Iterative Design of an Immunization Information System in Pakistan

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Overview

• Background & Context
• Previous System - Vaccinator Tracking App
• Our System Architecture
• Iterative design of application
• Small Scale Testing & Findings
• Discussion & Conclusion
Immunization status in Pakistan

- 56% immunization in 2014
- Missed the Millennium Development Goal of 90% national immunization coverage
- One of two countries with polio
Vaccinators

- Permanent employees
- Immunize at grass root level
- For underserved areas
- 3750 vaccinators in Punjab
### National Immunization Schedule of Pakistan

<table>
<thead>
<tr>
<th>Visit #</th>
<th>Child Age</th>
<th>Antigens</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>At Birth</td>
<td>BCG, OPV-0, Hep-B</td>
</tr>
<tr>
<td>2</td>
<td>At 6 Weeks</td>
<td>OPV-1, Penta-1, Pneumo-1</td>
</tr>
<tr>
<td>3</td>
<td>At 10 Weeks</td>
<td>OPV-2, Penta-2, Pneumo-2</td>
</tr>
<tr>
<td>4</td>
<td>At 14 Weeks</td>
<td>OPV-3, Penta-3, Pneumo-3</td>
</tr>
<tr>
<td>5</td>
<td>At 9 Months</td>
<td>Measles-1</td>
</tr>
<tr>
<td>6</td>
<td>At 15 Months</td>
<td>Measles-2</td>
</tr>
</tbody>
</table>

Table 1: EPI child Immunization Schedule
### Daily Vaccination Register

<table>
<thead>
<tr>
<th>Remarks</th>
<th>AEPI</th>
<th>Yes/No</th>
<th>Date of Vaccination</th>
<th>Name of Antigen</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>BCG</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>OPV</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pentavalent</td>
<td>OPV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pneumococcal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Measles</td>
</tr>
</tbody>
</table>

### Permanent Vaccination Register

<table>
<thead>
<tr>
<th>Remarks</th>
<th>AEPI</th>
<th>Yes/No</th>
<th>Date of Vaccination</th>
<th>Name of Antigen</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>OPV</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pentavalent</td>
<td>OPV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pneumococcal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Measles</td>
</tr>
</tbody>
</table>

### Vaccination Record

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</tr>
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<tbody>
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<tr>
<td></td>
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<td></td>
<td>Pentavalent</td>
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<td></td>
<td>Pneumococcal</td>
</tr>
<tr>
<td></td>
<td>Measles</td>
</tr>
</tbody>
</table>

### Child Vaccination Card

- Name: [Name]
- Date of Birth: [Date]
- Gender: [Gender]
- Father's Name: [Name]
- Mother's Name: [Name]
- Vaccination Details:
  - BCG
  - OPV
  - Pentavalent
  - Pneumococcal
  - Measles

- Immunization Schedule:
  - 1 month
  - 2 months
  - 3 months
  - 4 months
  - 5 months
  - 6 months
  - 9 months
  - 18 months
  - 2 years

- Health Check-Ups:
  - [Health Check-Ups]

- Emergency Contacts:
  - [Contact 1]
  - [Contact 2]
  - [Contact 3]
Research Questions:

Improve the coverage and retention of immunization in Punjab?

How can we

• Redesign the immunization card to be more informative for parents and useful for vaccinators?

• Support vaccinators work while collecting data?

• Design the card and the application to facilitate Digital Health Records?
Our Pilot

• Geographical area:
  • Two districts: Sheikhupura and Sahiwal
  • Selective 70 Union Councils

• Data Collection Methods:
  • Participant observation
  • Unstructured and semi-structured interviews
  • Surveys
  • Content analysis of government documents
  Through
  • 30 meetings
  • 10 focus groups
System Diagram

1. Immunization card
   - NFC embedded cards given to parents at their Kids’ first visit of immunization after writing kids data on NFC chip

2. Android App
   - Vaccinators enter kids information on NFC based android app and send it to central data

3. Central Database
   - Central repository with backup data for searching mechanism & presenting on dashboard

4. Web Dashboard
   - Web dashboard for policy makers to view the details of vaccination coverage of their region
Previous System - a Smartphone Vaccinator Tracking App

