

SORMAS® - Surveillance Outbreak Response Management and Analysis System



History of SORMAS



2015

- Development of **prototype** (based on HANA platform), short **field pilot**
- Primarily for **Ebola** plus 3 reference diseases
- Funding from Federal Ministry for Research and Education (BMBF) via German Centre for Infection Research (DZIF), Hasso-Plattner-Institute and SAP (in-kind)

2016

- Full transition to **open source**
- Expansion to **7 diseases**, inclusion of **laboratories**
- Funding from Federal Ministry for Economic Cooperation and Development (BMZ) via Gesellschaft für internationale Zusammenarbeit (GIZ)

2017

- Initiation of pilot and ad hoc activation in **Monkeypox outbreak**
- Expansion to **10 diseases**, further functional and technical expansion
- Funding from DZIF, BMBF, GIZ

2018

- Massive **roll-out** in **Nigeria**, response to simultaneous outbreaks
- Expansion to **12 diseases**, **French version**, further technical improvements
- Funding from GIZ, Helmholtz Association (HGF), BMBF

2019

- Further roll out in **Nigeria**, **pilot in Ghana**
- Addition of **clinical management module** and completion of **global goods model**
- Funding from BMZ&EU via GIZ, HGF, BMBF, Bill & Melinda Gates Foundation, Nigerian Basic Health Care Provision Fund (BHCCPF), CDC

Mission and Objectives of SORMAS

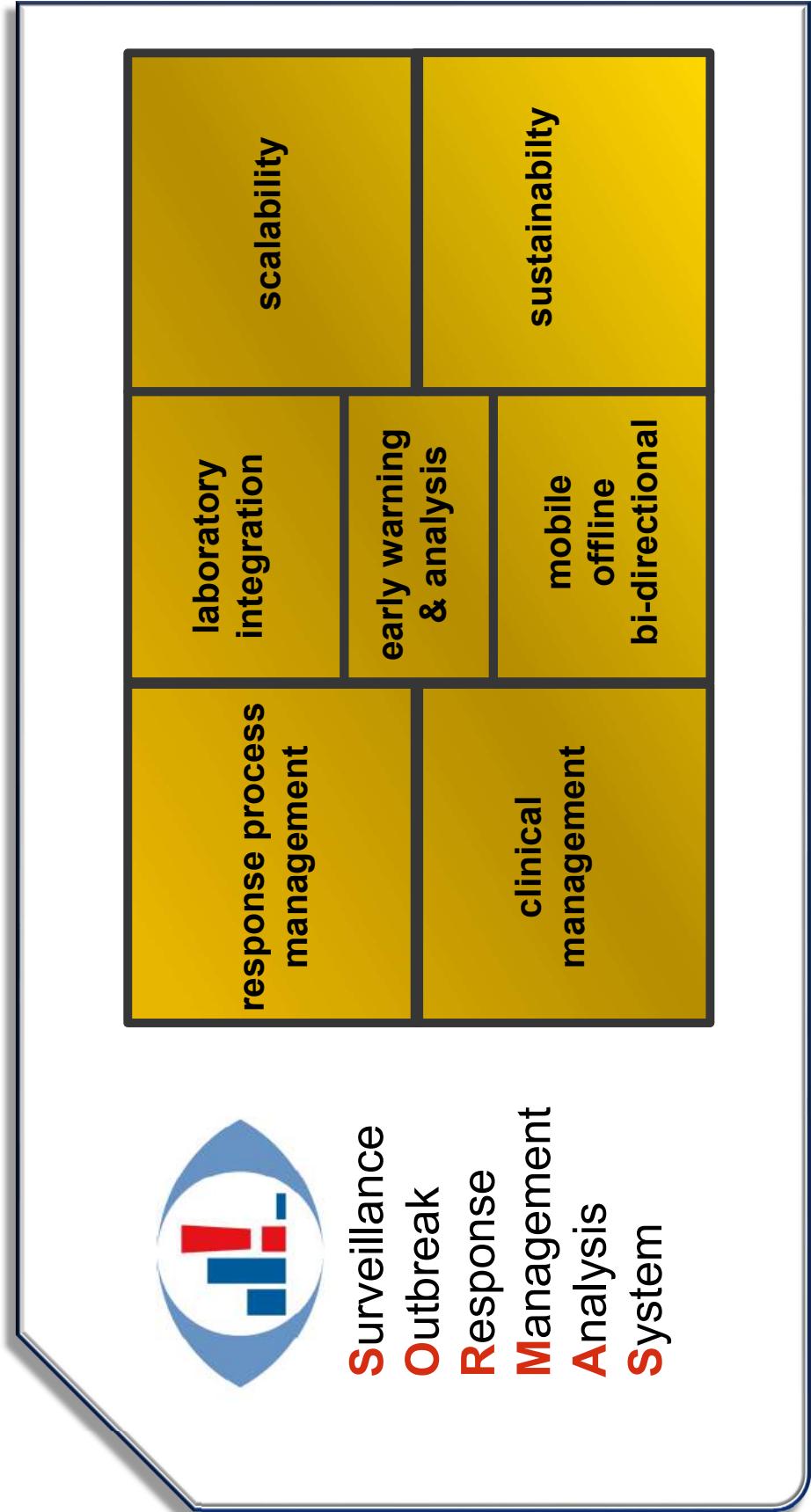
Surveillance Outbreak Response Management and Analysis System

Mission

- ➊ Improve prevention and control of communicable diseases particularly in resource-poor settings.
- ➋ Designed by those involved in public health surveillance and disease control.
- ➌ Free of charge, highest data protection, good scientific practice and open access policy
- ➍ Full integration of
- ➎ Response business process managements
- ➏ Surveillance and analysis
- ➐ Multi-directional and case based throughout
- ➑ Wireless and independent from continuous electricity or internet
- ➒ Open source and free of charge



Objectives: Digital, Mobile Outbreak Detection & Response



Integrated Disease Surveillance and Response System

Conventional Information Flow

Labs Form

For Health Facility: If lab specimen is collected, complete the following information and send a copy of this form to the facility with the specimen.

For other facilities: Complete this section and return it to GHS health facility or clinician

ID Number: _____ Date Specimen sent to Lab: _____

Date Lab received Specimen: _____ Specimen Condition: _____

Disease Condition: _____ Type of Test: _____

Result: _____

Malaria: P. Falciparum = Positive = Negative P. pending

Cholera Culture: P. VivaX Cholera suspect: specify the test used

N meningitis: Neisseria Meningitidis Other

Meningitis: S. pneumoniae Other

Meningitis: H. influenzae Other

Sputum: Other

Stool: Other

Urine: Other

Other: Other

Test for:

Parasite: Other

Viruses: Yellow Fever (IgM) = Positive = Negative No Shigella

Measles (IgM) Other IgM

Rubella (IgM) Other IgM

RT-PCR (IgM) Other

Blood (PCR) Other

Urea (IgM) Other

Lassa (IgM) Other

Measles (IgG) Other

HIV (IgM) Other

HIV (IgG) Other

Other lab test (specify): Results

Date to send results to GHS health facility: _____

Other facility sending results: _____

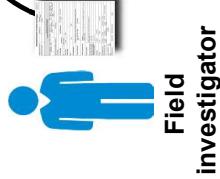
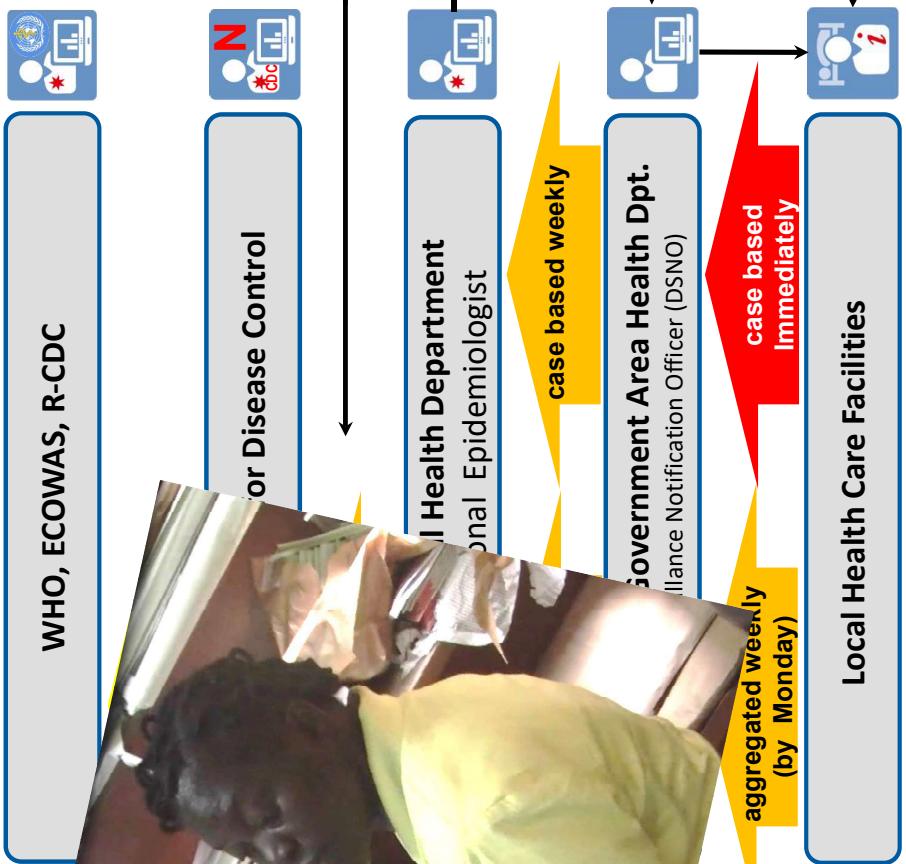
Date to GHS receive results: _____

Other facility sends results: _____

Date GHS receives results: _____

Signature: _____ LGA: _____

DSR 001B



Field investigator

Response Management in SORMAS (e.g. Ebola)

SORMAS Dashboard

DISEASE: Lassa

FROM EPI WEEK: 53/2017 (25/12 - 31/12) | TO EPI WEEK: 10/2018 (05/03 - 11/03) | APPLY FILTERS

My Tasks

- Cases: 761 (High: 0, Normal: 761, Low: 0)
- Contacts: 0
- Events: 0
- Samples: 0
- Reports: 0

New Cases: 967

| Category | Count |
|--------------------|-------|
| Confirmed | 251 |
| Probable | 87 |
| Suspect | 487 |
| Not Yet Classified | 139 |
| Not A Case | 0 |
| Indeterminate | 0 |
| Not An Event | 0 |
| Outbreak | 0 |

New Events: 0

| Category | Count |
|--------------|-------|
| Confirmed | 0% |
| Possible | 0% |
| Rumor | 0% |
| Not An Event | 0% |
| Outbreak | 0% |

New Test Results: 616

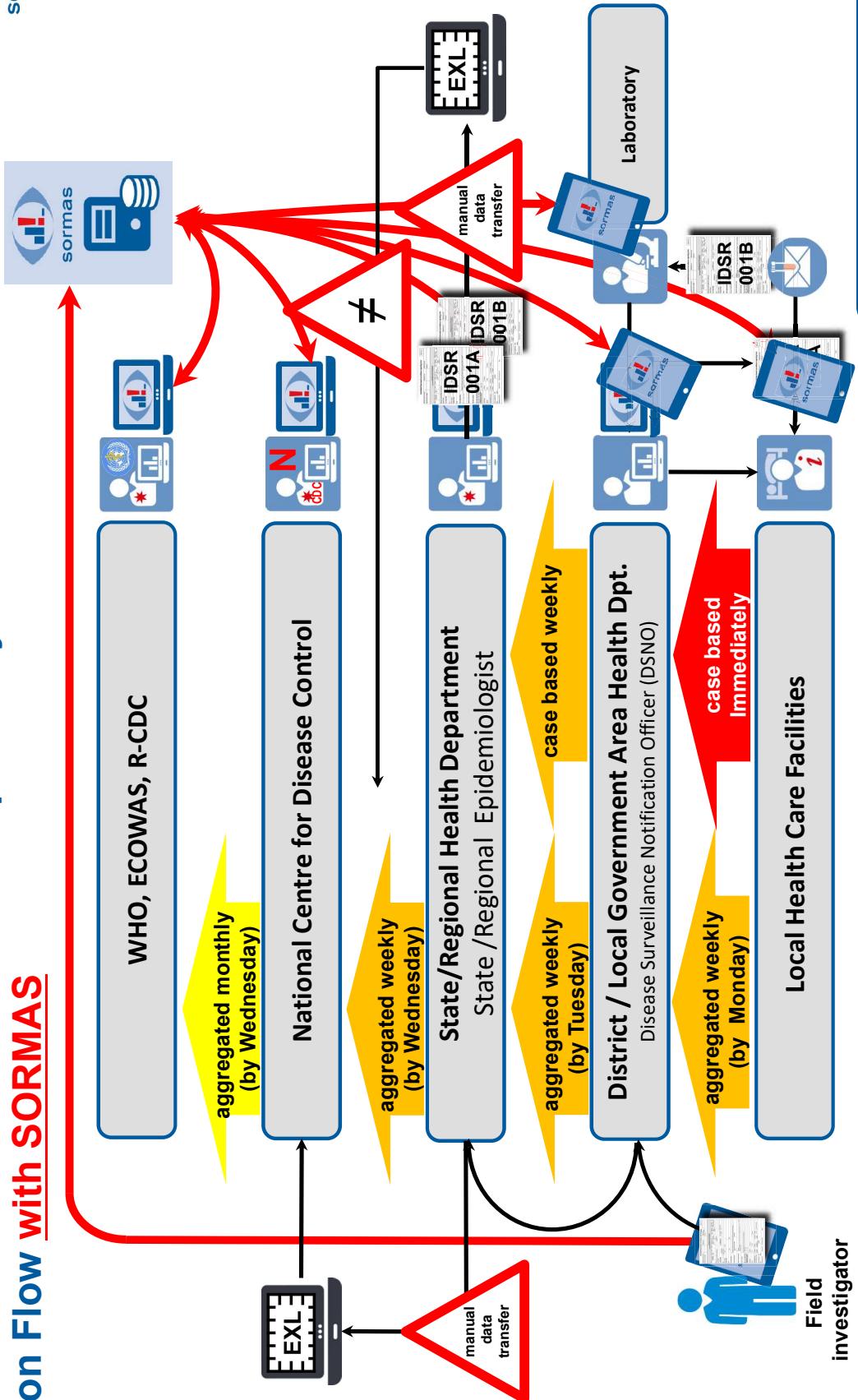
| Category | Count |
|---------------|-------|
| Positive | 201 |
| Negative | 395 |
| Pending | 18 |
| Indeterminate | 2 |

