Parents

Average age of parents interviewed at the vaccination center was 34 years and majority of them were semi to low literate (semi-literate: n=12/69, 17% and low literate: n=40/69, 58%, total semi-literate and low literate: n=52/69, 75%) and preferred Urdu (n=29/69, 42%), Punjabi (n=27/69, 39%) or both (n=13/69, 19%) as a language of communication. Keeping in view the importance of immunization card for parents, we analyzed the parents' level of understanding regarding next visit and dates of previously administered vaccines, immunization schedule and instructions written on immunization card. 22/69 (32%) parents said that they were unable to read next visit date because of how vaccinators inscribed it in a small date-of-next-visit column on the card and had to guess/calculate the next visit date based on their knowledge of the immunization schedule. 27/69 (39%) parents said that they were unable to understand the immunization schedule printed on card, because it was presented in a confusing two-column format which is hard to understand. Parents also claimed that the small font size of the advisory instructions for parents, written on the flip side of child immunization card make it too hard even for literate parents to read them.

Responses gathered from parents regarding what they would want to improve on the existing immunization cards include: (I) Information regarding child's health at different stages, (II) Visibility of next visit date as it was observed during interviews that most vaccinators write next visit day in fractional (dd/mm) format instead of date (dd-mm-yy) format, (III) Clear immunization schedule, (IV) Possible adverse reactions from an injection and how to cater to these reactions, (V) Contact information of a medical personnel in case of emergency and (VI) Stronger material for durability.

Parents largely agreed that the vaccination card was an important document. Three frequent responses regarding why the immunization card is important include: (I) Vaccinators need immunization card for administering vaccines to their children at vaccination center and vaccinators may refuse to vaccinate the child without the card, (II) Those parents who are government employees needed their child's health and immunization card in order to get free medication from hospital. And (III) Vaccination is important for children and card is important for correctly administrating vaccines.

Parents with multiple births or have more them one child in immunization age revealed that handling multiple cards for all children is a problem for them, hence they wanted either records for all children in the family combined in one card or inclusion of picture pockets in card to help identification of cards for each child. In accordance to the importance of immunization card stated by parents, card retention rate was very high among the parents we interviewed i.e. out of 69 only 4 parents said that they lost their child's immunization card. While the rest 65/69 (94%) said that they kept it safe as it is a necessity for their children to get admission in schools as well.

3.2 Lost Card and Data Retrieval

One theme which occurs repeatedly from vaccinators side is the issues they face while retrieving data from paper based registers in case if parents lost their children's vaccination card. One vaccinator said during discussion:

"We have to make it sure that all those who come to the vaccination center for their child's immunization should get vaccinated and hence we can't refuse administering vaccines in case they don't have card. So sometimes when parents don't bring the cards with them and we are unable to find that child's last vaccination record from our permanent registers, we have to go for mothers' recall."

Interviewed vaccinators wanted some sort of unique identification for children who need to be vaccinated. Computerized National Identification Card (CNIC) number is a unique identification for individuals above 18 years of age in Pakistan but people either don't remember their CNIC number or may not have a CNIC card made (especially in rural areas). Hence using CNIC number to uniquely identify a child would be infeasible. Other themes that emerged in the interviews include lack of central database that could facilitate quicker search for records of children whose vaccination cards are lost or are visiting a different Basic Health Unit than before. Other problems that emerged during interviews included: issues in convincing parents to complete immunization schedule, lack of strategies for identifying defaulter children (children who have missed a scheduled vaccination), increasing durability of immunization card and communicating off-schedule polio campaigns to make the process better organized.

4. CARD ITERATIONS

This section explains the three iterations of immunization card that we designed on the basis of findings we collected from our initial qualitative field research.

4.1 Initial Prototype

Based on the finding mentioned in section 3, the initial prototype (Figure 1) of immunization card was designed. This card had separate fields for each visit and within each visit, separate fields for each vaccine to be administered. Keeping in view the periodic off schedule polio and measles (or any other off-schedule) campaign, we added fields for such unscheduled visits conducted by the vaccinators. Fields for next due date for all 6 visits were prominently placed on the front side of first prototype. The instructions for the parents regarding mother and child health were also written in local language in bigger font at the back of the card (first prototype) under separate subheadings to make it more visible and readable. Extra space was designated to cater for the inclusion of any new antigen. In addition, this first prototype contained weight for age growth charts for male and female babies to monitor their weight and height. However, this version of card still did not contain any unique identifier, which as we later found, was an impediment in the process of digitalization of immunization records. This first prototype of immunization card was tested with vaccinators and mothers in the field. First, the vaccinators expressed concern about increasing workload, especially work related to noting down child weight and height.

