Zindagi Mehfooz (ZM) Electronic Immunization Registry in Pakistan 🇵🇰

Apr 19, 2021

Maternal & Child Health, IRD
mch@ird.global

Scale Up & Status of the ZM EIR in Pakistan – Apr 20, 2021

10,334
Annual Birth Cohort

0.3M
Population

→ Gilgit District

20,482
Annual Birth Cohort

0.7M
Population

→ Islamabad

Sindh

47.9M
Population

1.7M
Annual Birth Cohort
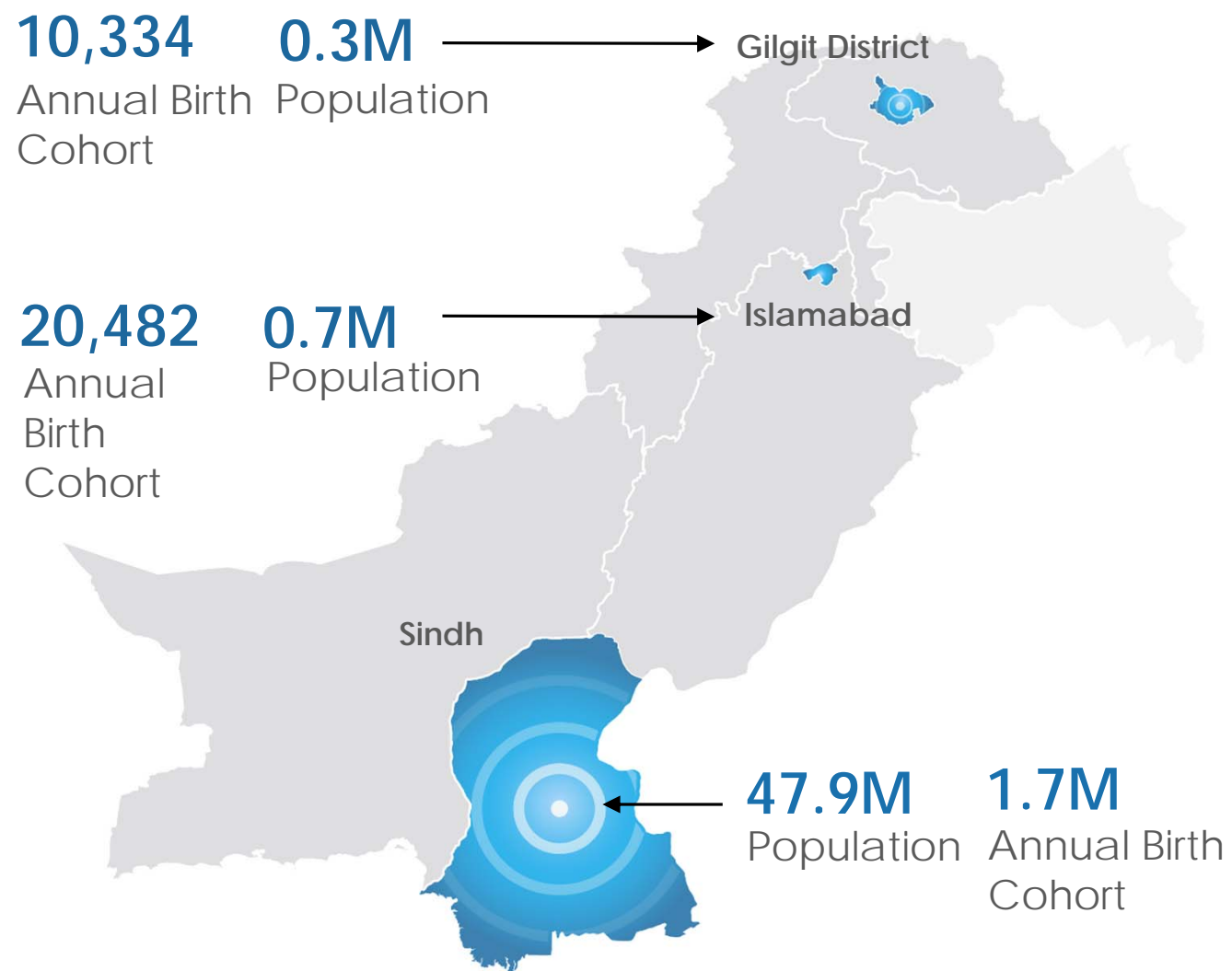
In 2020, ZM EIR enrolled 100% of the EPI estimated annual live birth cohort of Sindh

Total				
4.6M+ Children	**1.6M+** Women	**45M+** Immunizations	**3,532** Vaccinators	**1,818** Immunization Clinics
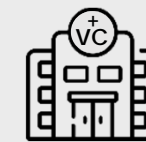
Sindh				
4.6M+ Children	1.6M+ Women	45M+ Immunizations	3,460 Vaccinators	1,752 Immunization Clinics

Gilgit District				
13,181+ Children	3,041+ Women	104,066+ Immunizations	41 Vaccinators	26 Immunization Clinics

Islamabad				
16,304+ Children	1,876+ Women	85,611+ Immunizations	31 Vaccinators	40 Immunization Clinics

In 2019, ZM EIR enrolled 83% of the EPI estimated annual live birth cohort of Sindh excluding Districts Khairpur & Dadu
Islamabad Population & Birth Cohort are estimated based on catchment areas where ZM is active

ZM started in 2011as **a phone-based electronic immunization registry** to improve immunization coverage and timeliness
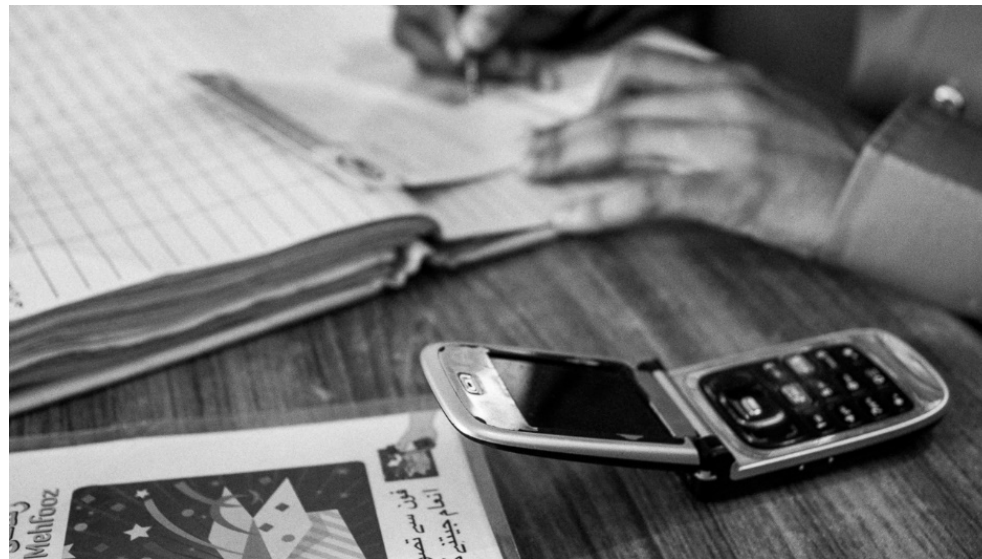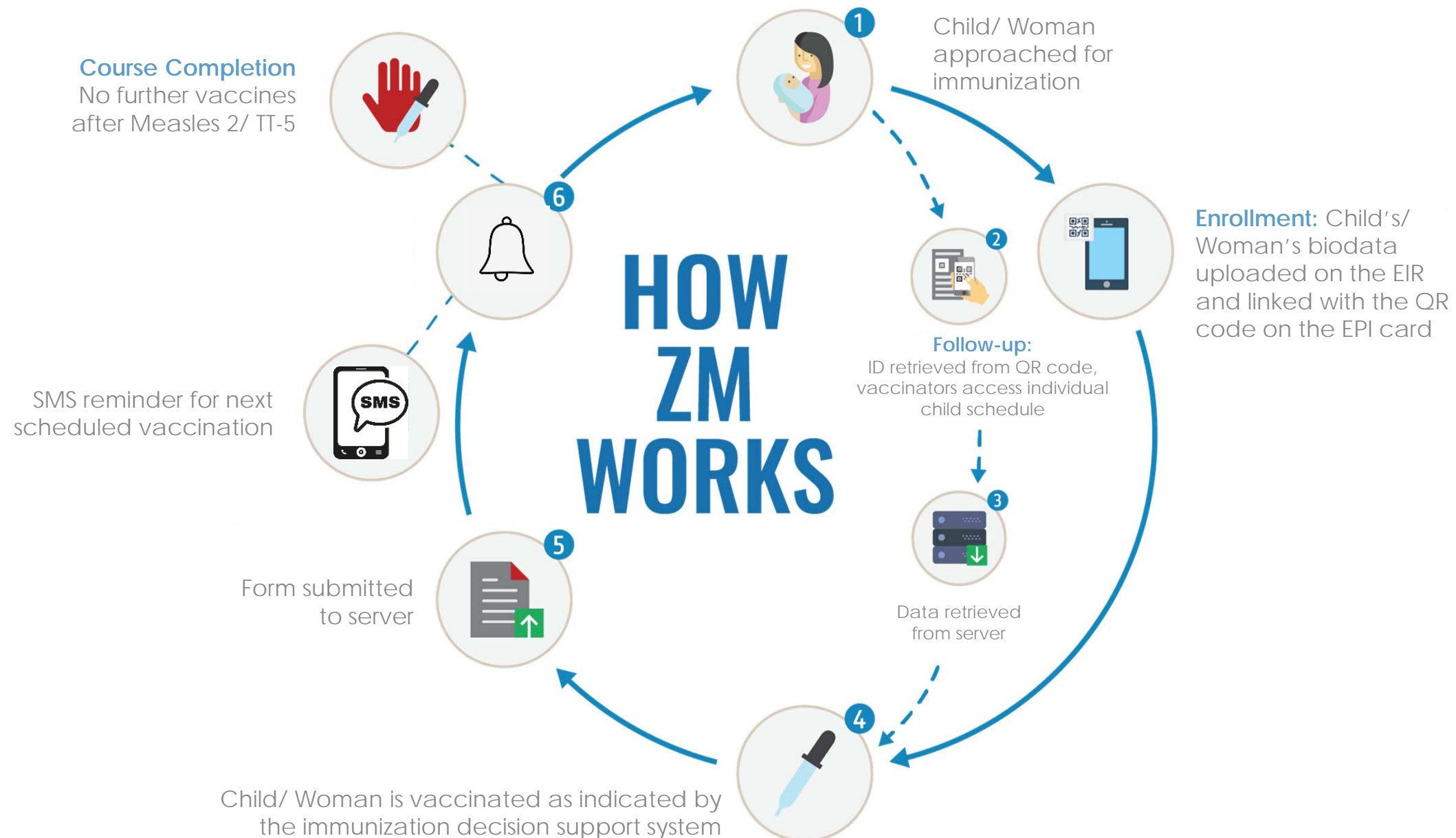