Epidemiological Curve: NEW CASES BETWEEN EPI WEEK 53 AND 10

Number of Cases: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 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Integrated Disease Surveillance and Response System

Information Flow with SORMAS



Personas / Users of SORMAS

Detect
notification, screening

Investigate
validation, analysis

Control
treatment, containment

| | | | | | | | | | | |
|------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| Community Informant refers suspect cases in community to hospital informant |  | Surveillance Officer LGA-DSNO Investigates case, identifies contact persons |  | Case Officer MD, head of isolation facility Executes case based control measures (eg. isolation) |  | Case Supervisor or State epidemiologist Coordinates surveillance officers |  | Contact Officer Assistant LGA-DSNO Conducts follow-up of contact persons |  | Contact Supervisor State epidemiologist Coordinates follow-up of contact persons |
| Hospital Informant Notifies suspect cases |  | Surveillance Supervisor State epidemiologist Coordinates surveillance officers |  | Laboratory Officer Documents and reports laboratory results |  | National CDC Incident Command Centre Assesses risk, coordinates national response |  | Point of Entry Officer Notifies suspect cases at airports, ports and border crossing |  | Supranational Centre Regional CDC, WAHO, WHO International coordination |
| Rumour Officer State DSNO Receives calls on events from general population |  | Point of Entry Officer Notifies suspect cases at airports, ports and border crossing |  | National CDC Incident Command Centre Assesses risk, coordinates national response |  | Rumour Officer State DSNO Receives calls on events from general population |  | Rumour Officer State DSNO Receives calls on events from general population |  | Rumour Officer State DSNO Receives calls on events from general population |
| Point of Entry Officer Notifies suspect cases at airports, ports and border crossing |  | Rumour Officer State DSNO Receives calls on events from general population |  | National CDC Incident Command Centre Assesses risk, coordinates national response |  | Point of Entry Officer Notifies suspect cases at airports, ports and border crossing |  | Rumour Officer State DSNO Receives calls on events from general population |  | Rumour Officer State DSNO Receives calls on events from general population |

Persona Profile: Laboratory Officer



Tasks

- Receives collected specimens from suspected cases from Surveillance supervisor
- Coordinates the laboratory sampling procedure and collection of results in hers/his respective laboratory
- Documents tests done, test results and gives feedback to Surveillance supervisor
- Coordinates specimen referrals for higher level laboratories when needed

Needs

- to get informed about incoming samples from surveillance supervisor
- to acknowledge the received samples
- to enter the information on the samples
- to have line list of tested specimens with results

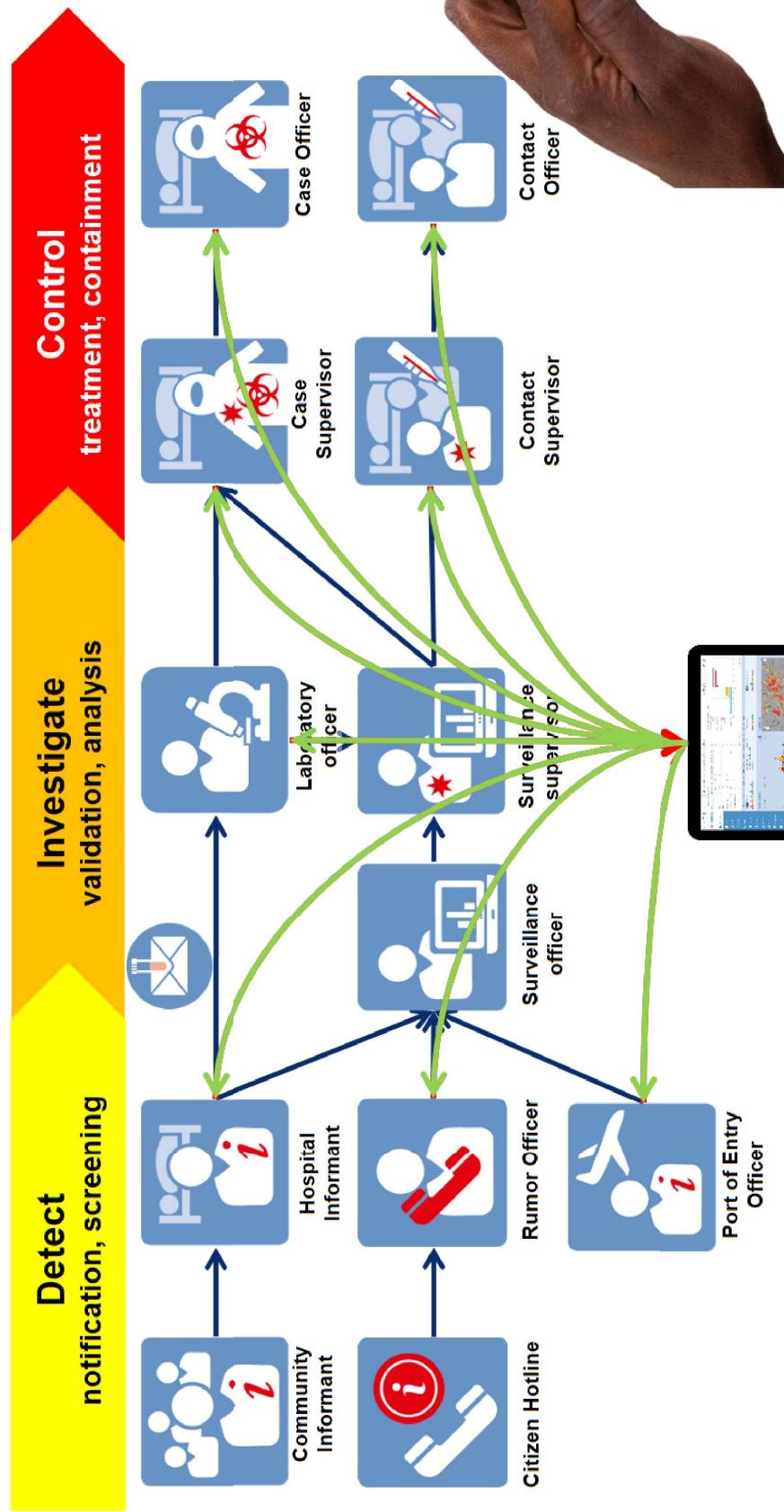
Interaction/Dependencies with/other personas

- Surveillance supervisor

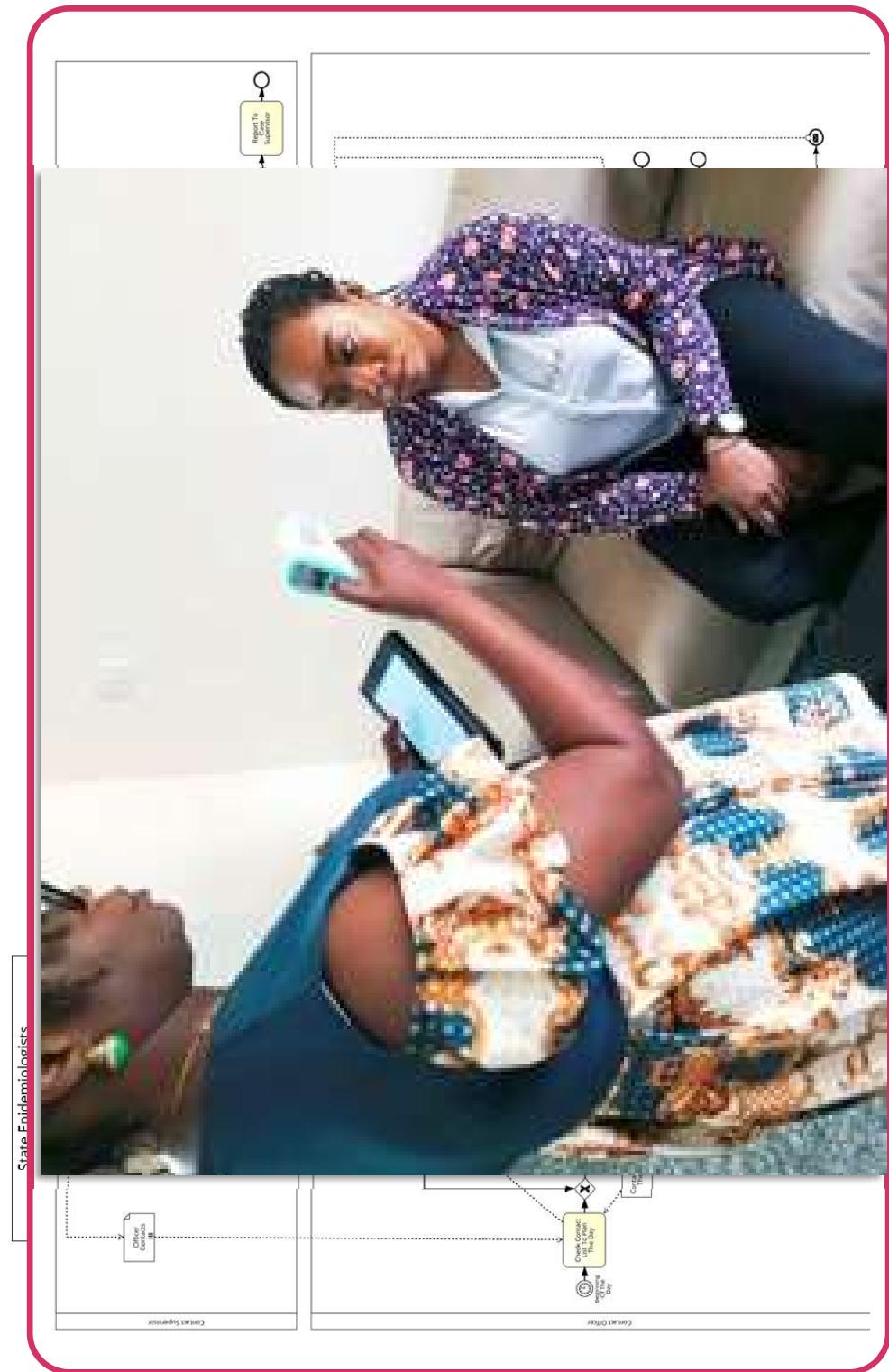
Artifacts (Input/Output)

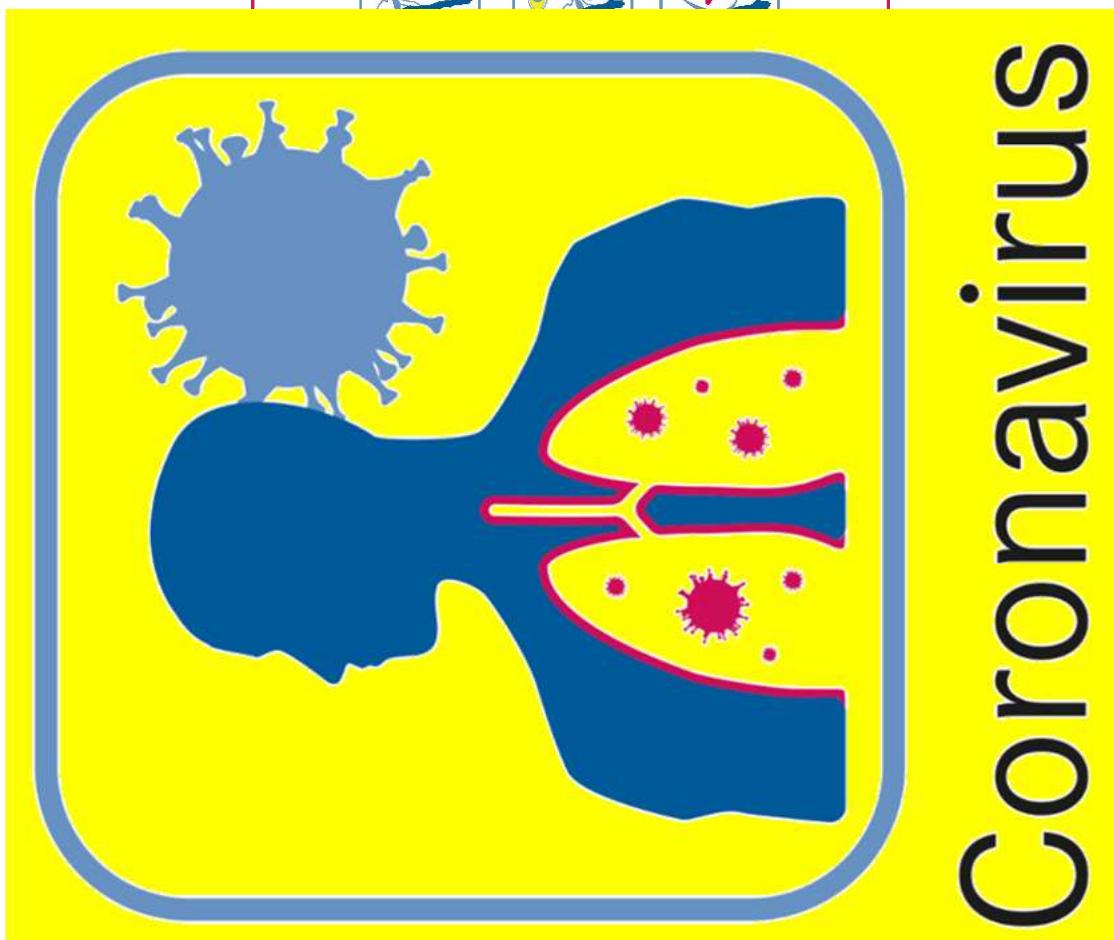
- Laboratory investigation form

Response Management in SORMAS (e.g. Ebola)