Second, measuring child's weight or height is currently under the job description of Lady Health Workers (LHWs).

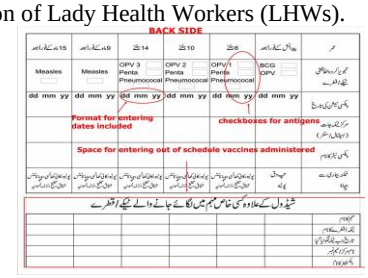

Figure 1: First Prototype

The job descriptions of either LHWs or the vaccinators cannot be changed on provincial level, as it needs long-term strategic changes in health services planning and integration, a process that falls outside of the domain of current research. Third, mothers were still unable to differentiate between dates of administration of antigens and next due date. It was perceived that this issue could be addressed if separate pages were used in the vaccination card to fill out dates and information about each round from the 6 rounds of vaccination. One theme that occurred frequently while talking to vaccinators is the entry of immunization records in a paper-based register. It is harder to collate records, prone to human-error and difficult to extract information in real-time. Furthermore, there is no central system countrywide for retrieving a child's data due in case the family moves from one place to another. Overall statistics collected from the current setup are not very accurate, and hard to monitor and evaluate.

4.2 Second Prototype

To resolve the issues identified in first prototype, we introduced the prototype 2 (Figure 2) of the immunization with a digital record system in order to bridge the gap between paper-based records and a digital record system.

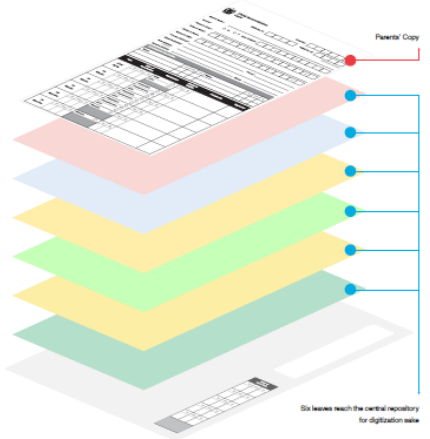

Figure 2 : Second Prototype

As the immunization process in Pakistan consists of six vaccination visits, we designed the second prototype, which had six carbonless copies of the original card. Upon each visit, one row is filled on the original form and the carbonless copy page directly below is torn off and sent to the Union Council offices for Optical Character Recognition (OCR) and Optical Mark Recognition (OMR) scanning. The data is sent to a central server to build a central repository for overall health record. Unique identifiers (HMIS- Health management information system) numbers were introduced for the first time, as a step towards digitalization of records in near future. The card had biographical information, including Computerized National Identification Cards (CNIC) number of parents/guardians on its front page. To reduce the chances of losing and damaging cards, they were designed with water proof material, shaped in a booklet form and also had a zip lock on the inner edges of the immunization cards to protect their contents and leaflets from any liquids. In order to increase the importance in the mind of the users, the shape of the booklet had a more formal appearance. The next visit date was printed on the card in such a way that one did not need to open the zip lock to see it. The outer layer of the card had a slit to view the next due date at all times without opening the card.

This prototype was again tested in field research. Even small-scale implementation of this card met a lot of resistance due to certain reasons. First, it required a lot of infrastructure improvement at union council level, which was deemed unrealistic at this stage. Filing of multiple copies of separate antigen record at the union council level tended to create a lot of paper work, causing hesitation among immunization staff to support the change. The new design also required handling many delicate carbonless papers. This made the process opposite to the idea of reduction in paper-based workload of immunization service record. Furthermore, on the user-end, mothers did not value the new design either, given the card was delicate to retain and it overwhelmed mothers with information that they could not understand due to lower literacy levels.

4.3 Third Prototype

All this feedback and research data was used to come up with a third prototype of immunization card (Figure 3A and 3B). Till now, no attempt had been made to digitize the entire immunization system. After the implementation of Punjab Government's new immunization information system (EPI dashboard), all vaccinators in Punjab (approximately 4000 in number) now have a low-cost android-based smart phone. Each smartphone comes preloaded with an android based application coupled with a web-based dashboard, a policy level information system used to monitor vaccinators' daily attendance and the number of children immunized. Exploiting this opportunity to implement an ICT solution, this third and final prototype has been designed with the following features:

- A unique identifier that is automatically generated via smart phone app.
- In term of physical appearance, this revision of the card is just like a passport having six unique pages, one for each visit. Unlike the previous version, the paper more durable than the lightweight carbonless paper.
- The embossed monogram of Punjab Government on the outer cover makes it look like an official document and increase its value in the mind of the user.
- The first page contains the record of next due dates, prominently visible and very easy to understand for the target population.
- Six distinct pages for each round of immunization for a child, color coded to include visual aid for users
- Relevant information for mothers is demonstrated in pictorial form so that even an illiterate person can comprehend parts of the information being disseminated.
- There is a page dedicated for the immunization of the mother, so that there would be no need to retain a separate card.
- An NFC chip is now embedded in the card, which can store information locally and supports multiple read/writes, with information such as unique identifier,

biographical information and the immunization details of a baby.