Awarded in 2011 by United Nations Foundation
through the UN Secretary General's Innovation
Working Group

Timeline of ZM EIR (2011-2020)

Commonwealth Digital Health Award

Commonwealth Digital Health Award

UN Foundation Innovation working group award

Limited deployment in Shikarpur

Innovation award

Immunization Decision Support System

AI Chatbot linked to ZM

Scale-up support & ICT expansion

| 2011 | 2012 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |

Software Deployment started

Pilot deployment in Korangi, Karachi

Limited deployment in Hafizabad, Punjab

Scale-up in Sindh

Scale-up support

ZM expansion to GB

Birth Registry

Piloting bar code & eVVM

Co-support

How ZM Works

Course Completion
No further vaccines after Measles 2/ TT-5

1 Child/ Woman approached for immunization

Enrollment: Child's/ Woman's biodata uploaded on the EIR and linked with the QR code on the EPI card

Follow-up:
ID retrieved from QR code, vaccinators access individual child schedule

SMS reminder for next scheduled vaccination

Form submitted to server

Data retrieved from server

Child/ Woman is vaccinated as indicated by the immunization decision support system

HOW ZM WORKS

Key Features of the ZM EIR: an Android SuperApp for Vaccines

IRD Interactive Research & Development

QR code-based identification

Web interface

Mobile based data entry & access

Geopoint field to capture GPS coordinates

Interactive SMS reminders

Offline mode

Child registry

Built in iDSS for routine & catch up immunization

Attendance & GIS tracking of vaccinators

Digital immunization certificate

Micro-planning activities

Defaulter list & reports

Predictive Analytics

ZM EIR Campaign & Outreach Mode

ZM EIR Child Enrollment & Registration

Data points

 Child ID

 Child Name

 Father Name

 National ID #

 Child DOB

Biodata entry

Data points

 Community

 Town/City

 Union Council

 Address

 Nearby Landmarks

Address entry

Immunizations Super App – ZM EIR Child Data Variables

- Name
- Gender
- Date of birth
- Place of birth
- Household address
- Contact number

- Age at vaccination
- Caregiver's National ID #
- Mother's education
- Father's name
- SMS reminders
- Modality (Fixed vs. outreach)

- Vaccination date
- Vaccination location
- Geo-location for each vaccination

Immunizations Super App – ZM EIR Vaccinator Data Variables
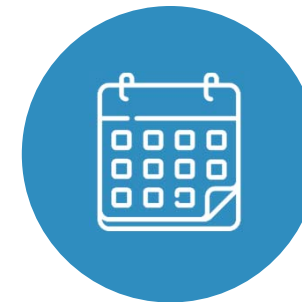

Name & gender

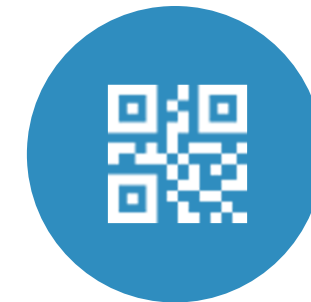Centre name
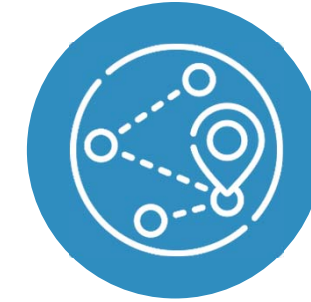
Vaccination route

EPI ID

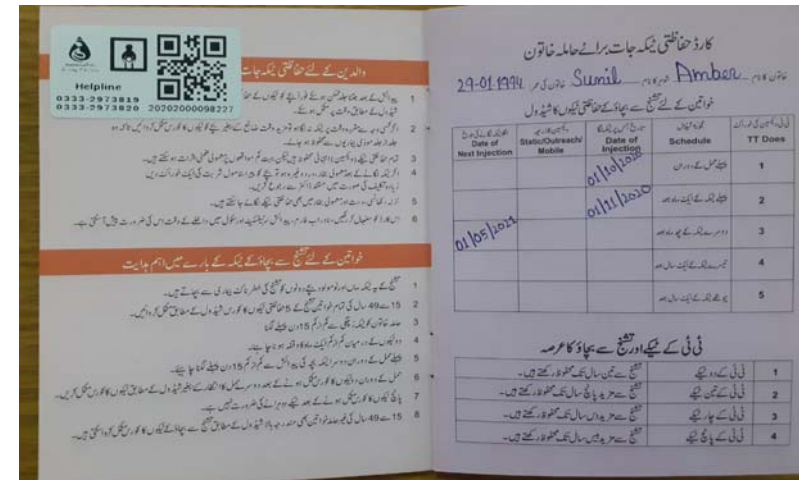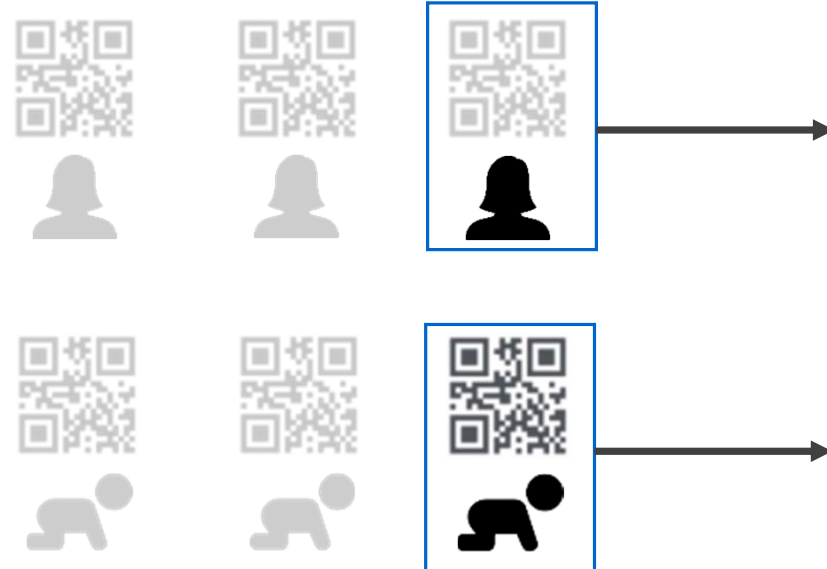Vaccination administration site (fixed vs outreach)

Attendance

QR Code

Geo-location

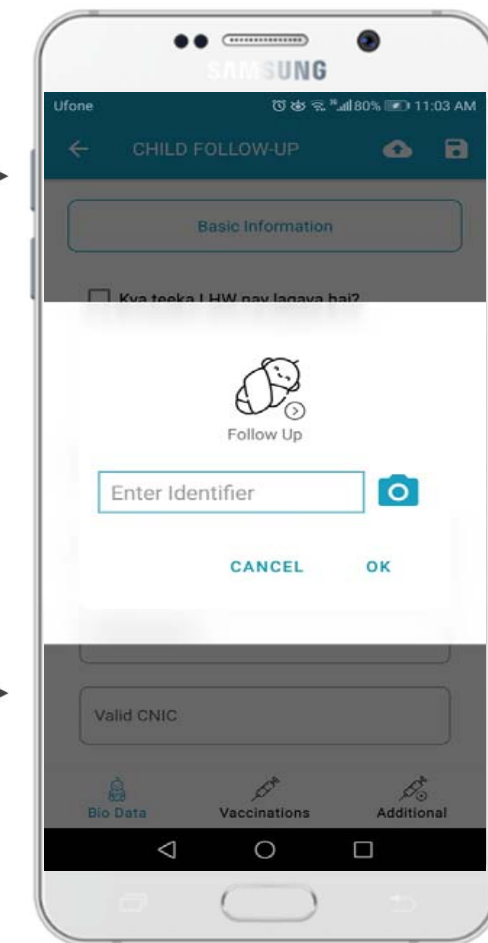# EIR Unique Identification Response Code (QR Code)

