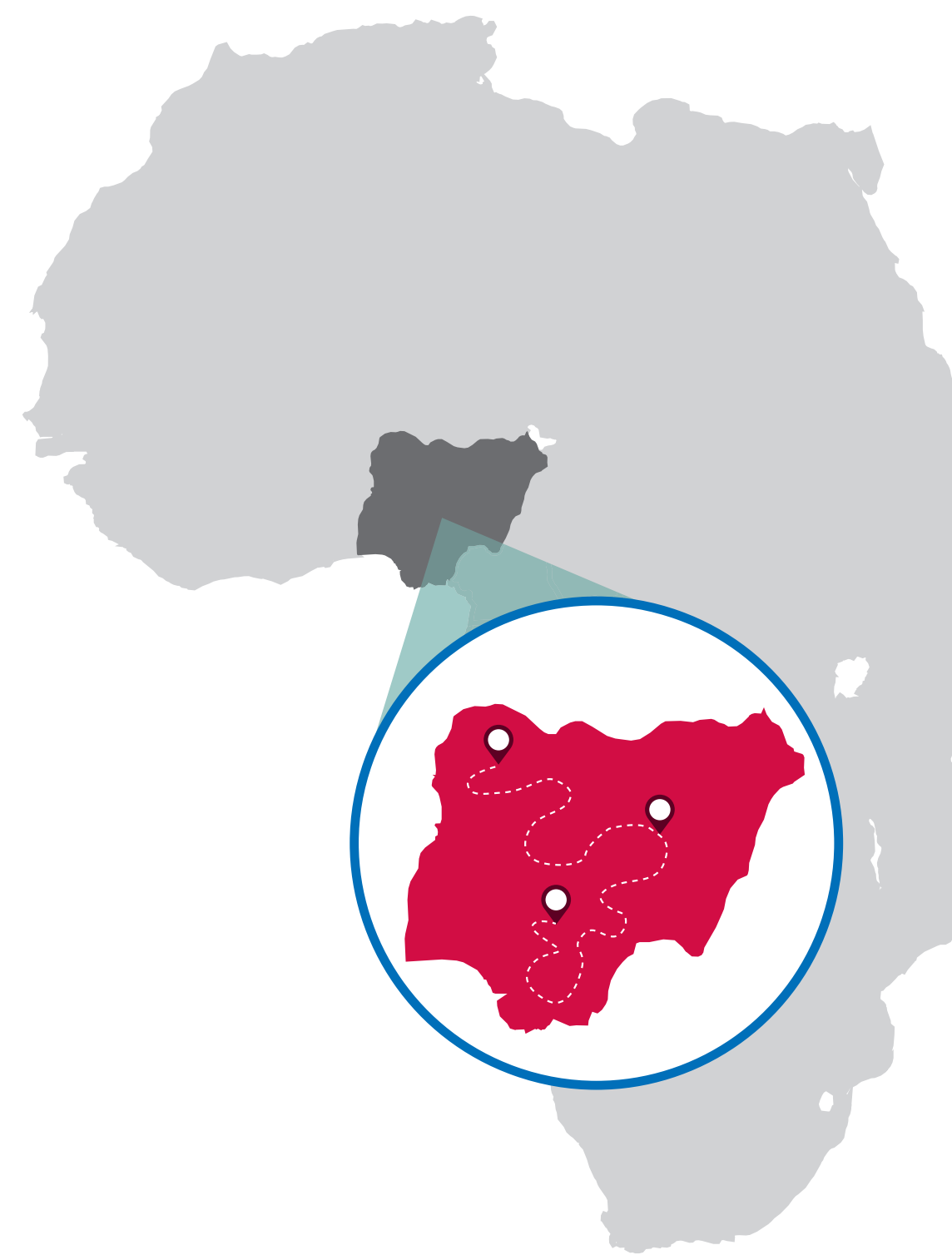# How can Geospatial Data be used to Strengthen Routine Immunization in the States of Bauchi and Sokoto, Nigeria?

Masduq Abdulkarim, Leanne Dougherty, Fiyidi Mikailu

USAID's Maternal and Child Survival Program
John Snow, Inc.