Our team has developed a new smart phone app for the use of the vaccinators, which is now able to read and write onto the NFC chip. The data on the NFC chip can be easily uploaded to the EPI dashboard via the smartphone app. This would make the tracking of the baby easier in areas where connectivity is a challenge. A new dashboard will be built, allowing us to centrally monitor relevant statistics of child immunization, aggregated on different levels. So far mothers and vaccinators have given positive feedback to this version, on features such as structure fields, durable material and informative pages. Our team conducted another field visit to gather user feedback on this final prototype of the immunization card. A total of 30 vaccinators and 10 mothers were interviewed, in order to gather their overall perception and feedback on the redesigned card. The focus of this round of feedback was intentionally directed towards vaccinators, as the new design attributed behavior change by requiring the vaccinators to create records on an android app and write it on the card via NFC as well as by hand so that the parents can also view the data entered digitally on the card. The interviews were conducted in Districts Lahore, Sheikhupura and Sahiwal of Province Punjab.

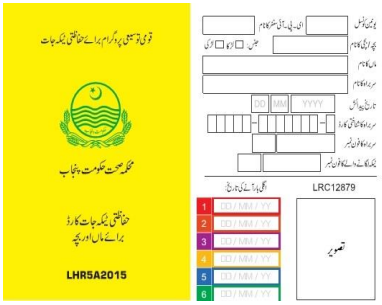

Figure 3A- Third prototype (Left: Front Cover, Right: First page)

24/30 (80%) vaccinators said they liked the physical material of prototype 3, and the official look of the document (passport shape, government monograms, booklet binding) appealed to them. 19/30 (63%) of these vaccinators found prototype 3 better in providing relevant information. 16/30 (53%) of the vaccinators said that filling out prototype 3 of the card was as exhaustive as filling out the prototype 2, but was relatively simpler to fill, due to separate pages allocated for each immunization round. However, 14/30 (47%) considered the prototype 3 to be more complex than the initial, single paged card. Regarding mothers, 60% (6/10) found the physical material and shape of prototype 3 better than the previous versions and said that they felt it was a significant official document. Only semi-literate mothers (3/10, 30%) were able to read the instructions provided on prototype 3 of the card. 80% (8/10) mothers could not understand the meaning of pictorial informative pictures.

5. DISCUSSION AND FUTURE WORK

Literature review and our findings from interviews suggest that redesigning immunization card to make it easier to understand, can serve as educational tool for parents regarding their children's immunization. As our literary review also highlighted, this process is an effective intervention to reduce immunization dropouts.

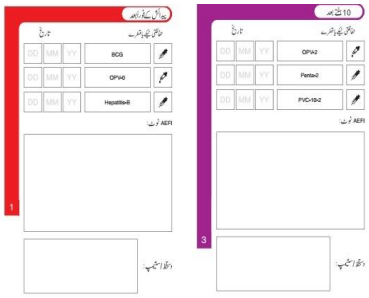

Figure 3B- Third prototype (Sample of Inner pages)

The overall immunization system can become more efficient, accurate, and reliable and less time intensive if it is shifted to a completely mobile or IT based system, and use of papers is thoroughly eradicated. However, this process not only requires centralized databases with features such as existence of complete digital records of each beneficiary with assigned unique ID's (which are as reliable as other official numbers such as Passport number, identity card numbers etc.), but also requires a lot of infrastructure and human resource training. Our ultimate goal remains the same, to slowly shift from paper based records management to a completely digitalized Immunization Information System (IIS) that can improve service delivery. Currently, we are in process of developing the technical system, including the android app and web dashboard, to digitize the record keeping process. We plan to implement our latest iteration in two districts of Punjab, Pakistan, to find out the impact of the redesigned system. This paper is an attempt to highlight some of the challenges in designing for a low-literate audience where multiple stakeholders are also involved, and the benefits of iterative design and feedback before implementation.

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