Unique ID assigned to each woman and child in the form of a **QR Code** which can be scanned at every follow up, leading to **instant data retrieval**
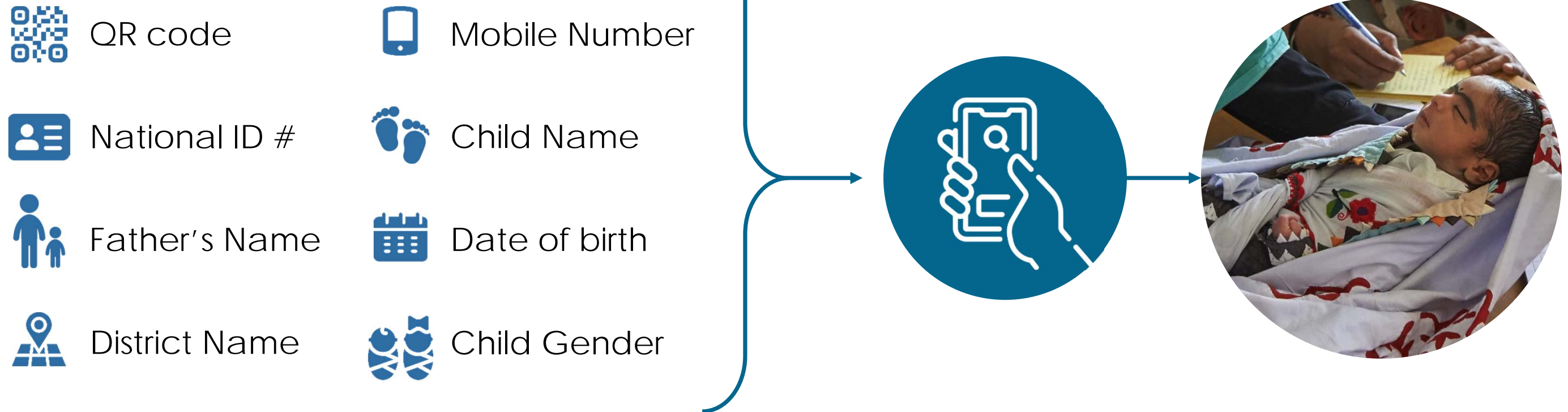

A unique QR Code is assigned to every child & woman

The QR code is pasted on the woman's & child's immunization card

The code is scanned at every visit for instant data retrieval

Unique Identification: ZM EIR Child Search Options

- QR code
- National ID #
- Father's Name
- District Name
- Mobile Number
- Child Name
- Date of birth
- Child Gender

Automated SMS Reminders to Parents

Apky bache ko Hifazati tika kal lgna hai, Lihaza ap corona se bachne ke Ihtiyati Tadabir ko apnaty hoe EPI centre tashrif lae. Maloomat k liye 03332973819,03332973820 milaen - Zindagi Mehfooz.

Apky bache ko Hifazati tika aj lgna hai, Lihaza ap corona se bachne ke Ihtiyati Tadabir ko apnaty hoe EPI centre tashrif lae. Maloomat k liye 03332973819,03332973820 milaen - Zindagi Mehfooz
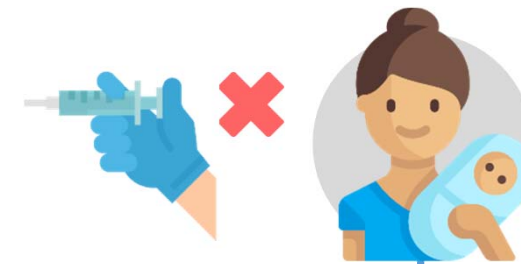
ko Hifazati tika Monday ko lgna tha, Lihaza ap corona se bachne ke Ihtiyati Tadabir ko apnaty hoe EPI centre tashrif lae. Maloomat k liye 03332973819,03332973820 milaen - Zindagi Mehfooz

Reminder 1
One day before
due date

Reminder 2
On the
due date

Reminder 3
6 days after the due date
if child not immunized

SMS Chat for Questions, Concerns & Complaints

COMPLAINTS
"They are out of the pentavalent vaccine"

ADVERSE EVENTS
"Zain has developed a rash. What should we do?"

VITAL EVENTS
"Sadia has died"

QUERIES & CONCERNS
"Sadia is sick, how long is the due date?"

INFORMATION
"We have lost the card. Can we get another one?"

ZM EIR Offline Mode

Data entered during periods of low/no connectivity

Saved on the app through the Saved Forms options

Data uploaded once device is back online

ZM EIR Child Defaulters List

Micro Planning Activities

The micro-planning feature boosts accountability and target achievement by helping to structure and monitor outreach activities

Scheduling outreach activities

Identifying target locations

Assigning adequate resources

Goal to increase number of immunized children

Using Geospatial data to track a Child's Immunization Progress

Fixed **1** **Landhi Medical Complex, Korangi**
📅 27 Days 💉 OPV-0, BCG

Fixed **2** **Landhi Medical Complex, Korangi**
📅 106 Days 💉 OPV-1, Penta-1, PCV-1

Outreach **3** **Karachi Central**
📅 154 Days 💉 OPV-2, Penta-2, PCV-2

Fixed **4** **BHU Darwaish Kakepota, Shikarpur**
📅 288 Days 💉 OPV-3, Penta-3, PCV-3, IPV

Fixed **5** **Majee Hospital Unit No 8, Hyderabad**
📅 344 Days 💉 Measles-1

Outreach **6** **Hyderabad**
📅 456 Days 💉 Measles-2

4 Shikarpur

5 6 Hyderabad

1 2 3 Karachi

1. Child Name: Redacted
2. Father's Name: Redacted
3. Gender: Female
4. DoB: 13-01-2018
5. Enrollment date: 09-02-2018
6. Enrollment age (in days): 27
7. Enrollment district: Korangi, Karachi
8. Residential city: Hyderabad
9. Mother's education: Matric
10. Place of birth: Hospital

Sites
🟠 Fixed
🔵 Outreach

GSM Tracking for Vaccinators

GSM based GIS tracking to improve workforce monitoring for improved geographic coverage of immunization services
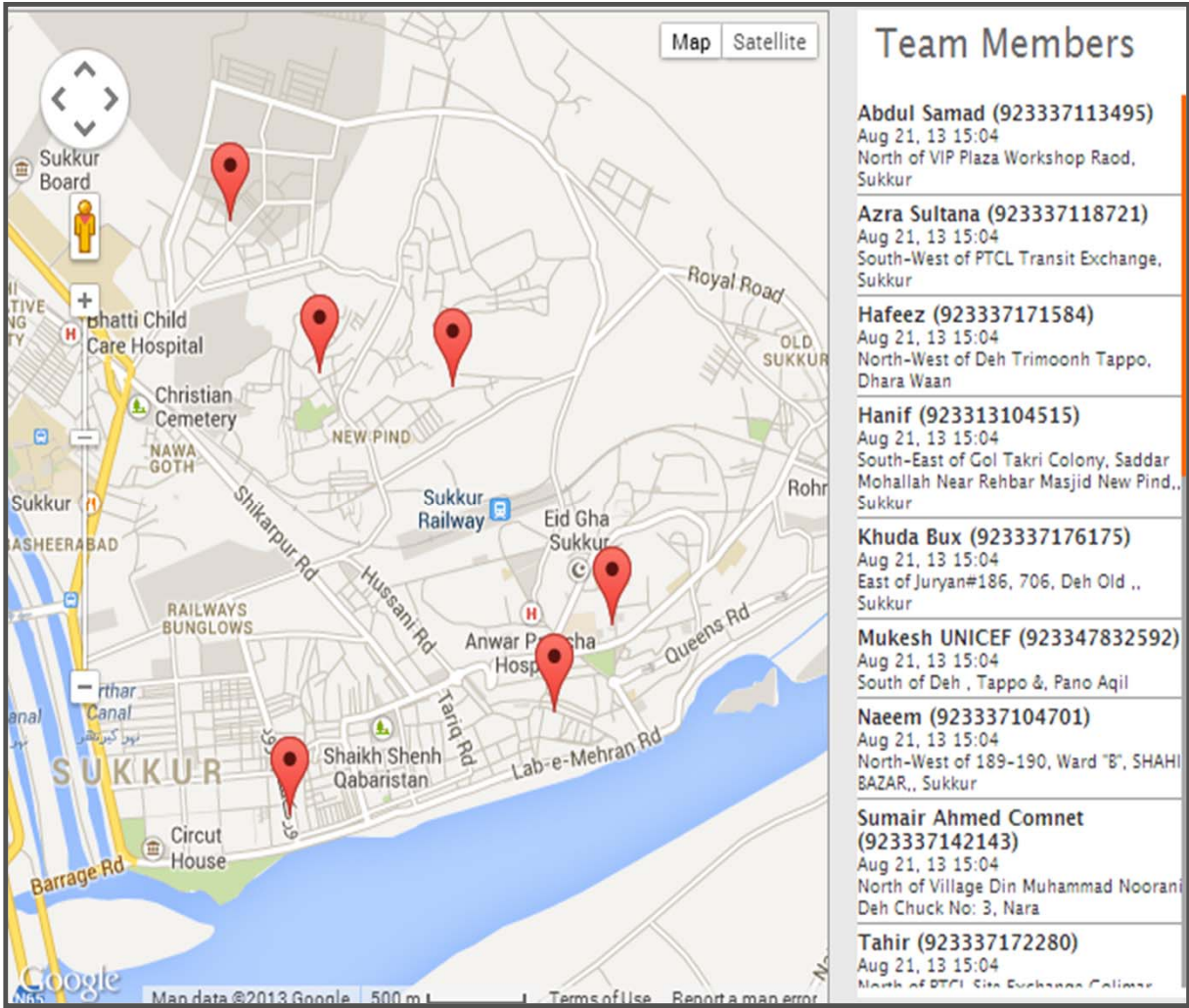
Team tracking