Immunization coverage rates in Nigeria are among the lowest and most inequitable in the world

33% DPT3 COVERAGE NATIONALLY

Percent of children fully immunized by first birthday:
2% SOKOTO | 14% BAUCHI

Source: MICS/NICS 2016/17

CHALLENGES FOR ROUTINE IMMUNIZATION (RI):

1. Weak demand due to immunizations not being a priority among caregivers
2. Shortage of vaccines and supplies
3. Poor quality health information system data that makes it difficult to generate population estimates for microplanning

HOW CAN GEOSPATIAL DATA BE USED TO STRENGTHEN RI PLANNING?

Objective:

Determine how Nigerian states can use GIS to produce more **accurate** primary health care (PHC) facility catchment area **maps** and **population estimates**

WHAT DATA ARE NEEDED TO PRODUCE A HEALTH FACILITY MAP FOR RI MICROPLANNING?

- name of health facility
- settlements in the catchment area
- target populations for the settlements
- landmarks (rivers, hills, important landmarks like markets, churches, schools, boreholes)
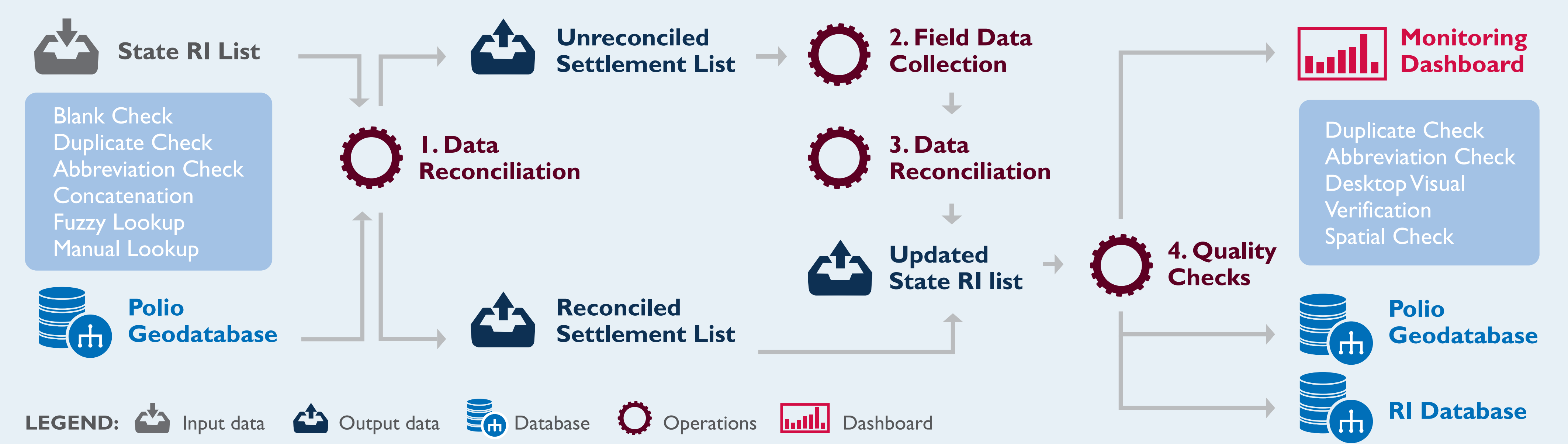- distance from the settlement to the health facility

STEPS TO PRODUCE GIS MAPS FOR RI

Step 1: Information gathering—dataset identification, and reconciliation
Step 2: Field data collection and reconciliation
Step 3: Geospatial data processing and analysis
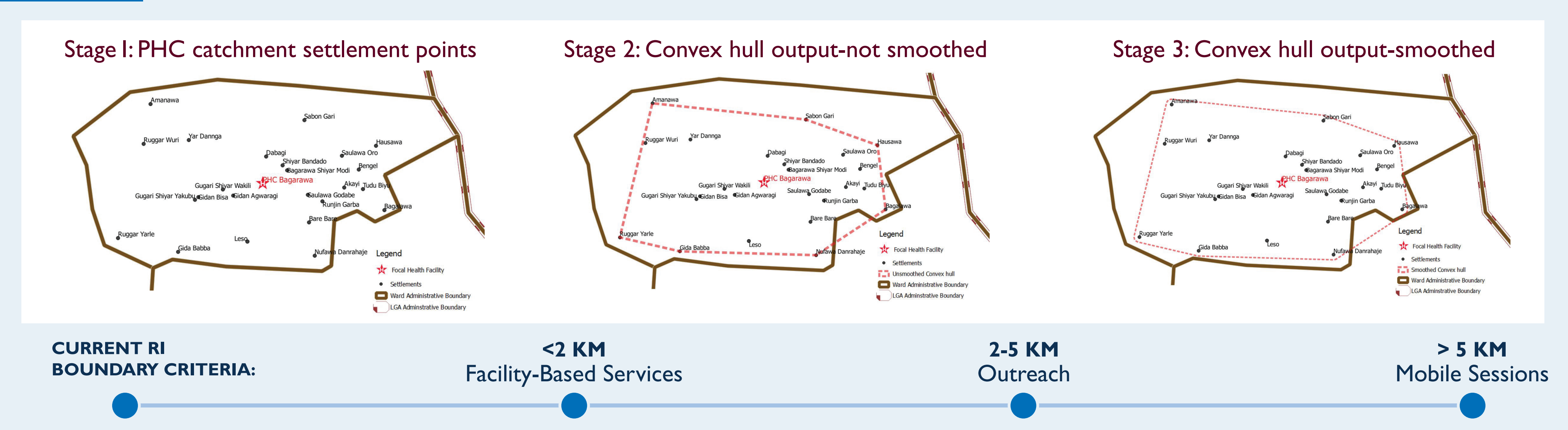**Step 4:** Map production and validation