• To increase vaccinator attendance and geographical coverage

• Digitized vaccinator attendance
• Geo-tagged Vaccinator visits

• Android based smart phone
• Customized, preloaded Android application
Previous system - E-vaccs

• Check-in and check-out
  • To mark vaccinator attendance

• Pictorial Evidence of Duties
  • Pictures of Remote vaccination centers
  • Pictures of Immunized Children

• Top Down Approach – No unique IDs
Insights about E-vaccs from vaccinators

- Internet connectivity to upload data
- Missing attendance
  - Uploading prerequisite to check-out for the day
- Separate data submission for each record
  - N clicks for N record upload
First iteration – Building on top of E-vaccs

- Plan My Day
  - Optimized movement
- Delay Tolerance
- Single Click image Upload
Feedback on version 1

- Translation of Application in local languages
  - Preferred data entry in English alphabets
  - Application text and prompts to be in Urdu

- Defaulters List

- Removing Plan my day
Iteration 2 – Four Core Functions

- Register a new child
- Scan a card (upon visit)
- View all children of Union Council
- Search a child
1 - Registration of Children

• Basic Information about the Baby:
  • Date of Birth
  • Gender
  • EPI number

• Information about guardians:
  • Name of guardian
  • Relation to the baby
  • National Identity (citizen) number
  • Mobile number

• Picture of the baby
2 - Scan a card

- Shows the exact visit on the screen
- Reducing search time

3 - View all children of Union Council

- (Immunization) Default Children
- (Immunized) On-time Children
- (Immunization) Completed Children
4 - Searching a child

• Reasons for Searching
  • Frequent lost cards
  • Forgot to bring with them
  • Movement and displacement

• Search Methods
  • Online Search
  • Offline Search using SMS
Iteration 3: Additional Features

• Facial detection for photographs
• Update application remotely
• Data recovery (from central server) on fresh install
• Calculation of next due date
• Image compression for uploading
Backward compatibility

Har Zindagi System

Previous E-vaccs System

Two parallel systems simultaneously

Learning from E-vaccs 1\textsuperscript{st} Iteration 2\textsuperscript{nd} Iteration 3\textsuperscript{rd} Iteration Field Testing
Small scale app testing with users

• Methodology:
  • 50 vaccinators from 2 districts

• Two step process:
  • Step 1: Training for using the new app:
    • Presentations and videos in Urdu and Punjabi
    • 2 hour long trainings
    • Followed by question and answer session
  • Step 2: Task based assessment
Task Based Assessment

• Groups with 3 to 4 vaccinators
  • Avg. 21 years of service

• Performed tasks:
  • Registering a child
  • Recording a visit (with card)
  • Recording a visit (without card)
  • Searching child

• Average time: 5 minutes

• Technical staff for support
• Research staff for participant observation
TASK COMPLETION PERCENTAGE BY USERS

- **Asked for help**
- **Did not ask for help**

**Not Completed**
- 5 asked for help
- 10 did not ask for help

**Completed**
- 15 asked for help
- 70 did not ask for help
Behavioural response while using app

- **Frustrate**: 5%
- **Confuse**: 11%
- **Asking for Hints**: 16%
- **Performing Task with Confidence**: 68%

Learning from E-vaccs → 1st Iteration → 2nd Iteration → 3rd Iteration → Field Testing
Qualitative Findings

Liked Features
• Data retrieval through NFC
• Face recognition
• Defaulters list
• Efficient record searching
• One click upload

Disliked Features
• Twice image capturing
• Duplicate entries on card

Suggestions
• Daily immunized list
• Offline check-out
Vaccinator’s feedback

“These vaccinators are not educated enough to learn everything in one go. You should give them more training sessions but **make sure** that for all next training session, **supervisors are not around**, especially if you want them to speak out and to give you their honest opinion.” [Vaccinator]
Discussion

• Seeking feedback with top down deployments

• Contradictory requirements of vaccinators and policy makers

• Look out for Implicit & Explicit requirements

• Need for validation of requirements by field knowledge
Future Work & Recommendations

• Simpler technology solutions for usability, administrative and security concerns

• Data binding to IMEI, pictorial evidence, GPS location to verify presence, Customization to users

• Consumers of data needed to add a feedback loop

• Parents need to be incentivized for immunization coverage
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