Route tracking

Features

Real-time tracking

Team view for simultaneous supervision of multiple teams

Active surveillance system to ensure complete coverage

Touch points to enable follow-up teams to locate refusal households

Route view to monitor attendance and mobility of field staff

Online mapping

Live web dashboard for supervision

Geo-fencing for effective coverage of remote areas

AI Powered Predictive Analytics to Prevent Missed Opportunities

Using logistic regression models, empirical data mining, and simulation models to accurately predict individual probability of incomplete immunization

Immunization → Predictive Analysis

- Machine learning
- Artificial intelligence

High Risk
(Likely to default)

Low Risk
(Likely to show up for follow-up immunization)
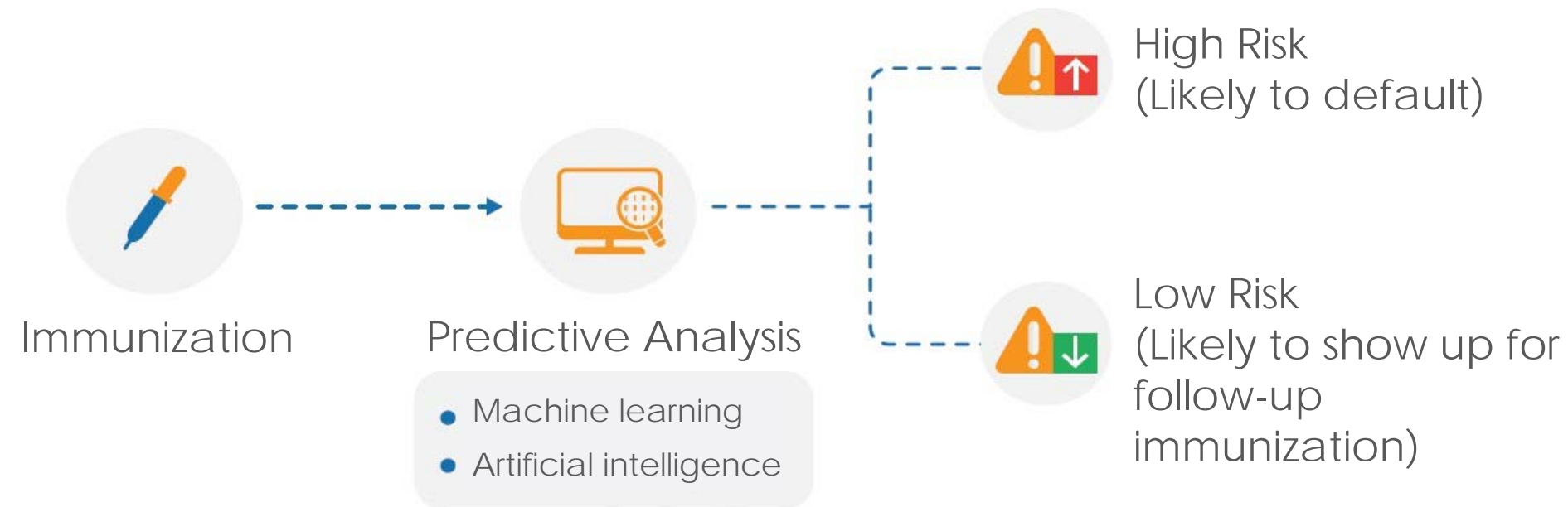
Improve Routine Immunization Timeliness
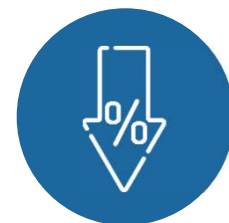
Lower BCG to Measles Drop-out Rate

Improve Immunization Equity

Identify Variables Correlating with High Drop-out Risk

Data Security and Confidentiality

Strict data sharing and access security, protection, and confidentiality in place

Follows industry standards for authentication, encryption, and secure communication

Pakistan based cloud storage

Prevents unauthorized access

Encryption of data in transit

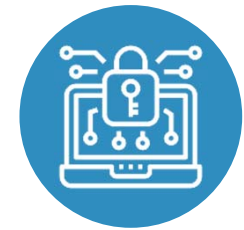Logs of who downloads which reports

Data sharing with third parties allowed only after written authorization

Role-based access to the system, with degrees of clearance for data viewing, editing, and downloads

Pregnant Women and Birth Registration

Pregnant Women & Birth Registry
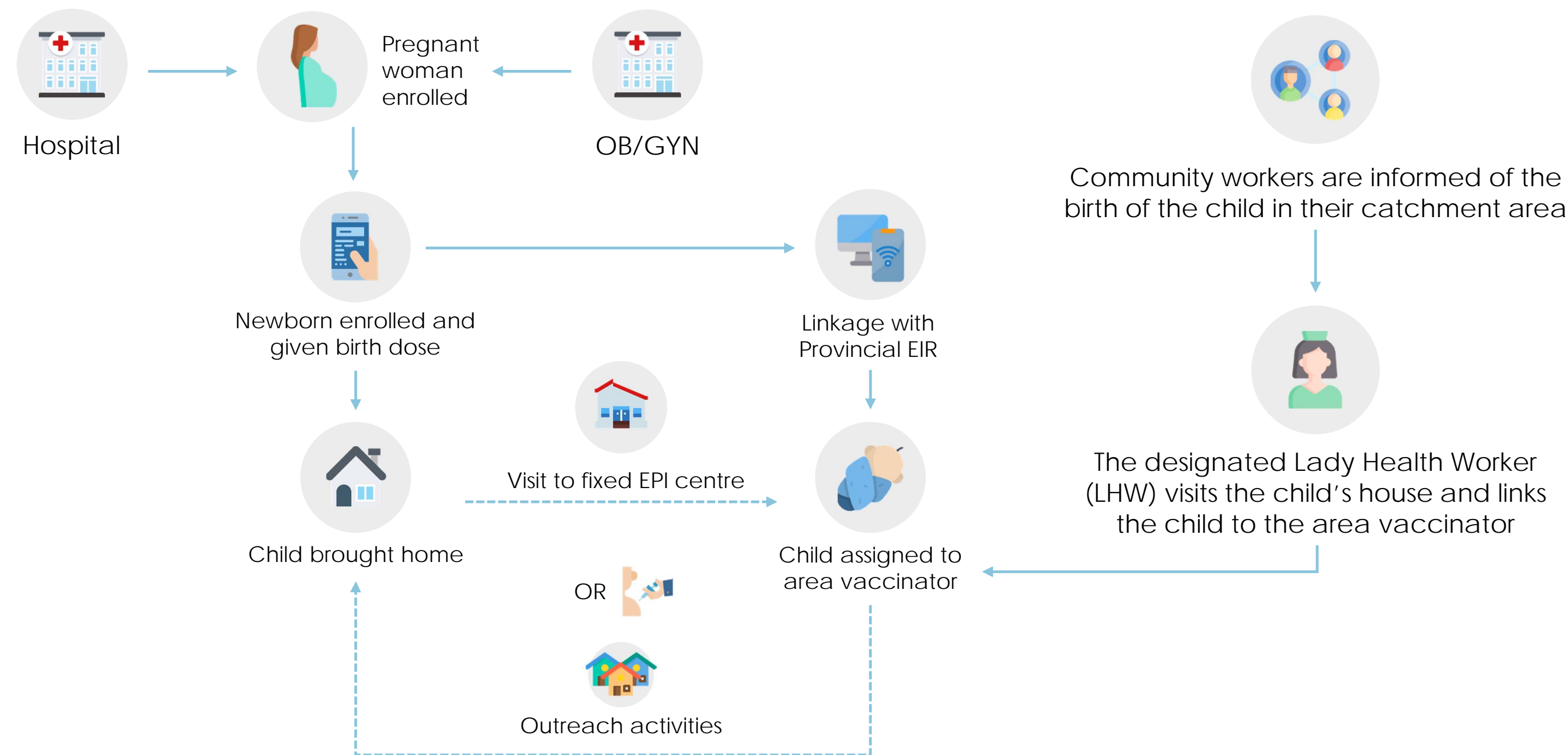
IRD — *Interactive Research & Development*

Hospital → Pregnant woman enrolled ← OB/GYN

Newborn enrolled and given birth dose

Linkage with Provincial EIR

Child brought home

Visit to fixed EPI centre

Child assigned to area vaccinator

OR

Outreach activities

Community workers are informed of the birth of the child in their catchment area

The designated Lady Health Worker (LHW) visits the child's house and links the child to the area vaccinator

EIR Unique Identification Response Code (QR Code)

Unique ID assigned to each woman and child in the form of a **QR Code** which can be scanned at every follow up, leading to **instant data retrieval**
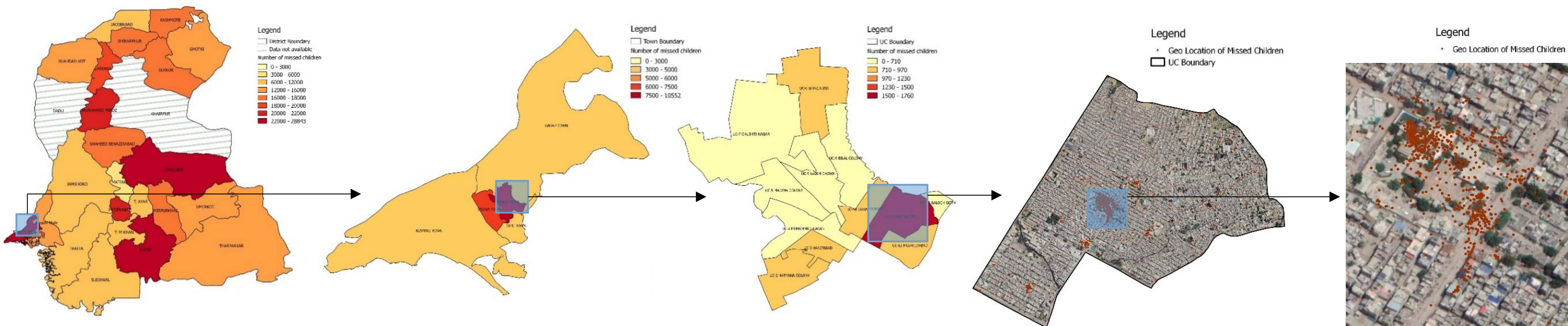