STEP 1 — Information gathering – dataset identification, and reconciliation

PHC FACILITIES: Government lists of facilities offering RI

SETTLEMENTS: Identified and captured using remote sensing techniques and high-resolution satellite imagery. Named through field data collection. Stored in the Vaccination Tracking System (VTS)

POPULATION: Estimates for children < 5 years and 0-1 year are available through VTS

POINTS OF INTEREST: Office of the Surveyor-General of the Federation (OSGOF)

ROADS, RAILWAYS, WATERWAYS, WATER BODIES: Open Street Map (OSM)

ADMINISTRATIVE BOUNDARIES: Global database of administrative areas (GADM) and OSGOF-provided information on administrative boundaries at state and local government area (LGA) level
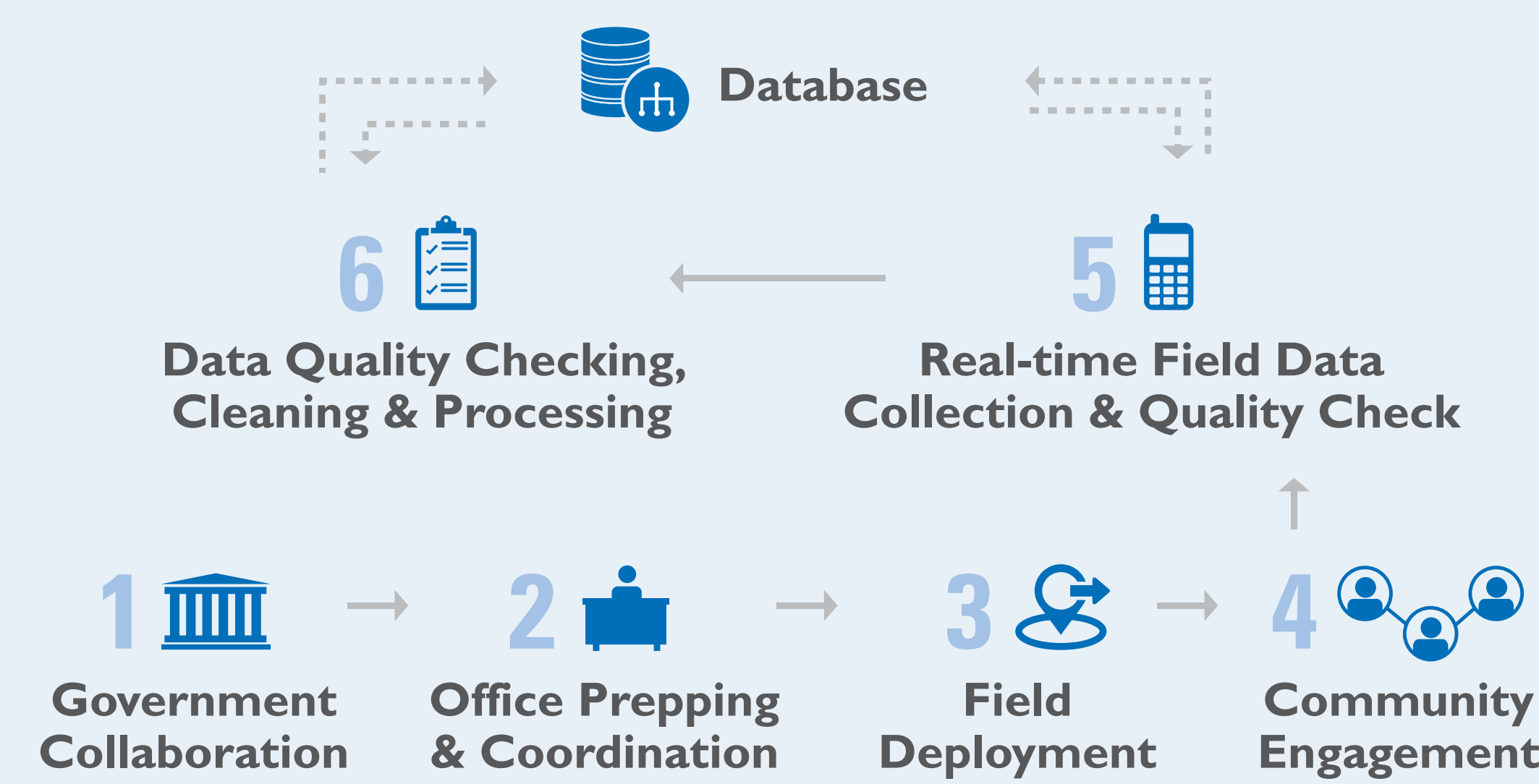
Data reconciliation occurs at multiple stages