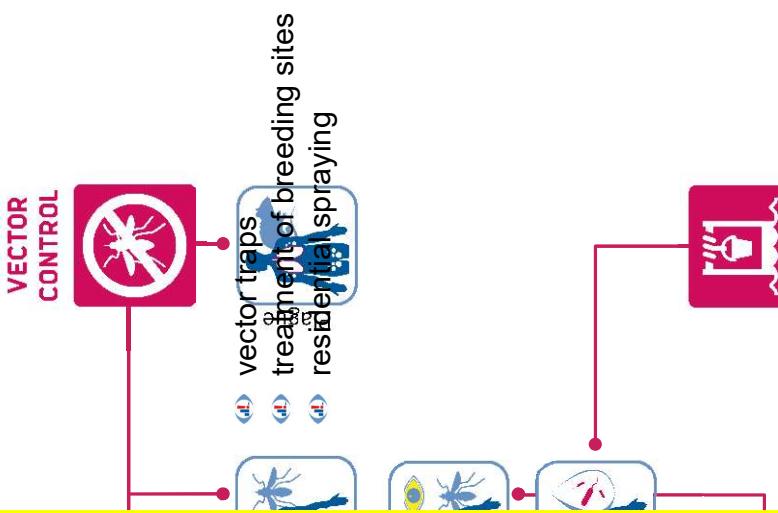


Process model Ebola virus - contact follow-up





Process Models for Di

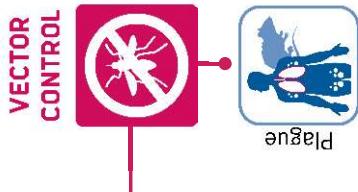


SORMAS Coronavirus Module (mobile offline and web online)

| Case Information | | | | | | | | |
|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------|----------------|----------------|------------|----|---------|
|  SORMAS | <input checked="" type="radio"/> CASE LIST | | | | | | | |
| | <input type="radio"/> CASE | | | | | | | |
| Cases data | CASE PERSON HOSPITALIZATION SYMPTOMS EPIDEMIOLOGICAL DATA THERAPY CLINICAL COURSE | | | | | | | |
| Dashboard | DATE OF REPORT*  15/01/2020 | | | | | | | |
| Tasks | REPORTING USER and MIN - Admin, National User | | | | | | | |
| Cases |  CASE CLASSIFICATION* <table border="1"> <tr> <td>NOT YET CLASSIFIED</td> <td>SUSPECT CASE</td> <td>PRIORABLE CASE</td> <td>CONFIRMED CASE</td> <td>NOT A CASE</td> </tr> </table> DATE OF CLASSIFICATION 20/01/2020 | NOT YET CLASSIFIED | SUSPECT CASE | PRIORABLE CASE | CONFIRMED CASE | NOT A CASE | | |
| NOT YET CLASSIFIED | SUSPECT CASE | PRIORABLE CASE | CONFIRMED CASE | NOT A CASE | | | | |
| mSERS | CLASSIFIED BY System | | | | | | | |
| Contacts | INVESTIGATION STATUS*  INVESTIGATION PENDING | | | | | | | |
| Events | END NUMBER NIE:ABz-EZa-20-0004 | | | | | | | |
| Samples | DISEASE*  Coronavirus (CoV) | | | | | | | |
| Reports | OUTCOME OF CASE* <table border="1"> <tr> <td>NO OUTCOME YET</td> <td>DECEASED</td> <td>RECOVERED</td> <td>UNKNOWN</td> </tr> </table> SEQUELAE <table border="1"> <tr> <td>YES</td> <td>NO</td> <td>UNKNOWN</td> </tr> </table> | NO OUTCOME YET | DECEASED | RECOVERED | UNKNOWN | YES | NO | UNKNOWN |
| NO OUTCOME YET | DECEASED | RECOVERED | UNKNOWN | | | | | |
| YES | NO | UNKNOWN | | | | | | |
| Statistics | DATE OF OUTCOME*  17/01/2020 | | | | | | | |
| Configuration |  CASE ORIGIN In-Country | | | | | | | |
| Users |  STATE* Abis | | | | | | | |
| About |  WARD Asa Okpulor Ward | | | | | | | |
| | RESPONSIBLE SURVEILLANCE OFFICER Sanya OBA/SANYO - Surveillance Officer | | | | | | | |
| | PHONE NUMBER OF RESPONSIBLE CLINICIAN  | | | | | | | |
| | NAME OF RESPONSIBLE CLINICIAN  | | | | | | | |
| | EMAIL ADDRESS OF RESPONSIBLE CLINICIAN  | | | | | | | |
| | Reception dates of paper form DATE RECEIVED AT IGA LEVEL  15/01/2020 | | | | | | | |
| | DATE RECEIVED AT STATE LEVEL  | | | | | | | |
| |  | | | | | | | |
| |  | | | | | | | |

| Android Emulator - development - android - 7:55:54 | | Android Emulator - development - android - 7:55:54 | | | | | | | | | | | | | | | | | | | | | | | | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|------------------------------------------------------------------|------------------------------------------------|-----------------------------|-------------------------|----------------------------------|----------------------|--------------------------------------------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------------------------------------------------------------------|------------------------------------------------|----------------------------------------|--|----------------------------------------------------------------|--------------------------------|------------------------------------------------|--|--|--|--|--|--|--|
| <p>CONTACTS</p> <p>Read Case</p> | | <p>Edit Pathogen Test</p> <p>Read Sample</p> | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p>SYMPTOM INFORMATION</p> <table border="1"> <tr> <td>FIRST SYMPTOM</td> <td>DATE OF SYMPTOM</td> </tr> <tr> <td>Not answered</td> <td>Not answered</td> </tr> <tr> <td colspan="2"> CURRENT BODY TEMPERATURE IN ° C Not answered </td> </tr> <tr> <td colspan="2"> SYMPOTMS THAT OCCURRED DURING THIS <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Abnormal lung X <input type="checkbox"/> Abdominal pain <input type="checkbox"/> Fluid in cavity through X-Ray <input type="checkbox"/> Fluid in lung cavity in auscultation <input type="checkbox"/> Pharyngeal exudate </td> </tr> <tr> <td colspan="2"> SYMPOTMS WITH NO RELIABLE OCCURRENCE <ul style="list-style-type: none"> <input type="checkbox"/> Conjunctival injection <input type="checkbox"/> Difficulty breathing/Dyspnea </td> </tr> </table> | | | | FIRST SYMPTOM | DATE OF SYMPTOM | Not answered | Not answered | CURRENT BODY TEMPERATURE IN ° C Not answered | | SYMPOTMS THAT OCCURRED DURING THIS <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Abnormal lung X <input type="checkbox"/> Abdominal pain <input type="checkbox"/> Fluid in cavity through X-Ray <input type="checkbox"/> Fluid in lung cavity in auscultation <input type="checkbox"/> Pharyngeal exudate | | SYMPOTMS WITH NO RELIABLE OCCURRENCE <ul style="list-style-type: none"> <input type="checkbox"/> Conjunctival injection <input type="checkbox"/> Difficulty breathing/Dyspnea | | | | | | | | | | | | | | | |
| FIRST SYMPTOM | DATE OF SYMPTOM | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Not answered | Not answered | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CURRENT BODY TEMPERATURE IN ° C Not answered | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| SYMPOTMS WITH NO RELIABLE OCCURRENCE <ul style="list-style-type: none"> <input type="checkbox"/> Conjunctival injection <input type="checkbox"/> Difficulty breathing/Dyspnea | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p>EDIT PATHOGEN TEST</p> <table border="1"> <tr> <td>TYPE OF TEST *</td> <td>TESTED DISEASE *</td> <td>DATE AND TIME OF RESULT *</td> <td>TEST RESULT *</td> </tr> <tr> <td>PCR / RT-PCR</td> <td>Coronavirus (CoV)</td> <td>28/01/2020 00:00</td> <td>28/01/2020 16:56</td> </tr> <tr> <td colspan="2"> SPECIFY TEST DETAILS * Specify test details </td> <td> LABORATORY * LUTH - Lagos University Teaching Hospital </td> <td> FINAL LABORATORY RESULT Not answered </td> </tr> <tr> <td colspan="2"> PURPOSE External lab testing </td> <td> LABORATORY LUTH - Lagos University Teaching Hospital </td> <td> COMMENT Not answered </td> </tr> <tr> <td colspan="2"> TYPE OF SAMPLE Endotracheal aspirate </td> <td></td> <td></td> </tr> <tr> <td colspan="2"></td> <td></td> <td></td> </tr> </table> | | | | TYPE OF TEST * | TESTED DISEASE * | DATE AND TIME OF RESULT * | TEST RESULT * | PCR / RT-PCR | Coronavirus (CoV) | 28/01/2020 00:00 | 28/01/2020 16:56 | SPECIFY TEST DETAILS * Specify test details | | LABORATORY * LUTH - Lagos University Teaching Hospital | FINAL LABORATORY RESULT Not answered | PURPOSE External lab testing | | LABORATORY LUTH - Lagos University Teaching Hospital | COMMENT Not answered | TYPE OF SAMPLE Endotracheal aspirate | | | | | | | |
| TYPE OF TEST * | TESTED DISEASE * | DATE AND TIME OF RESULT * | TEST RESULT * | | | | | | | | | | | | | | | | | | | | | | | | |
| PCR / RT-PCR | Coronavirus (CoV) | 28/01/2020 00:00 | 28/01/2020 16:56 | | | | | | | | | | | | | | | | | | | | | | | | |
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| TYPE OF SAMPLE Endotracheal aspirate | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p>SAMPLE INFORMATION</p> <table border="1"> <tr> <td>CORRESPONDING PERSON</td> <td>DISEASE</td> </tr> <tr> <td>Virgin WEDNESDAY</td> <td>Coronavirus</td> </tr> <tr> <td>DATE SAMPLE WAS COLLECTED</td> <td></td> </tr> <tr> <td>28/01/2020 00:00</td> <td></td> </tr> <tr> <td></td> <td></td> </tr> </table> | | | | CORRESPONDING PERSON | DISEASE | Virgin WEDNESDAY | Coronavirus | DATE SAMPLE WAS COLLECTED | | 28/01/2020 00:00 | | | | | | | | | | | | | | | | | |
| CORRESPONDING PERSON | DISEASE | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Virgin WEDNESDAY | Coronavirus | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DATE SAMPLE WAS COLLECTED | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 28/01/2020 00:00 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p>RECEIVED</p> <table border="1"> <tr> <td>SENT/DISPATCHED</td> <td>RECEIVED</td> </tr> <tr> <td>28/01/2020</td> <td>No</td> </tr> </table> | | | | SENT/DISPATCHED | RECEIVED | 28/01/2020 | No | | | | | | | | | | | | | | | | | | | | |
| SENT/DISPATCHED | RECEIVED | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 28/01/2020 | No | | | | | | | | | | | | | | | | | | | | | | | | | | |