A unique QR Code is assigned to every woman & child

The QR code is pasted on the woman's & child's immunization card

The code is scanned at every visit for instant data retrieval

Case examples of Geo-spatial analysis using Big Data from ZM EIR

Using Geospatial Analysis at Macro and Micro Level

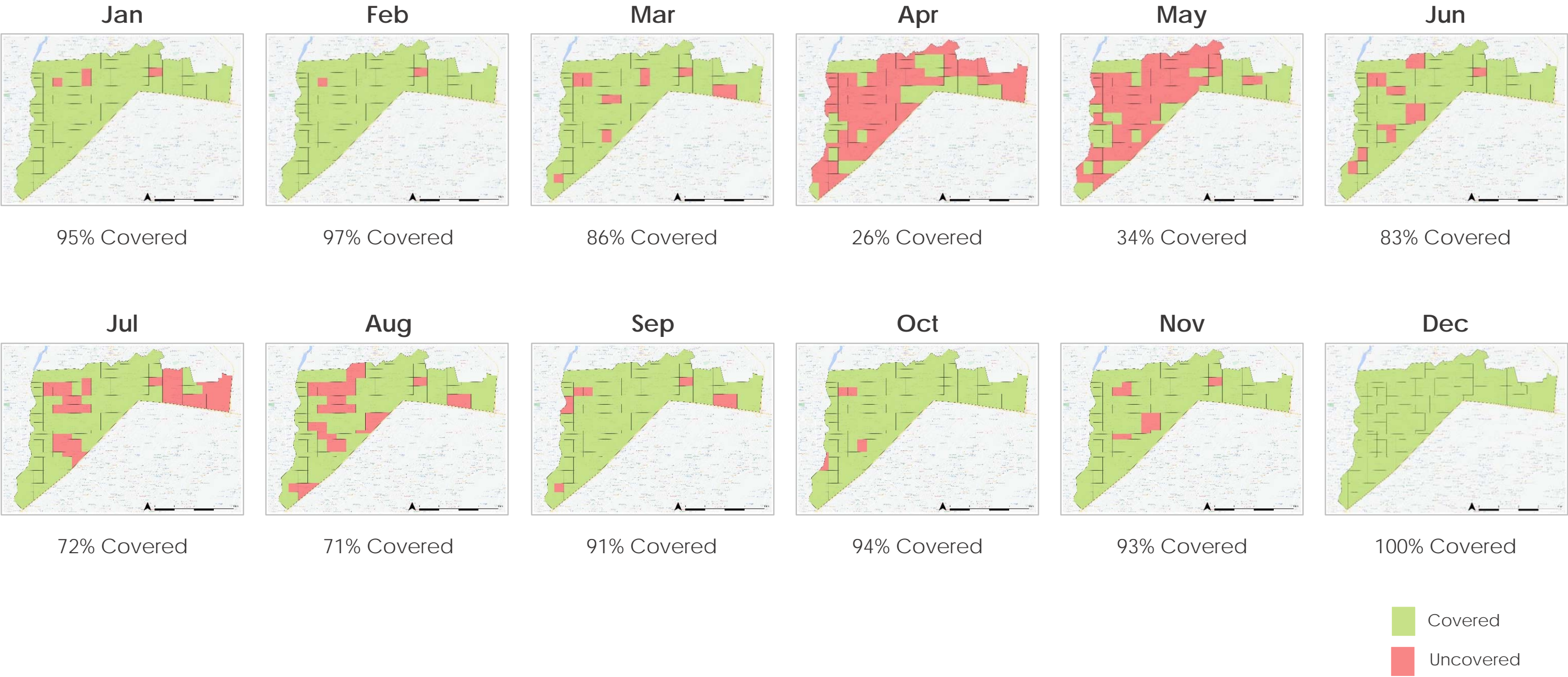| Province	District	Town	Union Council	Hotspot of Missed children
120,759 children missed follow-up immunizations during COVID-19 lockdown (Mar 23-May 9, 2020) and have not been covered	9.5% of the total missed children are from District West, Karachi	2.9% of the total missed children are from Town Orangi	0.3% of the total missed children are from UC Dad Nagar	Geo-locations of children missed during COVID-19 lockdown who have not been covered

GIS Polygon maps of UC Gujro Showing Population-wise Immunization Coverage Trend, by Month (Jan – Dec, 2020)

Jan — 95% Covered

Feb — 97% Covered

Mar — 86% Covered

Apr — 26% Covered

May — 34% Covered

Jun — 83% Covered

Jul — 72% Covered

Aug — 71% Covered

Sep — 91% Covered

Oct — 94% Covered

Nov — 93% Covered

Dec — 100% Covered

Legend:
- Covered
- Uncovered

Every polygon represents a population of 10,000. The polygon is considered covered if a vaccinator has visited the population at least once in the month
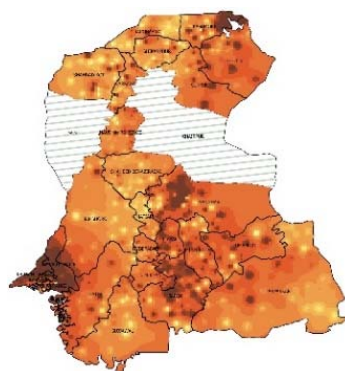
Cumulative catch-up coverage rate of children who missed* follow-up immunizations **during the COVID-19 lockdown (Mar 23 – May 9, 2020)** across Sindh Province, by month, and the heat map of **uncovered** children (n=417,553)
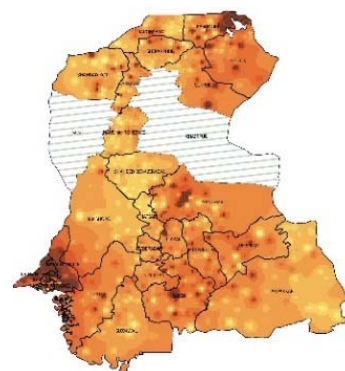Mar 23, 2020 – Mar 31, 2021

IRD
Interactive Research & Development

Children Missed during lockdown (n=417,553)
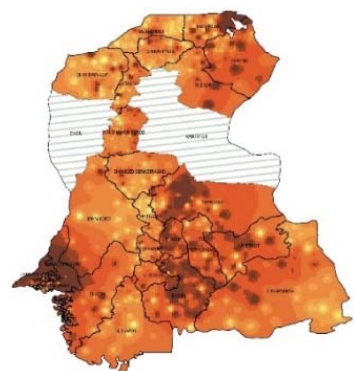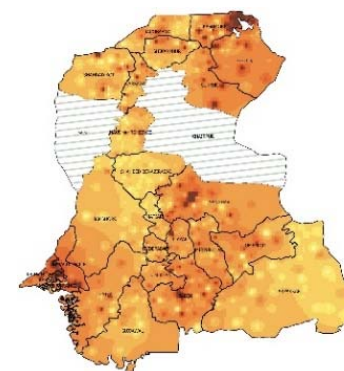
3.8% (15,920/417,553) children covered as of **Apr** 30, 2020
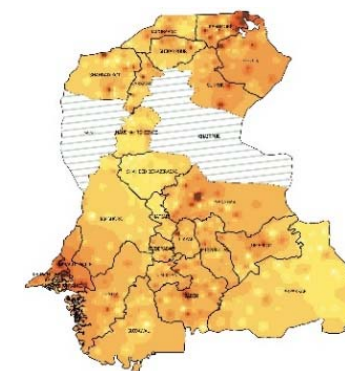
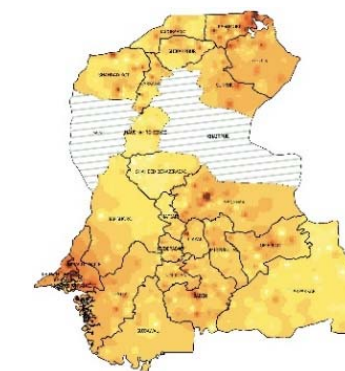**18.4%** (76,680/417,553) children covered as of **May** 31, 2020