State RI List
- Blank Check
- Duplicate Check
- Abbreviation Check
- Concatenation
- Fuzzy Lookup
- Manual Lookup

Polio Geodatabase

1. Data Reconciliation

Unreconciled Settlement List

Reconciled Settlement List

2. Field Data Collection

3. Data Reconciliation

Updated State RI list

4. Quality Checks

Monitoring Dashboard
- Duplicate Check
- Abbreviation Check
- Desktop Visual Verification
- Spatial Check

Polio Geodatabase

RI Database

LEGEND: Input data | Output data | Database | Operations | Dashboard

## STEP 3 — Geospatial data processing and analysis | Geoprocessing Stages to Develop PHC Catchment Area Polygons

Stage 1: PHC catchment settlement points

Stage 2: Convex hull output-not smoothed

Stage 3: Convex hull output-smoothed

CURRENT RI BOUNDARY CRITERIA:
- <2 KM Facility-Based Services
- 2-5 KM Outreach
- > 5 KM Mobile Sessions

STEP 2 — Field data collection and reconciliation

Database

6 Data Quality Checking, Cleaning & Processing
5 Real-time Field Data Collection & Quality Check

1 Government Collaboration → 2 Office Prepping & Coordination → 3 Field Deployment → 4 Community Engagement

STEP 4 — Map production and validation

Hand drawn map (left) and GIS map (right) of Miri health facility catchment area in Bauchi, Nigeria