Process Models for Disease Specific Control Measures



Process Models for Disease Specific Control Measures

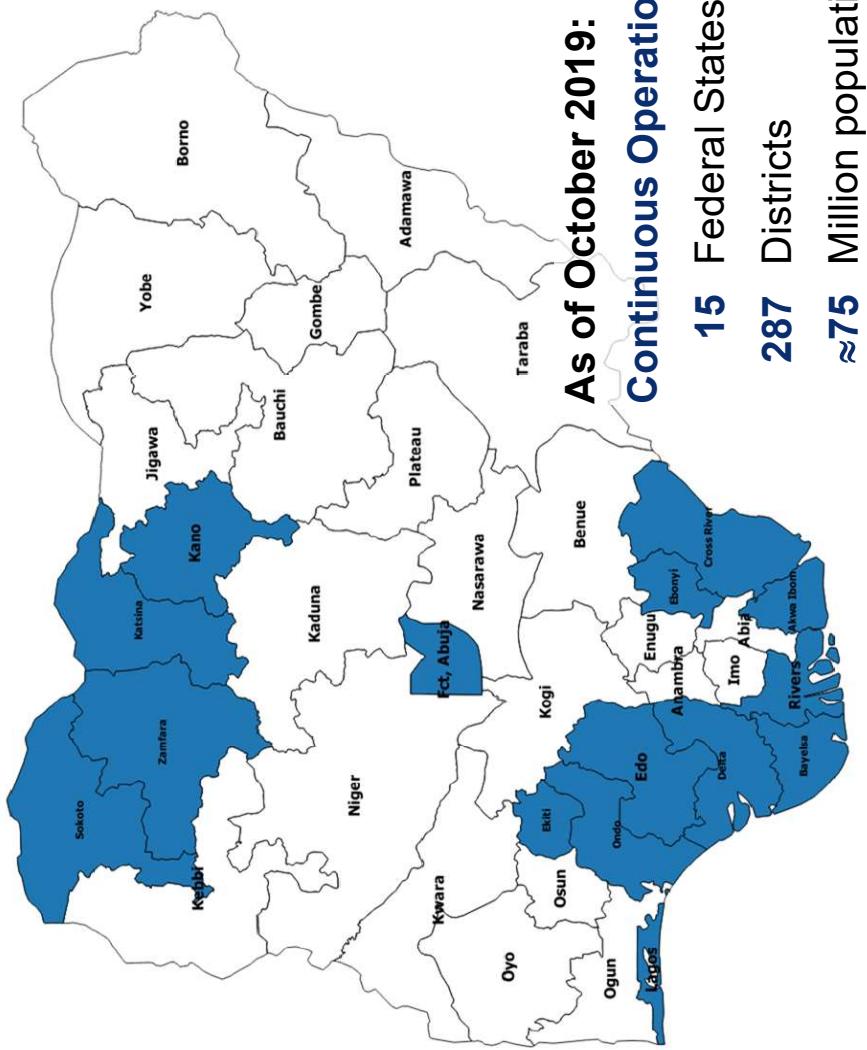


CLINICAL
MANAGEMENT

SORMAS Deployment in 3 Simultaneous Outbreaks

**November 2017 - July 2018
Monkeypox Outbreak**

8 Federal states
33 Districts



**January - March 2018
Bacterial Meningitis Outbreak**

8 Federal states
33 Districts

**February - April 2018
Lassa Fever Outbreak**

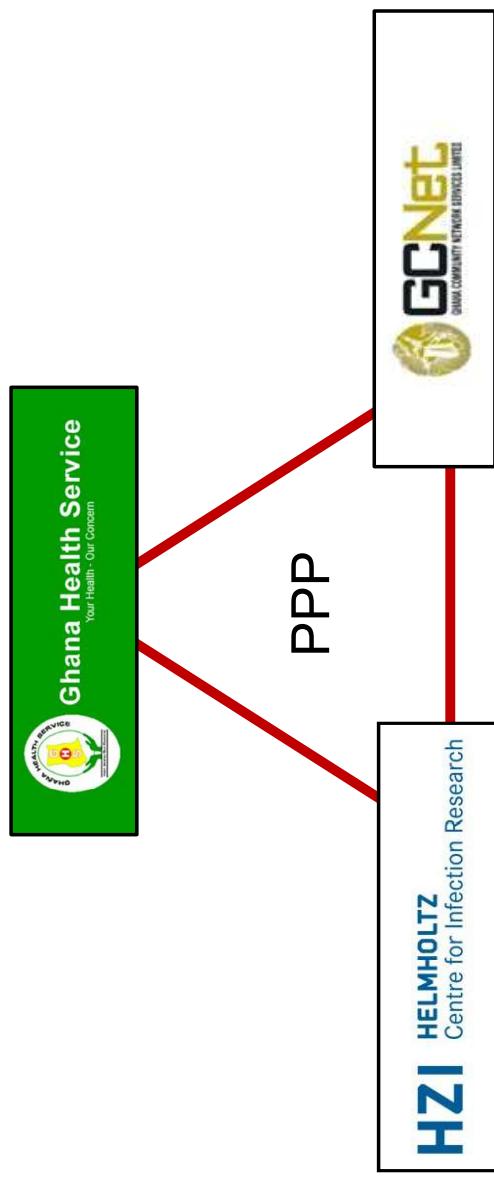
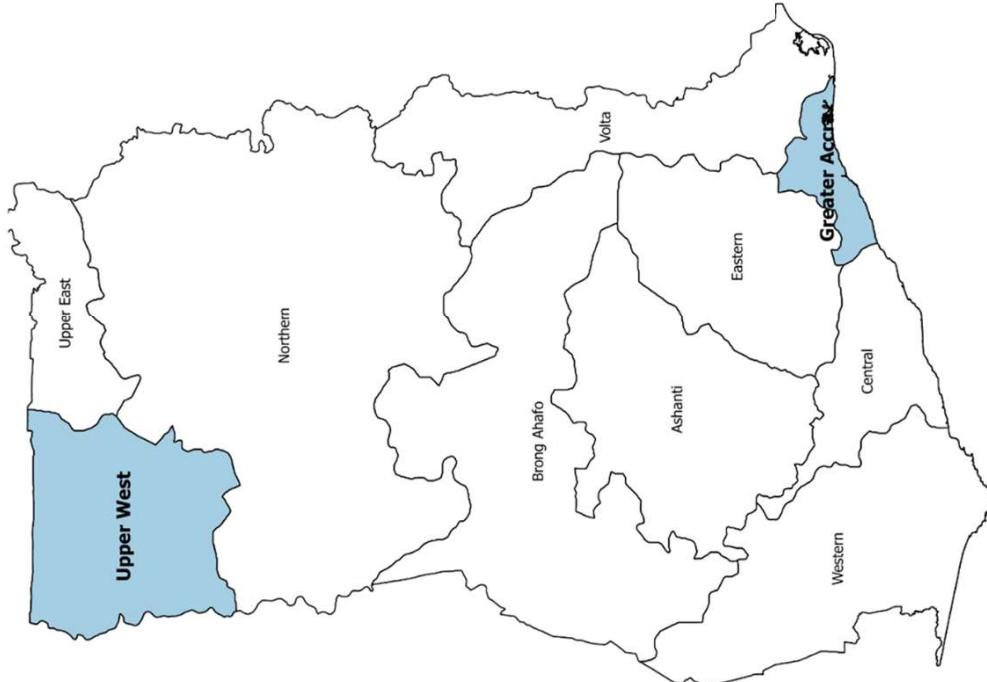
3 Federal states
49 Districts

**As of October 2019:
Continuous Operation in**

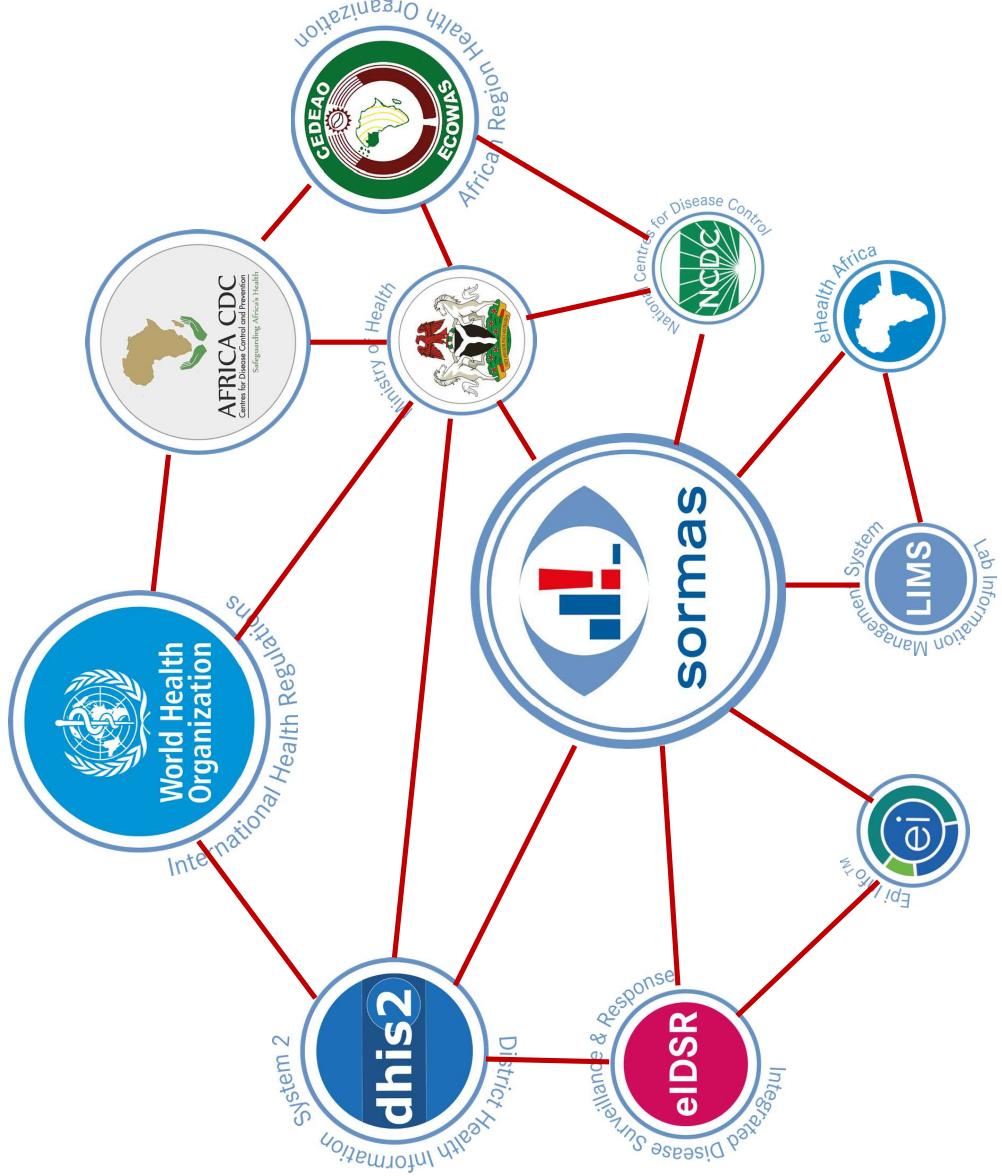
| |
|---------------------------------------|
| 15 Federal States |
| 287 Districts |
| ≈75 Million population covered |

SORMAS Implementation in Ghana

- Start November 2019
- 40 Districts in 2 Regions
- Private Public Partnership

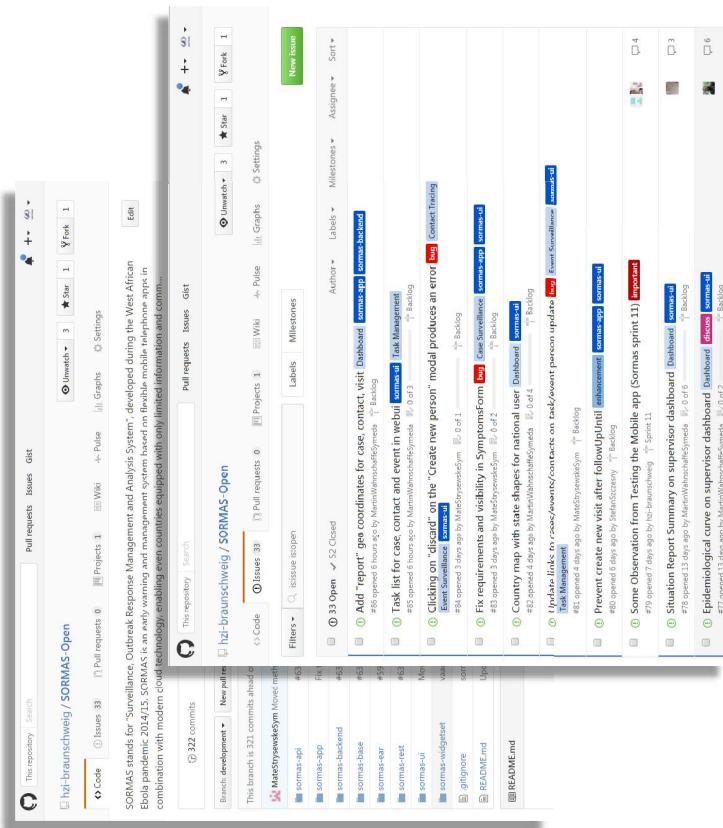


Technical and Organizational Interoperability of SORMAS



Technology Stack of SORMAS

- **UNIX System UBUNTU LTS 16 Server 16GB RAM, HDD efficient, 500GB**
 - **Data Backup (separate system storage from the scripts using CRON JOB scripts**
 - **Vaadin Web Client (vaadin.org)**
 - **JAVA EE Server Payara**
 - **POSTGRES SQL Database (pgadmin)**



➤ Codes and Roadmap on GitHub

Systematic Review on mHealth Tools for Surveillance and Outbreak Response for Viral Hemorrhagic Fevers

Sources

- Google Scholar, MEDLINE, CAB Abstracts, Popline, Web of Science

Search strategy

- 01.01.2014 - 31.12.2015
- any language
- "Outbreak" OR "Epidemic") AND ("mobile phone" OR "smartphone" OR "smart phone" OR "mobile phone" OR "tablet" OR "mHealth") AND ("Ebola" OR "VHF" OR "EVD" OR "Ebola Virus Disease" OR "viral hemorrhagic fever"