29.3% (122,430/417,553) children covered as of **Jun** 30, 2020
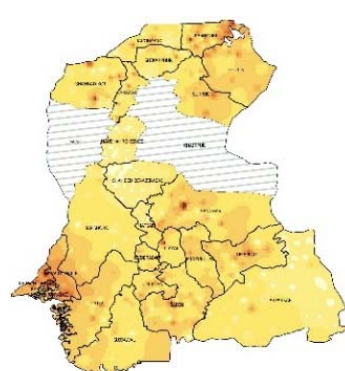
41.5% (173,313/ 417,553) children covered as of **Jul** 31, 2020
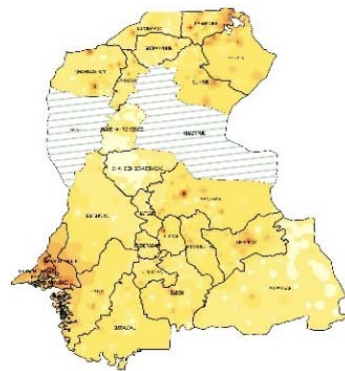
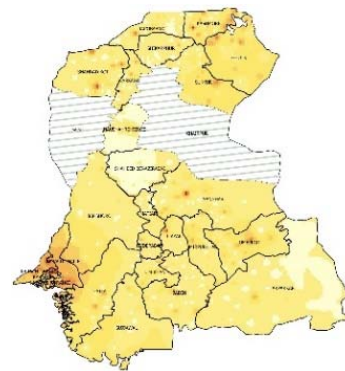**50.0%** (208,677/417,553) children covered as of **Aug** 31, 2020

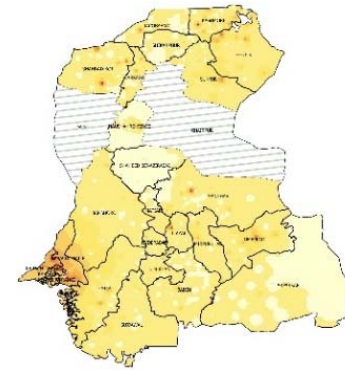**60.9%** (254,335/417,553) children covered as of **Sep** 30, 2020

68.4% (285,432/417,553) children covered as of **Oct** 31, 2020
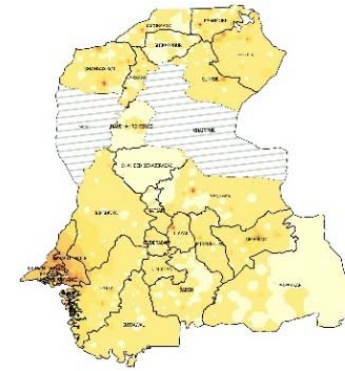
72.4% (302,401/417,553) children covered as of **Nov** 30, 2020
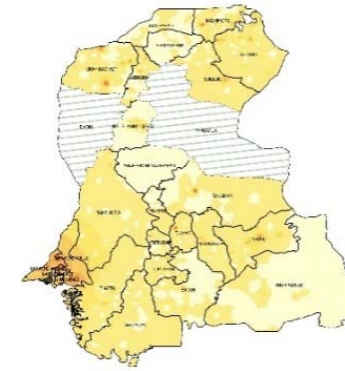
75.8% (316,630/417,553) children covered as of **Dec** 31, 2020

77.3% (322,836/417,553) children covered as of **Jan** 31, 2021

78.9% (329,492/417,553) children covered as of **Feb** 28, 2021

79.2% (330,650/417,553) children covered as of **Mar** 31, 2021
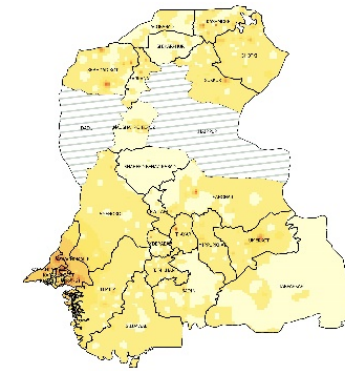
Out of the 417,553 children missed during the COVID-19 lockdown (Mar 23 – May 9, 2020) in Sindh, 79.2% have been covered as of Mar 31, 2021

Missed/Uncovered children <= 51 51-102 102-153 153-204 204-255 255-306 306-357 357-408 408-459 459-510 >510 Data not available

*A child is categorized as missed if he/she has not received vaccination within 28 days of his/her vaccine due date

Province Sindh
Crude M:F ratio: **1.12**

District Ghotki
Crude M:F ratio: **1.18**

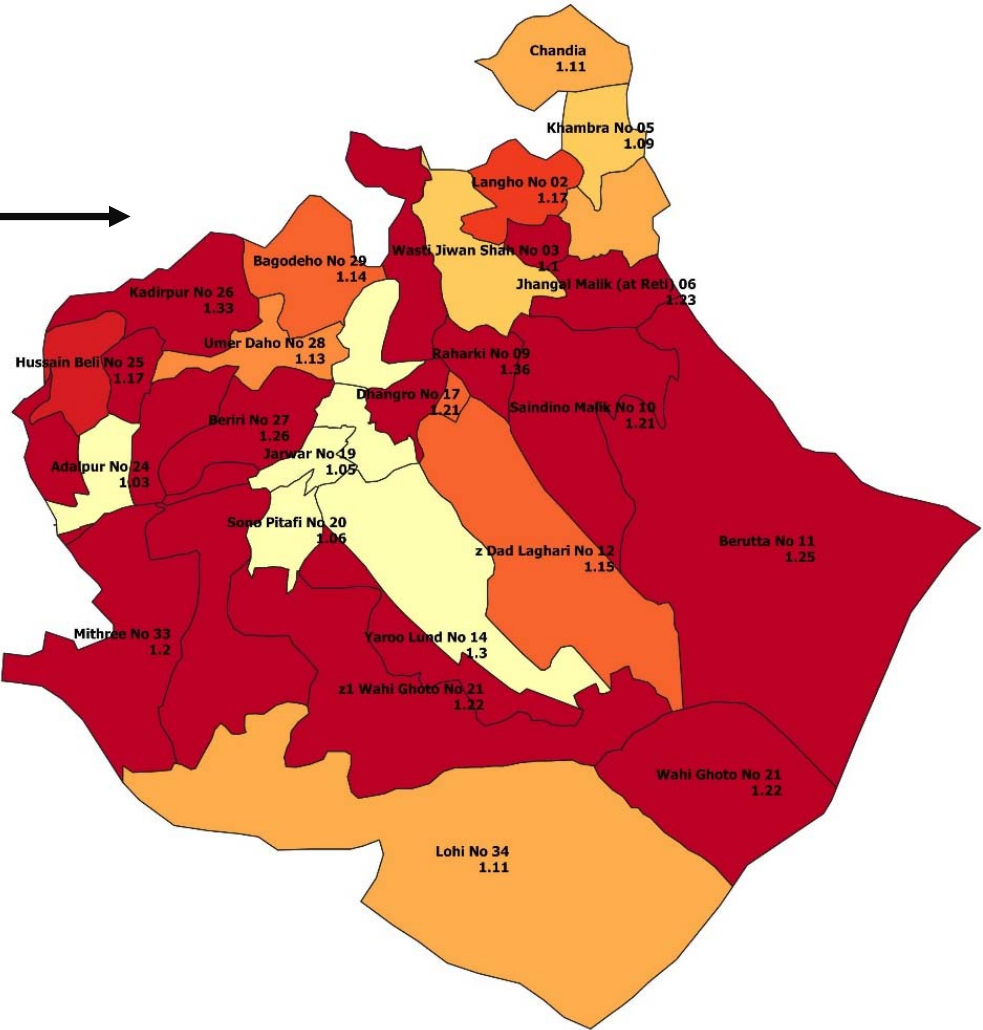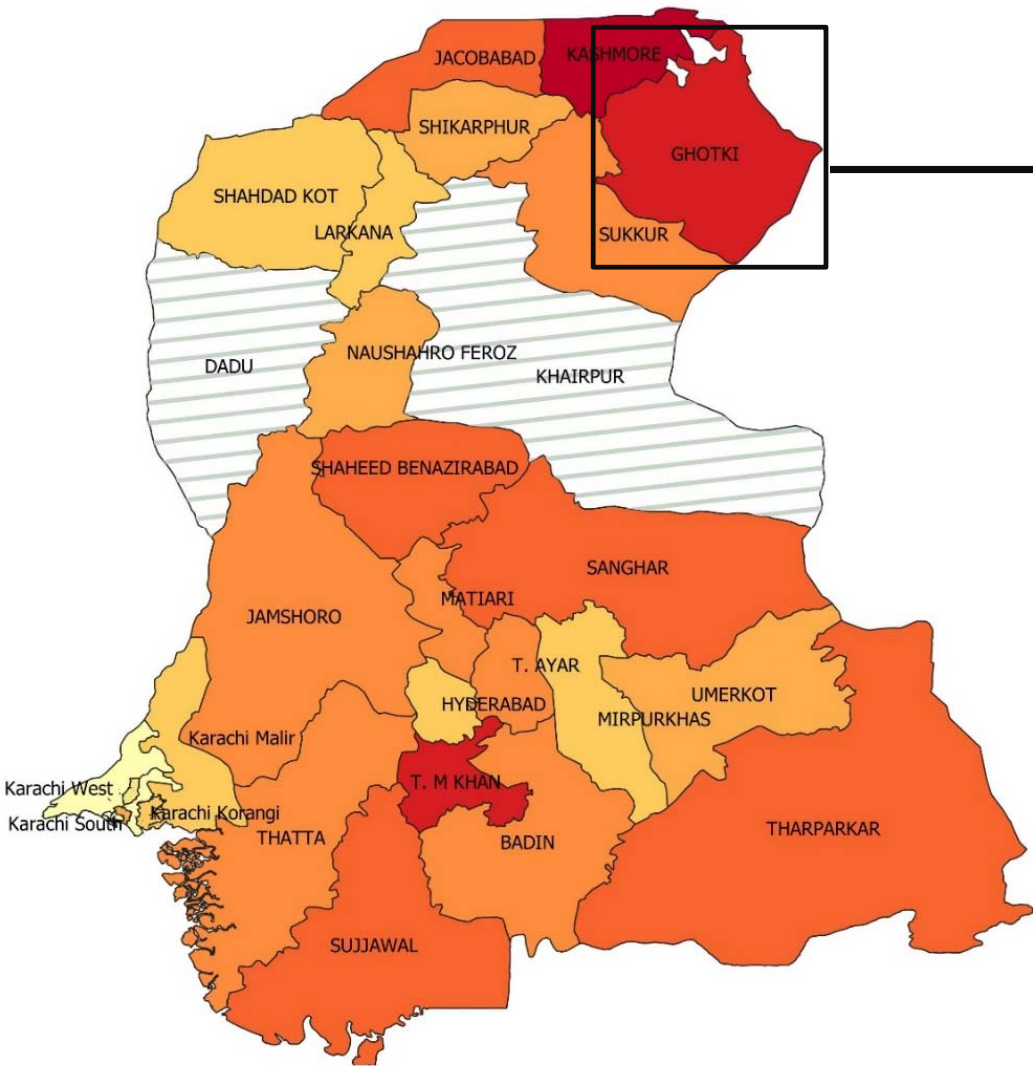# Crude M:F ratio among children vaccinated through outreach and fixed activities, outreach activity only during baseline (Sep 23, 2019 – Mar 22, 2020) and Enhanced Outreach Activity phase 16 (Feb 15-27, 2021), by district in Sindh Province