JULY - AUG - SEPT 2017
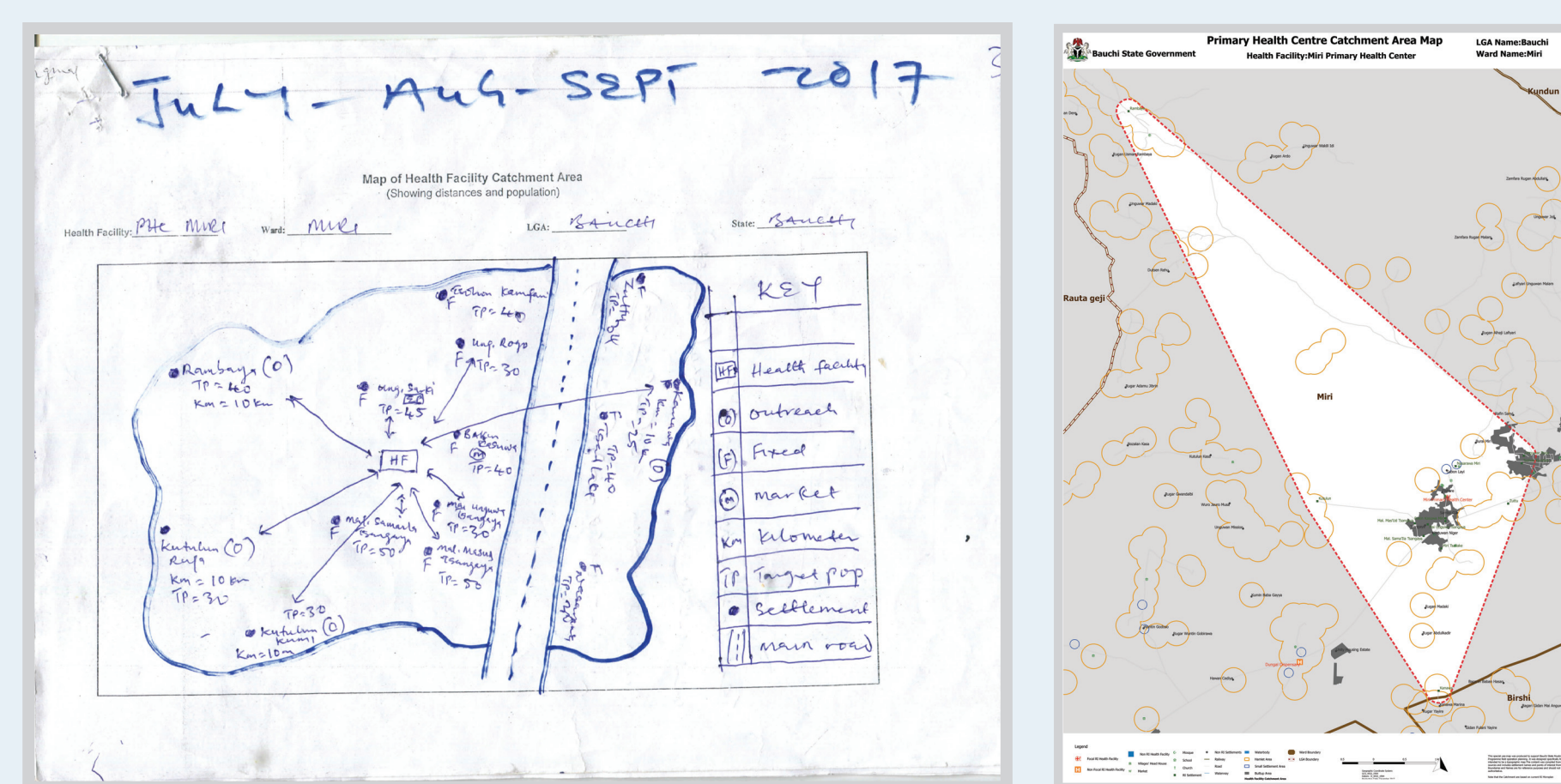
> "When you look at maps, you think about things differently. You think about a settlement alone and the type of strategy you need. The visual depiction means something. [The settlement] is alone, far from the facility…."
>
> — Sokoto State

IMPLEMENTATION EXPERIENCE

Users found the electronic maps that reflected their current understanding of the health facility catchment area easy to use

Lessons learned:

- Map iconography should be culturally relevant
- People used to reading hand-drawn maps need time to learn how to "read" GIS maps
- Lack of a Master Facility List with unique identifiers limits potential

UPGRADING FROM HAND-DRAWN MAPS TO GIS:

Key differences

- More accurate population estimates
- Better distance estimates
- Updated databases
- More realistic physical features
- Other key structures mapped (e.g., schools)
- New settlements identified that were not on hand-drawn maps
- More accurate catchment area maps
- More accurate location of settlements

WHAT DOES THIS MEAN FOR HEALTH WORKERS AND HEALTH MANAGERS?

- Improved microplanning
- More equitable service provision through targeted outreach and mobile sites
- Knowledge of missing communities and ability to target community engagement strategies
- Ability to plan travel time more accurately
- Visibility of opportunities for integration and collaboration with schools and other outreaches activities
- Improved health facility microplans
- More realistic budgets
- Better allocation of resources
- Improved planning and conduct of supervision and mentoring
- Last mile vaccine and logistics distribution
- Appropriate human resource distribution
- Improved health plans overall

CONCLUSIONS & RECOMMENDATIONS

- Using satellite imagery to generate more accurate population estimates and settlement listings enables an RI program to overcome the limitations of outdated census data, extend its reach, improve geographical equity, maximize efficiencies and improve accountability.
- Open data sources for GIS data are becoming more widely available and can be an option for increasing the use of spatial analysis for health planning.
- Establishing a list of health facilities providing services with a unique identifier can ensure more accurate source data and robustness of the health system.
- Putting GIS tools in the hands of health workers and decision makers works and leads to new norms for planning, increased access to RI services, and better outcomes.