Result

- 1,220 publications manually screened
- 77 (6%) publications identified as relevant and original
- 58 mHealth tools for surveillance of hemorrhagic fevers
- 3 tools (ComCare, Ebola SenseFollowup, SORMAS)
 - surveillance
 - contact tracing
 - case management
 - laboratory data
- only SORMAS covers
 - >12 epidemic prone diseases
 - ad-hoc process models
 - task management

Tom-Aba et al, JMIR Public Health and Surveillance, 2018

Overview of functionalities of eSurveillance tools in Nigeria

| INDICATORS | SORMAS | DHIS2 | EWARS | EWORS | AVADAR | eIDSR | ARGUS | eSurveillance | mSERS | GO.DATA |
|-------------------------------|-----------|-----------|----------|----------|----------|-------|-------|---------------|-------|---------|
| Number of states | 15 | 37 | 1 | 1 | 2 | ? | ? | ? | ? | ? |
| Primarily short term use | NO | NO | NO | NO | NO | NO | NO | NO | NO | YES |
| Continuous use | YES | YES | ? | YES | ? | YES | ? | YES | ? | ? |
| Long term use | YES | YES | NO | YES | ? | YES | ? | YES | ? | NO |
| Aggregate reporting | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Case based reporting | YES | NO | NO | NO | NO | NO | ? | ? | NO | YES |
| Number of case based diseases | 12 | 0 | ? | ? | ? | ? | ? | ? | 8 | ? |
| Response process management | YES | NO | YES | YES | NO | NO | NO | NO | NO | YES |
| Bi-directional information | YES | NO | ? | ? | ? | ? | ? | ? | NO | YES |
| Mobile app (YES/NO) | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Offline included | YES | ? | ? | ? | ? | ? | ? | ? | ? | ? |
| Web app (YES/NO) | YES | YES | YES | YES | NO | YES | YES | YES | YES | YES |
| Case management (EMR) | YES | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| Contact tracing | YES | NO | ? | NO | NO | NO | NO | NO | NO | YES |
| Health facility use | YES | YES | ? | YES | NO | ? | ? | ? | ? | ? |
| Laboratory use | YES | NO | ? | ? | ? | ? | ? | ? | ? | ? |
| Event based surveillance | YES | NO | YES | YES | NO | ? | ? | ? | ? | ? |
| Point of entry | YES | NO | ? | NO | NO | NO | NO | NO | NO | NO |
| Task management | YES | NO | ? | NO | ? | ? | ? | ? | ? | ? |
| Multi-lingual platform | YES | YES | NO | NO | ? | ? | ? | NO | NO | YES |

Case-Based versus Aggregate Notification

Aggregate Reporting

- Advantage**
 - + Little training need
 - + Short data entry

Case Based Reporting

- | Advantage | Disadvantage |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> + No Delay + Enables updates & corrections + Detailed + Facilitates risk assessment + Allows quality control + Allows response management + Can migrate to aggregation | <ul style="list-style-type: none"> - More training need - Long data entry |

Create New Cases via Line Listing

| X_HCT Individuals HIV counselled tested and received results - total | | | | | | | | | | | |
|----------------------------------------------------------------------|-----|--------|--------|--------|--------|-----------|--------|-----------|--------|-----------|--------|
| | | Male | | Female | | 20+ years | | 15-19 yrs | | 10-14 yrs | |
| | | 10 | 14 | 15+ | 19+ | 20+ | 24+ | 25+ | 29+ | 30+ | 35+ |
| X | HCT | 12 856 | 12 856 | 15 355 | 15 355 | 15 424 | 15 424 | 18 515 | 18 515 | 20 702 | 20 702 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 2 251 | 4 330 | 11 239 | 0 | 2 221 | 4 338 | 13 101 | 13 101 | 32 985 | 32 985 |
| | | 4 234 | 10 225 | 18 859 | 0 | 4 338 | 15 355 | 23 431 | 0 | 6 200 | 0 |
| | | 5 560 | 13 101 | 23 431 | 0 | 5 560 | 15 424 | 27 067 | 40 74 | 9 242 | 0 |
| | | 8 501 | 36 073 | 36 137 | 0 | 8 501 | 18 515 | 36 173 | 0 | 11 262 | 0 |
| | | 9 414 | | | | 9 414 | 28 059 | | | 34 564 | 53 98 |

hybrid case based reporting (SORMAS)

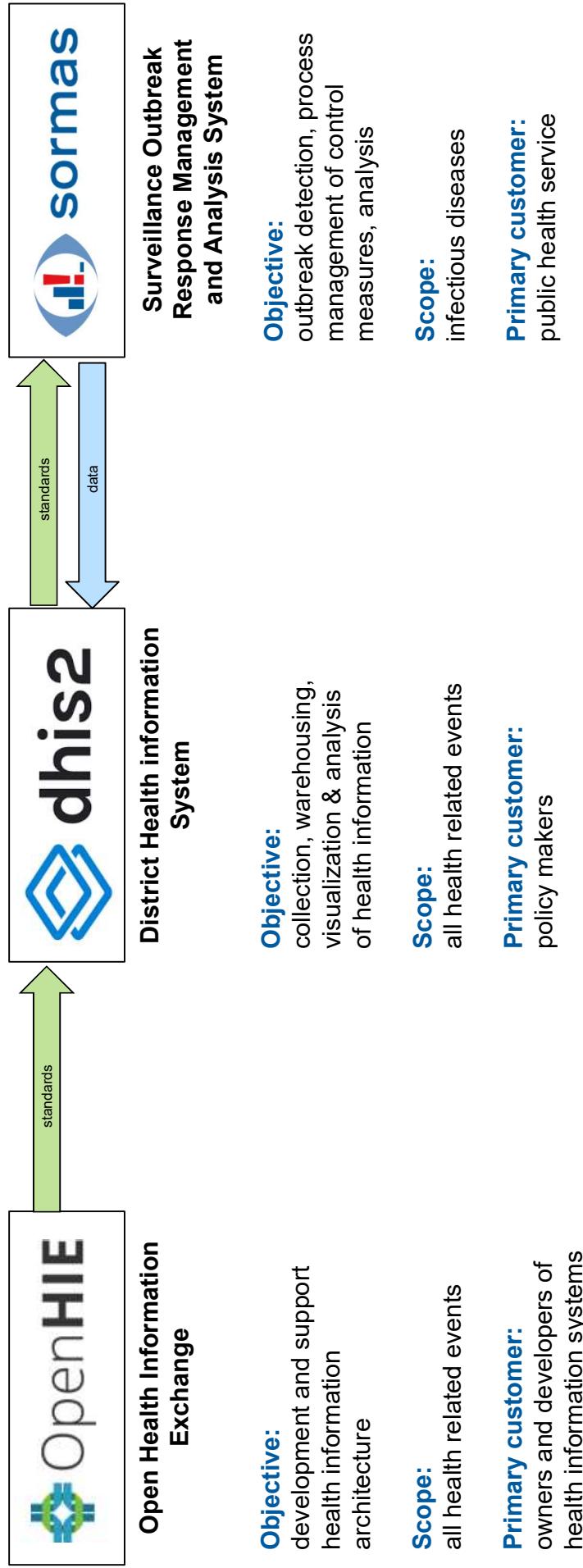
aggregate reporting (DHIS2)

case based reporting (SORMAS)

SORMAS vs DHIS2 Tracker 2.29

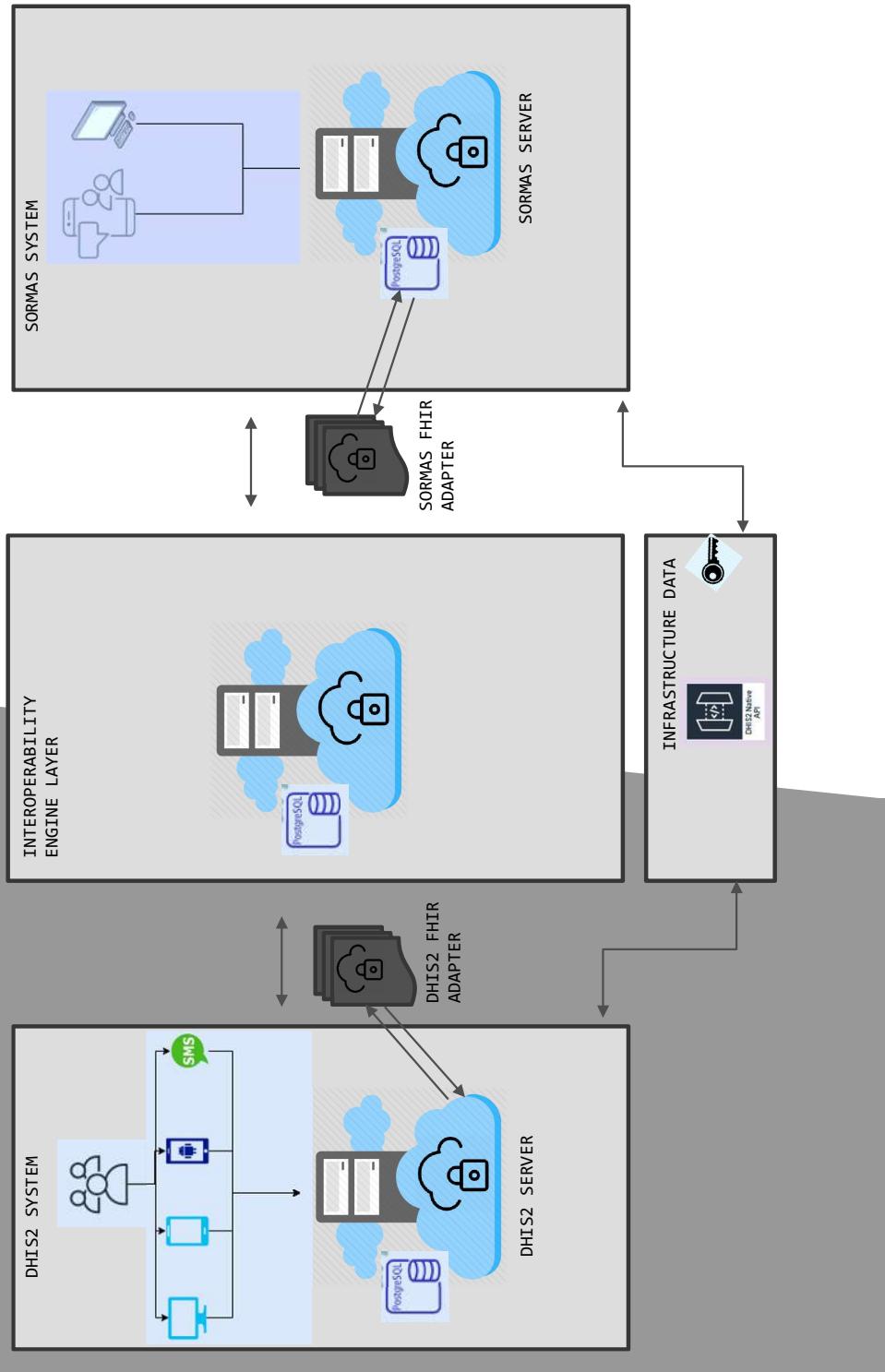
| Indicator | SORMAS | DHIS2 |
|------------------------------------------------------------|--------|-------|
| Surveillance Notification | Yes | No |
| Outbreak response | Yes | No |
| Case Management (Patient) | Yes | No |
| Contact tracing | Yes | Yes |
| Follow up visits & Automatic Scheduling | Yes | No |
| Visualization & Analysis | Yes | Yes |
| Lab Sample Management | Yes | Yes |
| Automatic Task management | Yes | No |
| Integrated User Work flow | Yes | No |
| Disease process model | Yes | No |
| Case Based Surveillance | Yes | No |
| Automated Message Reminder | Yes | Yes |
| Automated Aggregation | Yes | No |
| Automatic Case Classification | Yes | No |
| Interactive Epidemiological Maps (cases, contacts, events) | Yes | No |
| Event Surveillance (rumor management, persons involved) | Yes | No |

Complementarity between openHIE, DHIS2 and SORMAS



DHIS2

SORMAS



Training Materials for SORMAS



Instructional Cartoon Videos

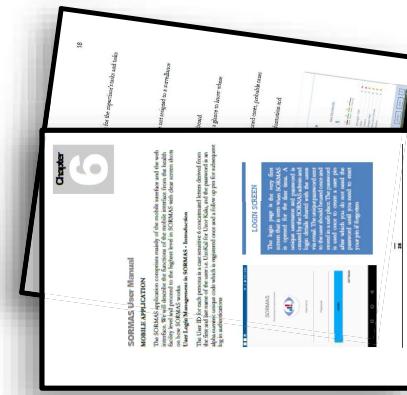
- Surveillance Supervisor
- Contact Officer
- Contract Supervisor
- Hospital Informants
- Surveillance Officer

- <https://www.youtube.com/watch?v=0vTKZZr8-yE> – Surveillance Supervisor
- https://www.youtube.com/watch?v=YCA_0K46dgE&t=43s – Contact Officer
- <https://www.youtube.com/watch?v=17Ud1IePQ&t=11s> - Contract Supervisor
- <https://www.youtube.com/watch?v=t12ve1ARRbU> – Hospital Informants
- https://www.youtube.com/watch?v=nVJ1k-84d_0&t=65s – Surveillance Officer