Outreach and Fixed Activities during baseline
(n= 1,566,384)
Crude M:F ratio: **1.09 (range: 0.60-2.87)**

Outreach during baseline
(if child has received >=50% vaccines through outreach as compared to fixed sites)
(n= 799,314)
Crude M:F ratio: **1.08 (range: 0.40-2.78)**

Phase 16 of Enhanced Outreach Activity
(n= 304,410)
Crude M:F ratio: **1.08 (range: 0.42-2.50)**

District Boundary | UC Boundary M:F ratio | <= 0.70 | 0.71 - 0.75 | 0.76 - 0.80 | 0.81 - 0.85 | 0.86 - 0.90 | 0.91 - 0.95 | 0.96 - <1.00 | 1.00 | >1.00 - 1.05 | 1.06 - 1.10 | 1.11 - 1.15 | 1.16 - 1.20 | 1.21 - 1.25 | 1.26 - 1.30 | =>1.31
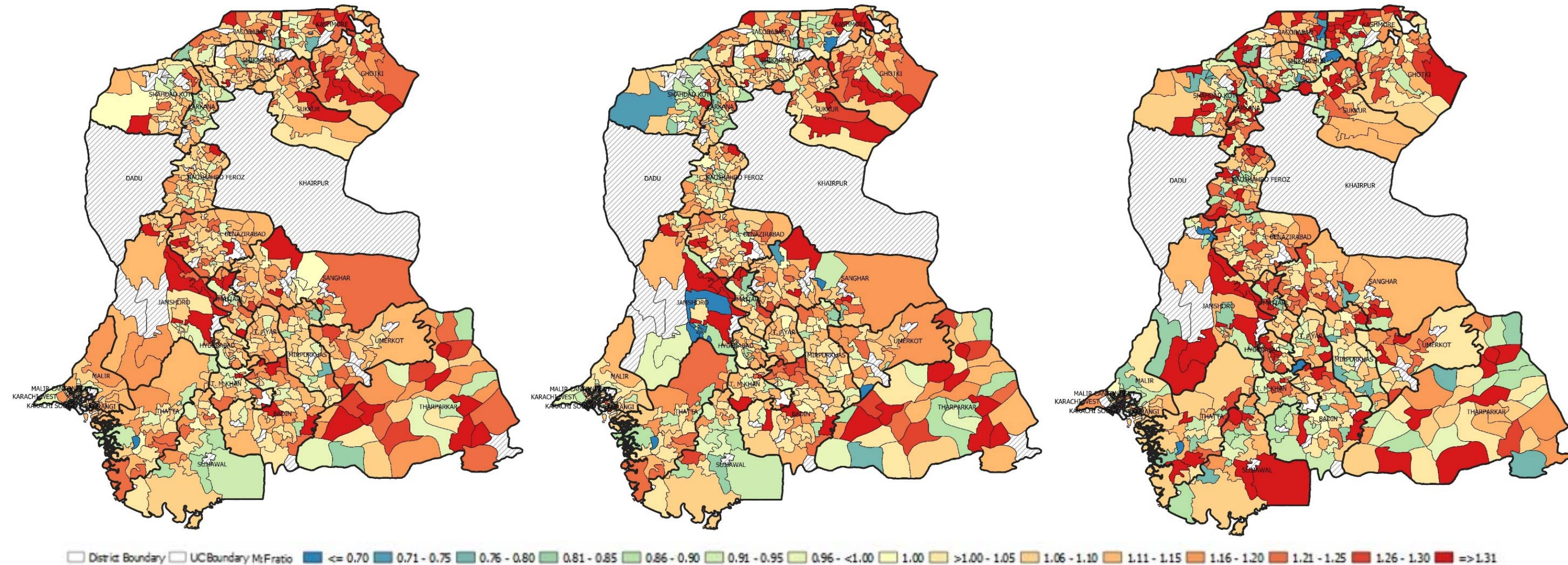
EOA phase 16 was conducted in 27 out of 29 Districts in Sindh excluding Districts Khairpur & Dadu

Children under 2 years of age who missed follow-up immunization visits **during COVID-19 lockdown (Mar 23 – May 9, 2020)** and have not been covered, per 5 km radius (n=86,903)
Mar 23, 2020 – Mar 31, 2021

Province Sindh

Division Karachi

District Central Karachi

# of missed children per 5 Sq.km
- 200
- 400
- 600
- 800
- 1000

☐ District Boundary
▨ Data not available

Population per sq.km grid
- 0 - 50
- 50 - 100
- 100 - 200
- 200 - 300
- 300 - 500
- 500 - 700
- 700 - 900
- 900 - 1100
- 1100 - 1300
- 1300 - 1500
- 1500 - 2000
- 2000 - 5000
- 5000 - 7000
- >7000
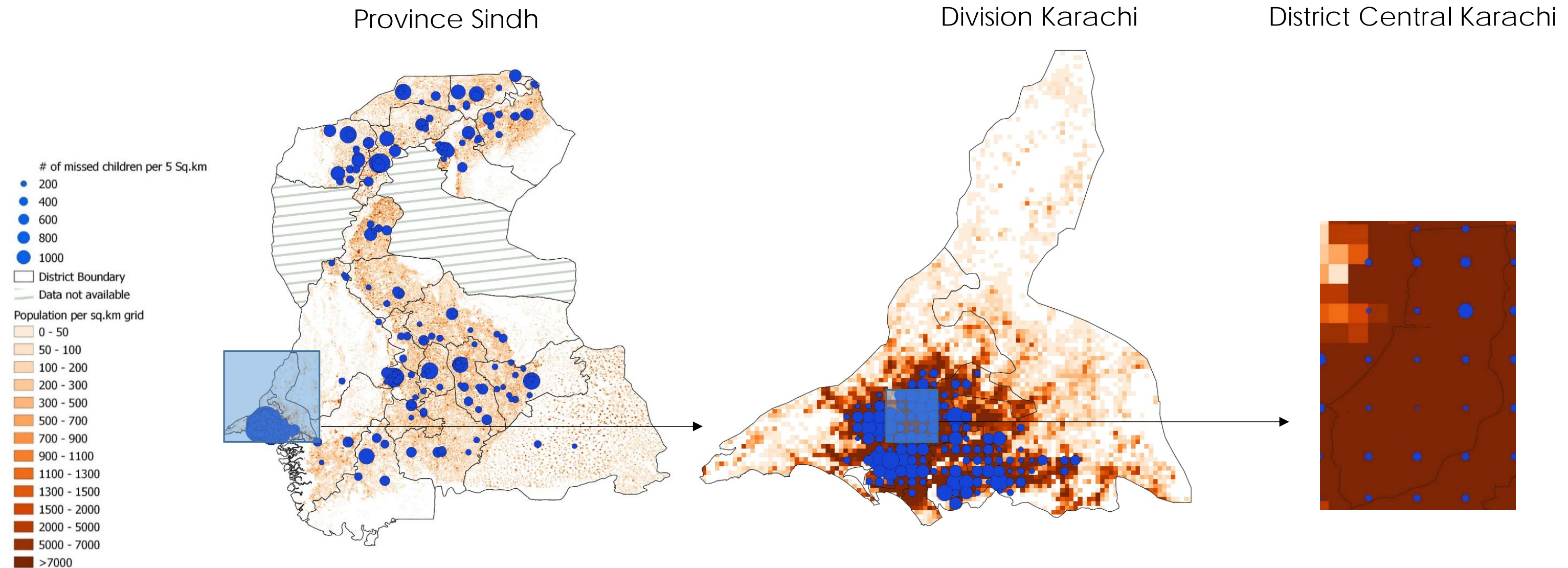
64.0% (21/33) of the biggest hotspots with at least 400 missed children are concentrated in Division Karachi

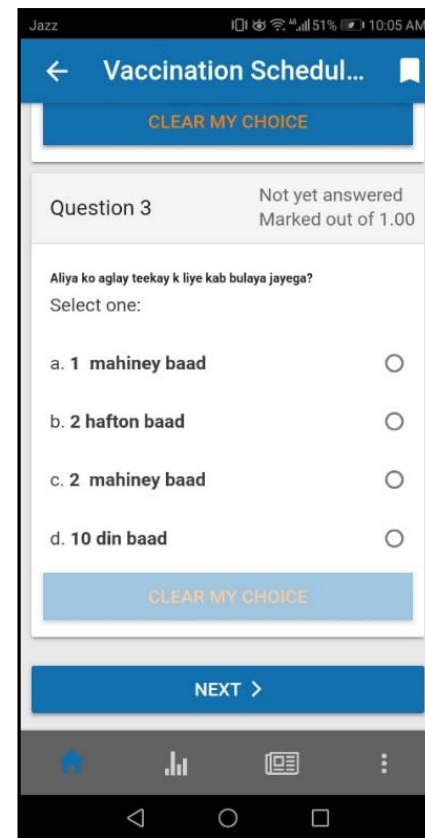# R&D Features in ZM

Interactive, Game-based Trainings to Boost Vaccinator Performance

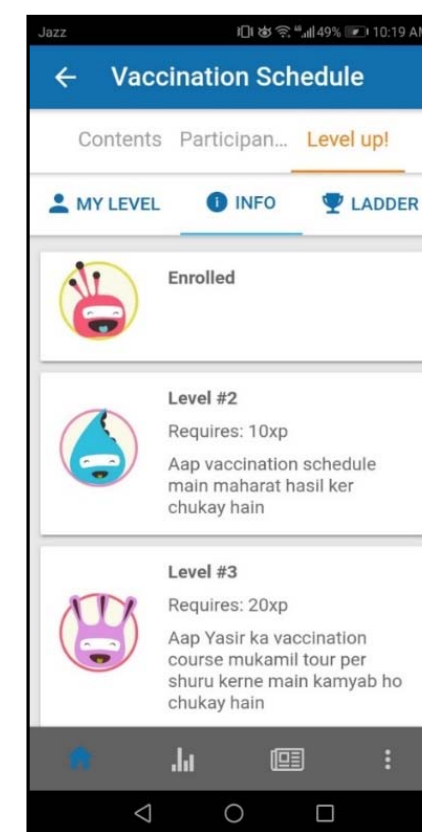Through the ZM EIR, vaccinators across Sindh can access digital, game-based learning modules to receive on-job training, access refresher courses and learn new information
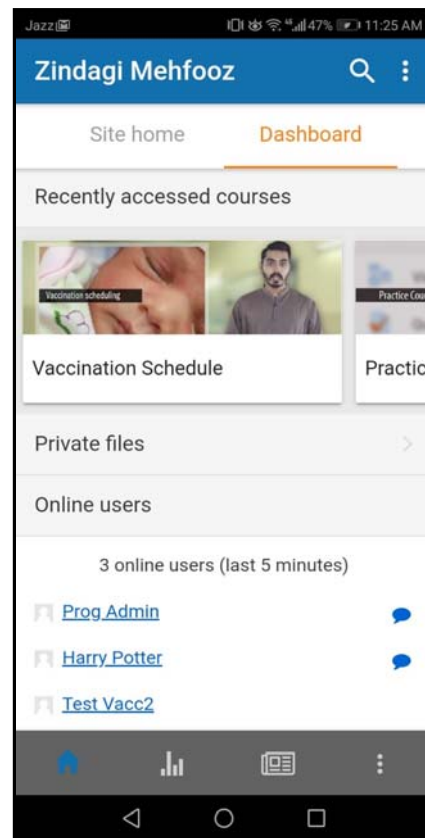
Story-based videos

Multiple choice questions for each chapter

Friendly Competition/ Leaderboard
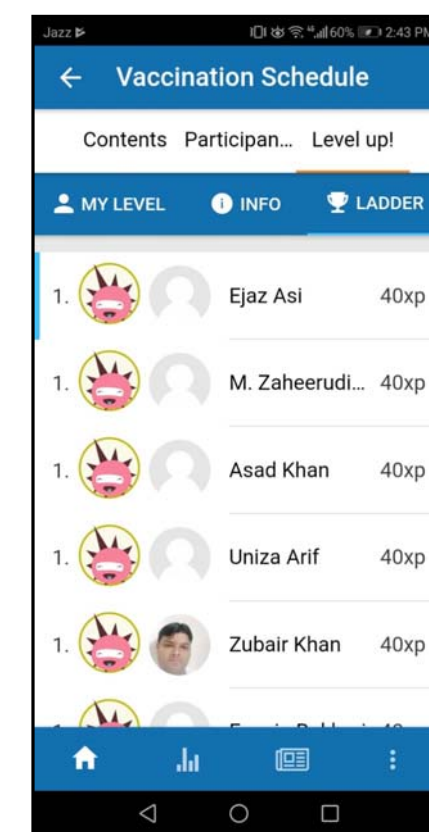
Peer to peer communication

Innovative 2D bar codes with eVVM

Automated Instant interpretation for vaccinator + EIR record linking vial-to-child
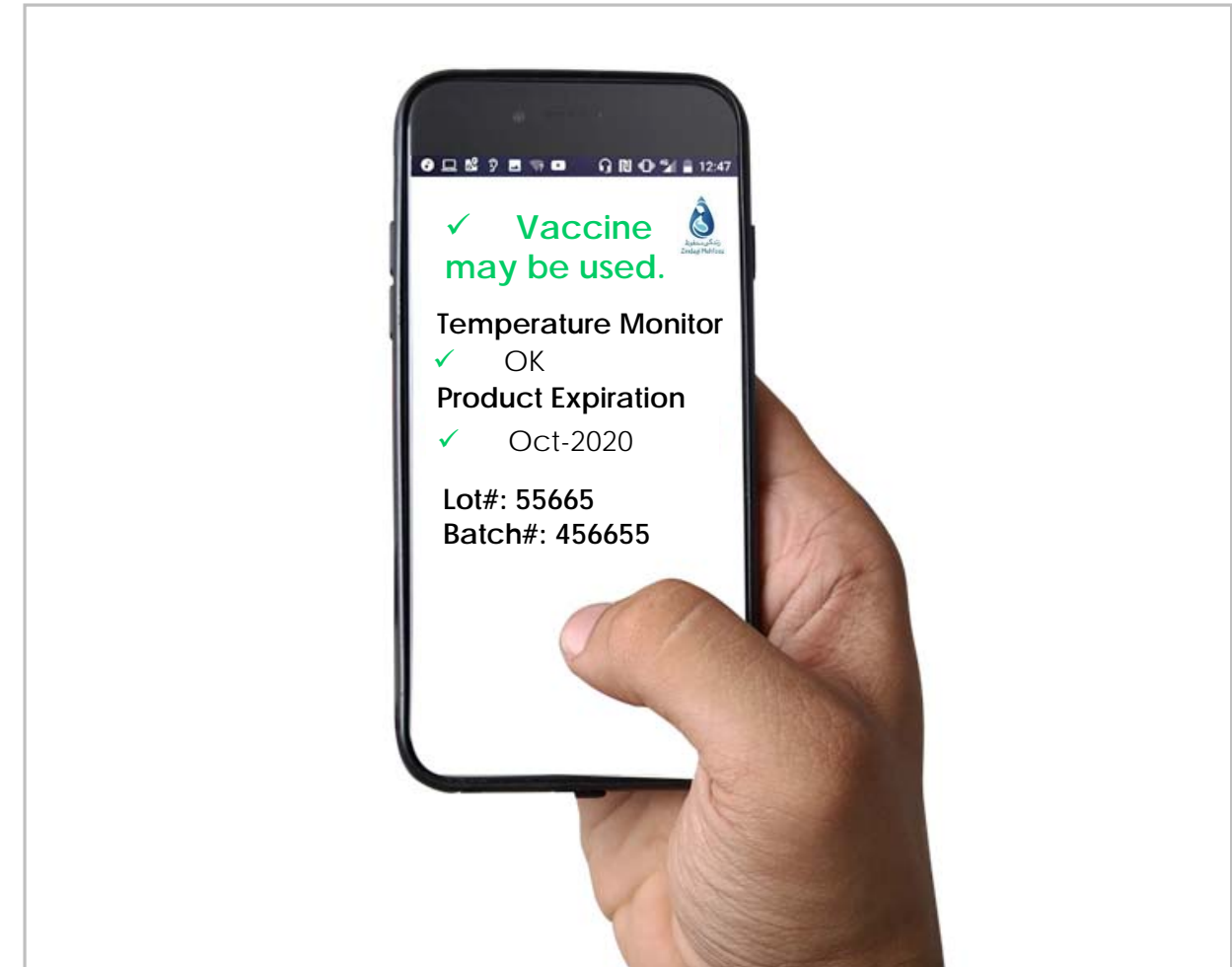
Vial to Child Link in ZM EIR

Leveraging existing digital technologies to merge supply-side
barcoded vaccine vials with service-delivery-side **barcoded immunization cards**

Vaccine with 2D
serialized barcode
+ eVVM

Real-time Child
immunization in
ZM EIR

Vial to
child

Bablibot – ZM integrated AI Chatbot
Better Delivery of Immunization Information to Caregivers

IRD — Interactive Research & Development

Development

Development of chatbot using AI, NLP and HITL technologies

Integration

Integration with the ZM Registry for data retrieval

BabliBot

▶ Immunization Center Information
- Vaccine Days
- Locations
- Timings
- Rush Hours

▶ Individual Immunization Queries
- Due Dates
- Catch-up Immunizations
- Doses completed & remaining
- New vaccines & schedules

▶ Soliciting caregiver feedback
- Service delivery experience

▶ Care for Adverse Events
- Vaccine Safety

▶ Health education

Message...

Thank you

Maternal & Child Health Program
mch@ird.global

Picture: Vaccine administration in a super high-risk UC through a Mobile Immunization Van.