Didactic Lectures



Interactive Training Scenarios



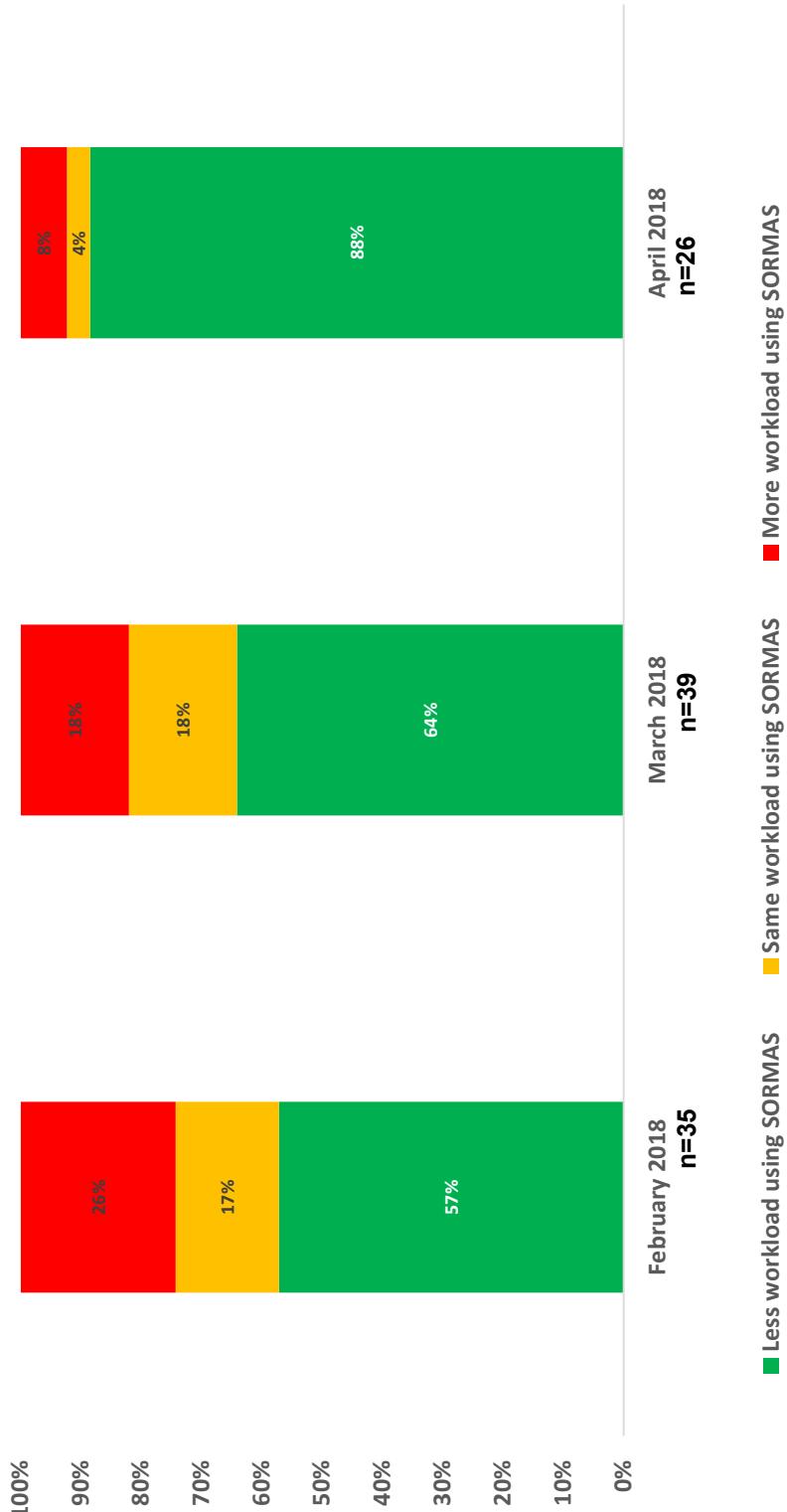
User Manual

HZI HELMHOLTZ Centre for Infection Research

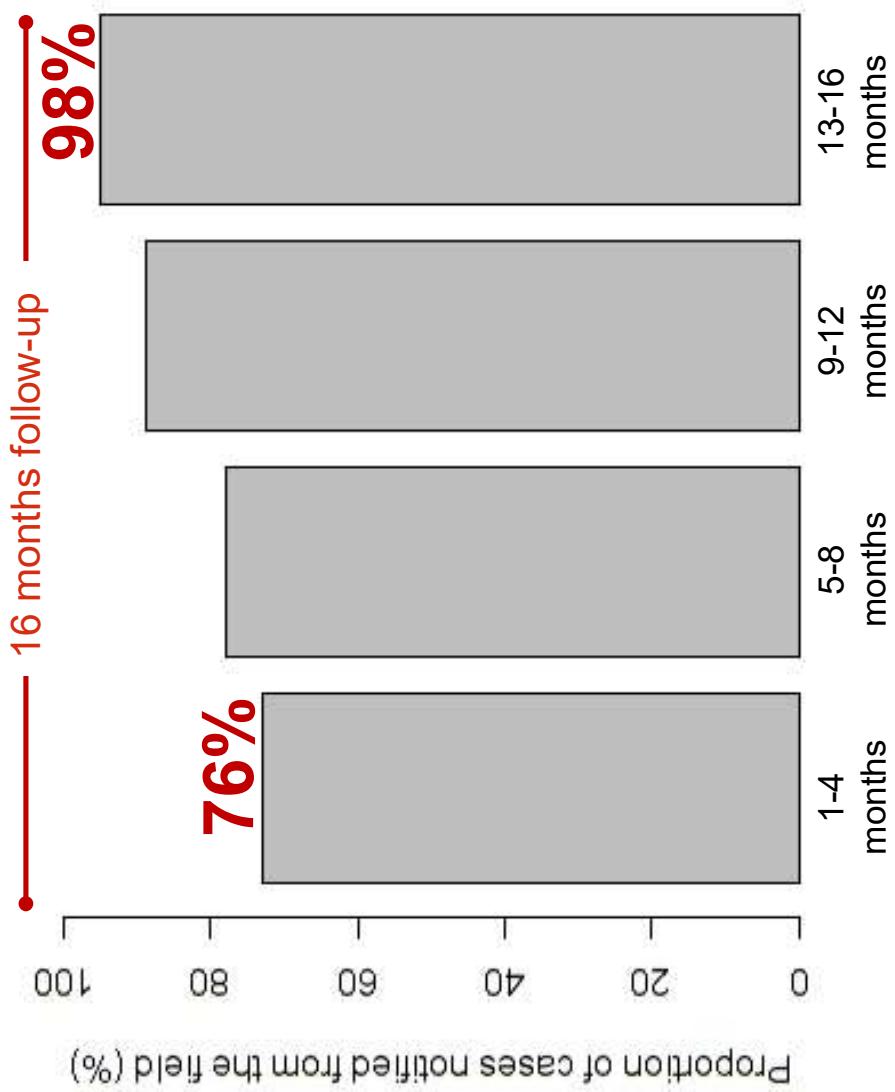
Trouble Shooting Guide

Repetitive User Survey among SORMAS Users, Nigeria 2018

How does SORMAS change your workload?



Increasing Performance upon Deployment



Four-month-intervals after implementation of SORMAS
N = 15491 reports of 5 diseases in 10 states in Nigeria

Global Good Maturity Model for Digital Health Software

Global
Utility

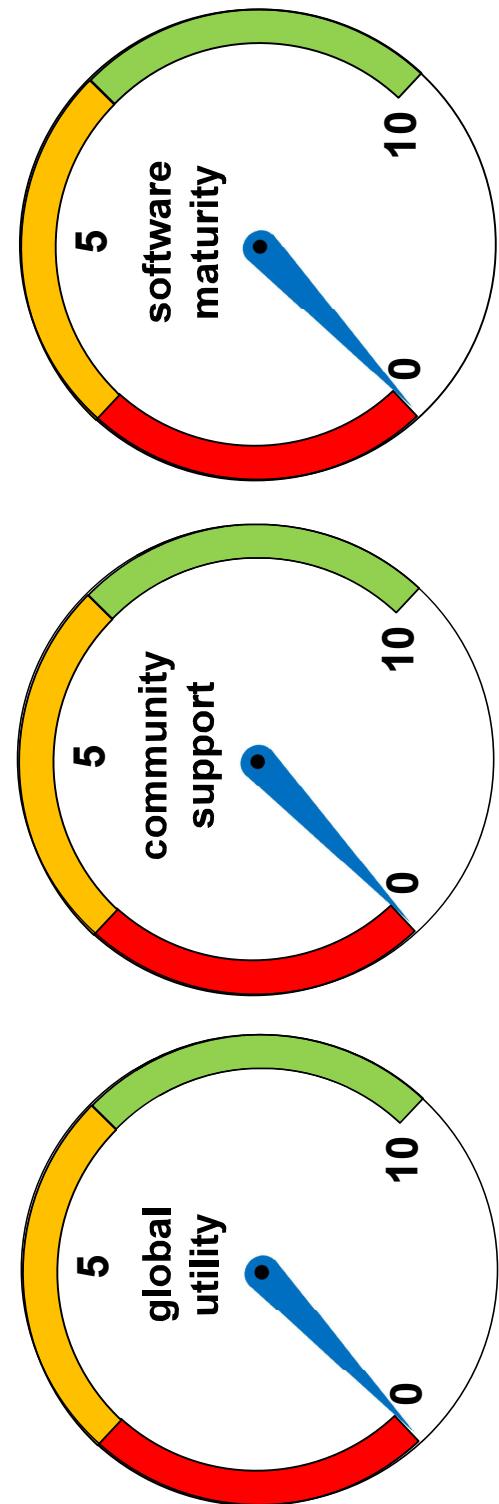
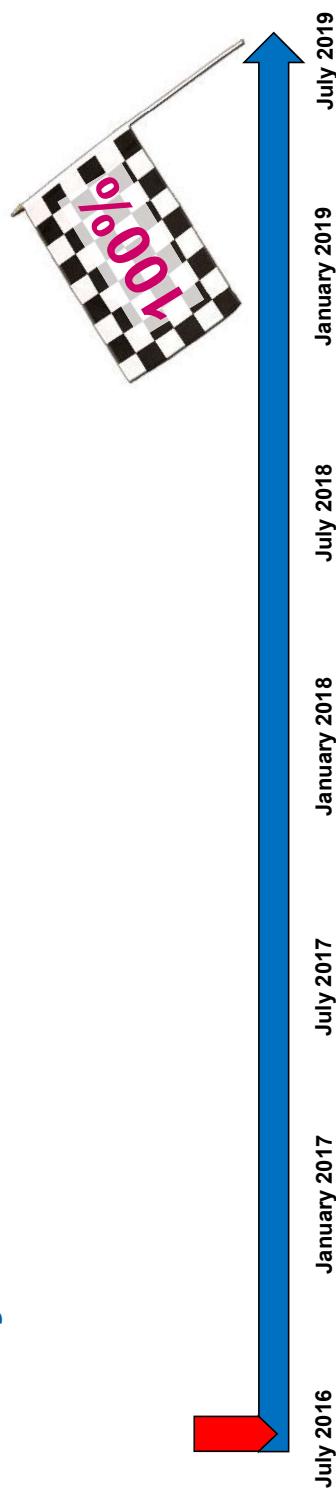
Community
Support

Software
Maturity



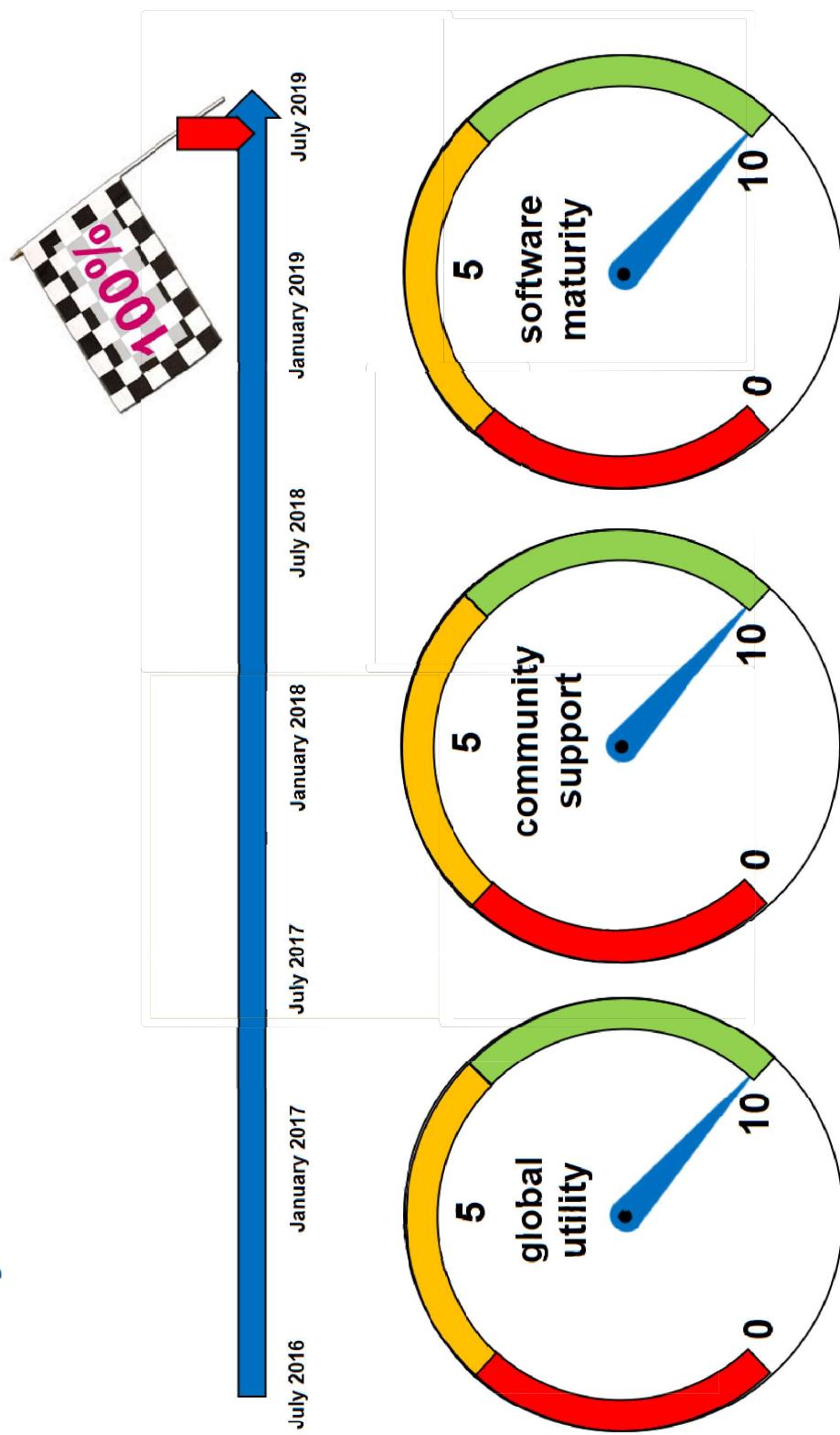
https://wiki.digitalsquare.io/index.php/What_are_Global_Goods

Progress of Global Good Maturity Score of SORMAS: full score as of July 2019



https://wiki.digitalsquare.io/index.php/What_are_Global_Goods

Progress of Global Good Maturity Score of SORMAS: full score as of July 2019



https://wiki.digitalsquare.io/index.php/What_are_Global_Goods

Acknowledgements to all Partners, Sponsors, Advisors and Contractors



sormas

Partners

- African Field Epidemiology Network (AFENET)
- Centers for Disease Control and Prevention (CDC)
- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
- Digital Square
- Ghana Community Network Services Limited (GCN)
- Ghana Health Service (GHS)
- Helmholtz Center for Infection Research (HZI) [leads]
- Nigerian Centre for Disease Control (NCDC)
- University College London (UCL)
- University of Maryland Baltimore, Nigeria (UMB)

Sponsors

- Basic Healthcare Provision Fund Nigeria (BHCF)
- Bill and Melinda Gates Foundation (BMG)
- Centers for Disease Control and Prevention (CDC)
- Centre for Infection Research (DZIF)
- European Union (EU)
- German Federal Ministry for Economic Cooperation and Development (BMZ)
- German Federal Ministry for Education and Research (BMBF)
- Helmholtz Center for Infection Research (HZI)
- Heimholtz Association (HGF)
- WHO-Country Office Nigeria
- World Bank

Contractors

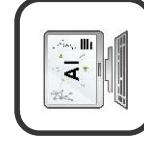
Symeda
Scigraphix
Crowdcode
Mirabilia
Elektro- & Datentechnik



Strategy on Future Concepts and Methods in SORMAS



Tuberculosis
+ 32 additional diseases



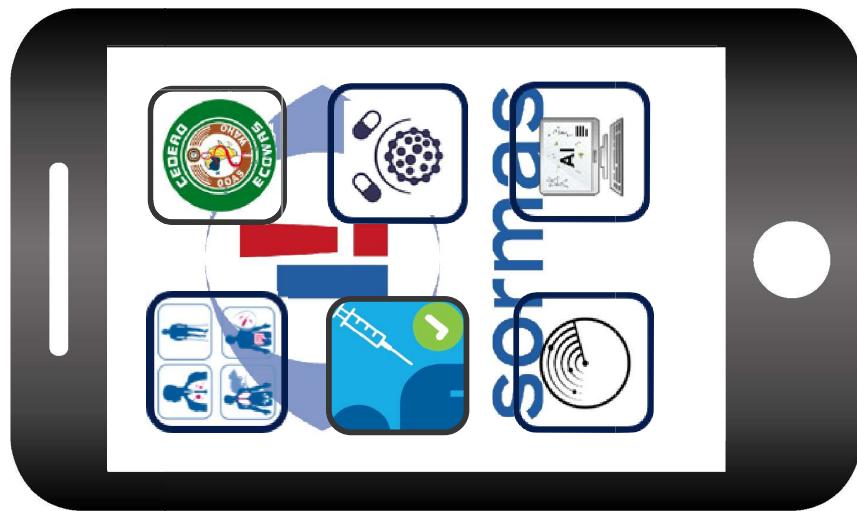
Regional Center for Surveillance and Disease Control
(RCSDC) of WAHO/CEDEAO

Vaccination campaign & vigilance

Antimicrobial resistance monitoring

Molecular surveillance

Predictive analytics & epidemic intelligence



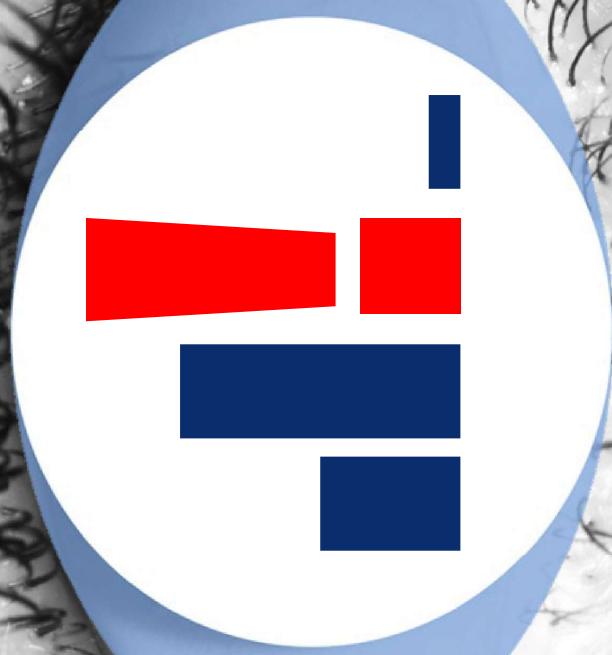
Challenges and Measures to Overcome them

- ⚠ Variable competency in disease control at local level
 - ✓ Interactive algorithms serve training and supervision
 - ✓ Training portfolio covers more than just SORMAS
- ⚠ Low contribution from industry (data bundles, hardware)
 - ✓ Negotiations between GAVI and telecom industry
 - ✓ Private Public Partnership (example Ghana)
- ⚠ Inappropriate private use of data plans by users (whatsapp, youtube)
 - ✓ Complete block of non-related apps
 - ✓ Considering in-built messenger service
- ⚠ Weak and irregular internet connectivity via mobile phone net
 - ✓ Development of novel “LBDS”-technology (Low Bandwidth Database Synchronization)
- ⚠ Duplicate parallel initiatives in eSurveillance
 - ✓ Full transparency of road map in SORMAS
 - ✓ Expansion of diseases in SORMAS
 - ✓ Back-up option for aggregate entry
 - ✓ Concept for integration of tools
 - ✓ Adherence to common standards
 - ✓ Intensive exchange between groups

Peer Reviewed Scientific Publications on or from SORMAS

1. Tom-Aba D et al: Digital Health Global Goods Maturity Assessment of the Surveillance Outbreak Response Management & Analysis System (SORMAS) JMIR public health and surveillance. 2020 in print
2. Silenou BC et al.. Use of Mobile Digital Surveillance Outbreak Response Management & Analysis System (SORMAS) for Human Monkeypox Outbreak, Nigeria, 2017–2019. *Emerg Infect Dis.* 2020;26(2):345-349.
3. Yinka-Ogunleye A et al. Outbreak of human monkeypox in Nigeria in 2017-18: a clinical and epidemiological report. *Lancet Infect Dis.* 2019;19(8):872-9
4. Tom-Aba T et al. User Evaluation Indicates High Quality of the Surveillance Outbreak Response Management and Analysis System (SORMAS) After Field Deployment in Nigeria in 2015 and 2018. *Studies in health technology and informatics.* 2018;253:233-7.
5. Tom-Aba et al. Assessing the Concepts and Designs of 58 Mobile Apps for the Management of the 2014-2015 West Africa Ebola Outbreak: Systematic Review. *JMIR public health and surveillance.* 2018;4(4):e68
6. Perscheid C,et al.. Ebola Outbreak Containment: Real-Time Task and Resource Coordination With SORMAS. *Frontiers in ICT.* 2018;5.
7. Adeoye O, et al. Implementing Surveillance and Outbreak Response Management and Analysis System (SORMAS) for Public Health in West Africa- Lessons Learnt and Future Direction. *IJTIDH.* 2017;22(2):1-17.
8. Moyer Det al. Taking Digital Innovation into the Field of Infectious Diseases: The Case of SORMAS®. In *Shaping the Digital Enterprise 2017* (pp. 219-236). Springer, Cham.
9. Fähnrich C et al. Surveillance and Outbreak Response Management System (SORMAS) to support the control of the Ebola virus disease outbreak in West Africa. *Euro Surveill.* 2015;20(12).

Surveillance **O**utbreak **R**esponse **M**anagement and **A**nalysis **S**ystem



www.SORMAS.org

Risks and challenges resulting from multiple parallel digital tools

- Duplication of separate data collection increases data discrepancies
- Duplication of workload for local officers
- Risk for incompleteness in all systems
- Unnecessary expenses for
 - Training
 - Hardware
 - Data plans
 - Data transfer
 - Quality control
 - Software maintenance, security measures, support



Envisioned diseases for immediate case based notification in Nigeria and digital implementation

Aggregate weekly (11) Envisioned

MAL - Malaria
 TYF - Typhoid fever
 AVH - Acute viral hepatitis
 NNT - Non-neonatal tetanus
 HIV - HIV/AIDS
 SCH - Schistosomiasis
 STH - Soil transmitted helminths
 TRY - Trypanosomiasis
 DWD - Diarrhea w. dehydration (<5)
 DWB - Diarrhoea with Blood (Shigella)
 SNB - Snake bite

Aggregate digital weekly (11) To be added into **SORMAS**

MAL - Malaria
 TYF - Typhoid fever
 AVH - Acute viral hepatitis
 NNT - Non-neonatal tetanus
 HIV - HIV/AIDS
 SCH - Schistosomiasis
 STH - Soil transmitted helminths
 TRY - Trypanosomiasis
 DWD - Diarrhea w. dehydration (<5)
 DWB - Diarrhoea with Blood (Shigella)
 SNB - Snake bite

Aggregate Monthly (9) Envisioned

AEF - Adverse event follow. immunisation (AEFI)
 DIM - Diabetes mellitus
 EPL - Epilepsy
 HYP - Hypertension
 SCD - Sickle cell disease
 INJ - Injuries (road traffic accidents)
 MNU - Malnutrition (<5 Y)
 SPN - Severe pneumonia (<5 Y)
 STI - Sexually transmitted infections

Aggregate Monthly (9) already covered in **DHS2**

AEF - Adverse event follow. immunisation (AEFI)
 DIM - Diabetes mellitus
 EPL - Epilepsy
 HYP - Hypertension
 SCD - Sickle cell disease
 INJ - Injuries (road traffic accidents)
 MNU - Malnutrition (<5 Y)
 SPN - Severe pneumonia (<5 Y)
 STI - Sexually transmitted infections

Envisioned diseases for immediate case based notification in Nigeria and digital implementation

Case based IDSR (24) Envisioned

Aggregate digital (8) already in MSERS 2019

Case based A (13) already digital in SORMAS 2019

| | |
|---------------------------------|----------------------------------------|
| CSM - Cerebrospinal Meningitis | CSM - Cerebrospinal Meningitis |
| CLR - Cholera | CLR - Cholera |
| MEA - Measles | MEA - Measles |
| YWF - Yellow Fever | YWF - Yellow Fever |
| LAF - Lassa fever | LAF - Lassa fever |
| DEF - Dengue | DEF - Dengue |
| INS - Influenza new subtype | INS - Influenza new subtype |
| GUW - Guinea Worm | GUW - Guinea Worm |
| AFP - Acute flaccid paralysis | AFP - Acute flaccid paralysis |
| MPX - Monkeypox | MPX - Monkeypox |
| RAB - Dog bites (Rabies) | RAB - Dog bites (Rabies) |
| RUV - Rubella | RUV - Rubella (congen. synd.) |
| TUB - Tuberculosis | RUV - Rubella |
| LEP - Leprosy | TUB - Tuberculosis |
| LYF - Lymphatic filariasis | LEP - Leprosy |
| BUU - Buruli ulcer | LYF - Lymphatic filariasis |
| PER - Pertussis | BUU - Buruli ulcer |
| NTE - Neonatal tetanus | PER - Pertussis |
| ONC - Onchocerciasis | NTE - Neonatal tetanus |
| DOP - Diphtheria | ONC - Onchocerciasis |
| TRA - Trachoma | DOP - Diphtheria |
| YAW - Yaws and endemic syphilis | TRA - Trachoma |
| MAD - Maternal deaths | YAW - Yaws and endemic syphilis |
| PED - Perinatal deaths | MAD - Maternal deaths |
| | PED - Perinatal deaths |

EVD - Ebola
ANT - Anthrax
PLA - Plague

Transition & Integration Phases for Digitalization of Case Based Surveillance in Nigeria

Status Quo (duplication):

- Total of envisioned case based
- Overlap and redundancy between MSERS and SORMAS
- Case based missing in any of the digital systems

Phase 1 (alignment and integration):

- SORMAS adds case based GW & AFP
- SORMAS includes mSERS-app for aggregate notification
- MSERS adds all aggregate diseases
- Wherever SORMAS runs
 - aggregate diseases are entered in SORMAS via mSERS app
 - only one mobile device needed per LGA

Phase 2 (transition):

- SORMAS adds all remaining case based diseases
- SORMAS covers all remaining diseases as aggregate
- MSERS covers all diseases as aggregate
- Wherever SORMAS runs
 - only one mobile device needed per LGA
 - integrated mSERS app via SORMAS for remaining aggregate diseases
 - Excel optional

Phase 3 (full integration):

- SORMAS covers all case based diseases
- integrated mSERS app via SORMAS for all aggregate diseases
- Paper based optional as back up

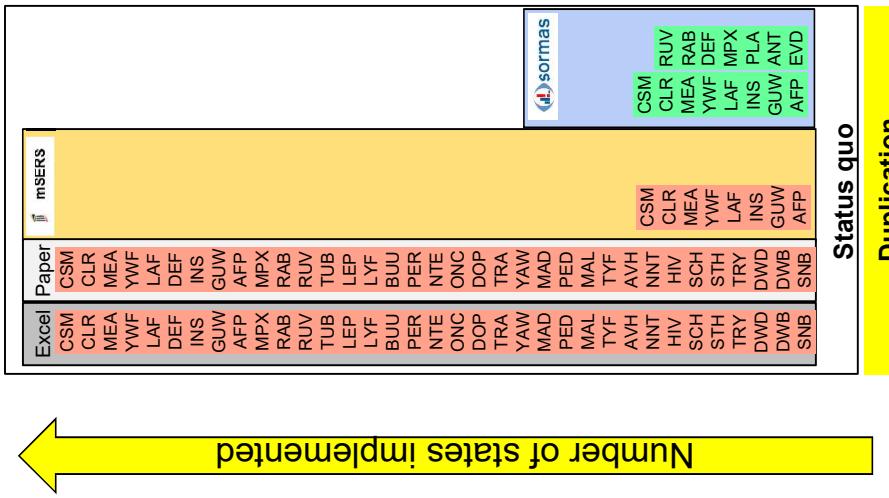
24 diseases
6-8 diseases
12 diseases

12+2 diseases
20 diseases
22 diseases

24+3 diseases
11 diseases
34 diseases

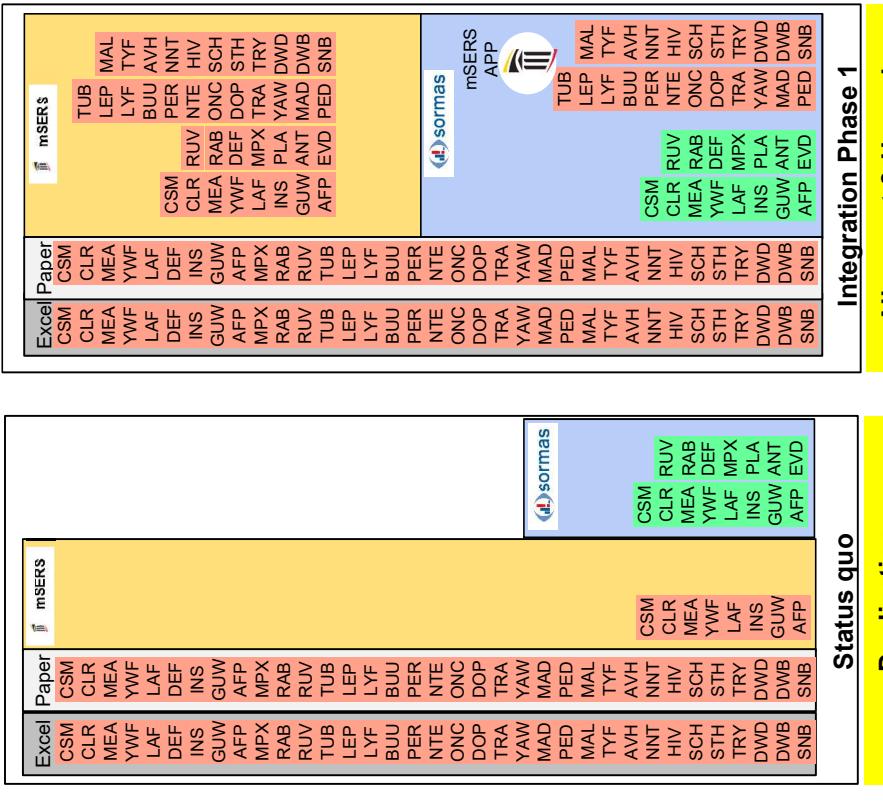
24+2 diseases
11 diseases

Transition & Integration Phases for Digitalization of Case Based Surveillance in Nigeria



= case based
= aggregate

Transition & Integration Phases for Digitalization of Case Based Surveillance in Nigeria



Number of states implemented

Transition & Integration Phases for Digitalization of Case Based Surveillance in Nigeria

| | mSERS | | | | | | | | | | | | | | | | | |
|-------|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Paper | CSM | CLR | MEA | YWF | LAF | DEF | INS | GUW | APP | MPX | RAB | TRA | TRY | INS | PLA | YAW | DWD | TUB |
| | CSM | CLR | MEA | YWF | LAF | DEF | INS | GUW | APP | MPX | RAB | TRA | TRY | INS | PLA | YAW | DWD | LYF |
| | CSM | CLR | MEA | YWF | LAF | DEF | INS | GUW | APP | MPX | RAB | TRA | TRY | INS | PLA | YAW | DWD | BUU |
| | CSM | CLR | MEA | YWF | LAF | DEF | INS | GUW | APP | MPX | RAB | TRA | TRY | INS | PLA | YAW | DWD | PER |
| | CSM | CLR | MEA | YWF | LAF | DEF | INS | GUW | APP | MPX | RAB | TRA | TRY | INS | PLA | YAW | DWD | NTE |
| | CSM | CLR | MEA | YWF | LAF | DEF | INS | GUW | APP | MPX | RAB | TRA | TRY | INS | PLA | YAW | DWD | AVH |
| | CSM | CLR | MEA | YWF | LAF | DEF | INS | GUW | APP | MPX | RAB | TRA | TRY | INS | PLA | YAW | DWD | ONC |
| | CSM | CLR | MEA | YWF | LAF | DEF | INS | GUW | APP | MPX | RAB | TRA | TRY | INS | PLA | YAW | DWD | SCH |
| | CSM | CLR | MEA | YWF | LAF | DEF | INS | GUW | APP | MPX | RAB | TRA | TRY | INS | PLA | YAW | DWD | DOP |
| | CSM | CLR | MEA | YWF | LAF | DEF | INS | GUW | APP | MPX | RAB | TRA | TRY | INS | PLA | YAW | DWD | STH |
| | CSM | CLR | MEA | YWF | LAF | DEF | INS | GUW | APP | MPX | RAB | TRA | TRY | INS | PLA | YAW | DWD | TRY |
| | CSM | CLR | MEA | YWF | LAF | DEF | INS | GUW | APP | MPX | RAB | TRA | TRY | INS | PLA | YAW | DWD | DWB |
| | CSM | CLR | MEA | YWF | LAF | DEF | INS | GUW | APP | MPX | RAB | TRA | TRY | INS | PLA | YAW | DWD | SNB |
| | CSM | CLR | MEA | YWF | LAF | DEF | INS | GUW | APP | MPX | RAB | TRA | TRY | INS | PLA | YAW | DWD | EVD |
| | CSM | CLR | MEA | YWF | LAF | DEF | INS | GUW | APP | MPX | RAB | TRA | TRY | INS | PLA | YAW | DWD | PED |



Number of states implemented

| | mSERS | | | | | | | | | | | | | | | | | |
|-------|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
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| | CSM | CLR | MEA | YWF | LAF | DEF | INS | GUW | APP | MPX | RAB | TRA | TRY | INS | PLA | YAW | DWD | BUU |
| | CSM | CLR | MEA | YWF | LAF | DEF | INS | GUW | APP | MPX | RAB | TRA | TRY | INS | PLA | YAW | DWD | PER |
| | CSM | CLR | MEA | YWF | LAF | DEF | INS | GUW | APP | MPX | RAB | TRA | TRY | INS | PLA | YAW | DWD | NTE |
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| | CSM | CLR | MEA | YWF | LAF | DEF | INS | GUW | APP | MPX | RAB | TRA | TRY | INS | PLA | YAW | DWD | PED |

| | mSERS | | | | | | | | | | | | | | | | | |
|-------|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
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| | CSM | CLR | MEA | YWF | LAF | DEF | INS | GUW | APP | MPX | RAB | TRA | TRY | INS | PLA | YAW | DWD | NTE |
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| | CSM | CLR | MEA | YWF | LAF | DEF | INS | GUW | APP | MPX | RAB | TRA | TRY | INS | PLA | YAW | DWD | PED |

Status quo

Duplication

Integration Phase 1

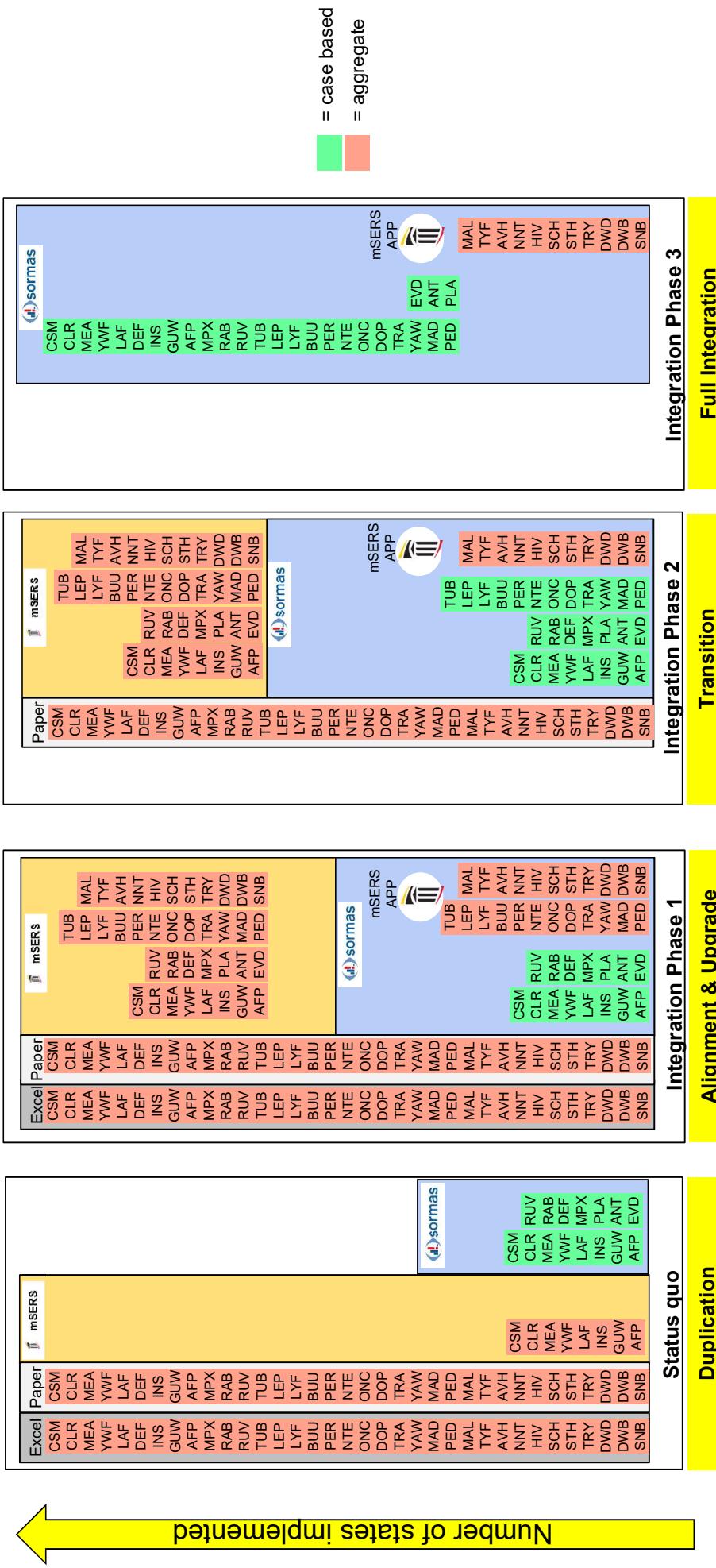
Alignment & Upgrade

Integration Phase 2

Transition



Transition & Integration Phases for Digitalization of Case Based Surveillance in Nigeria

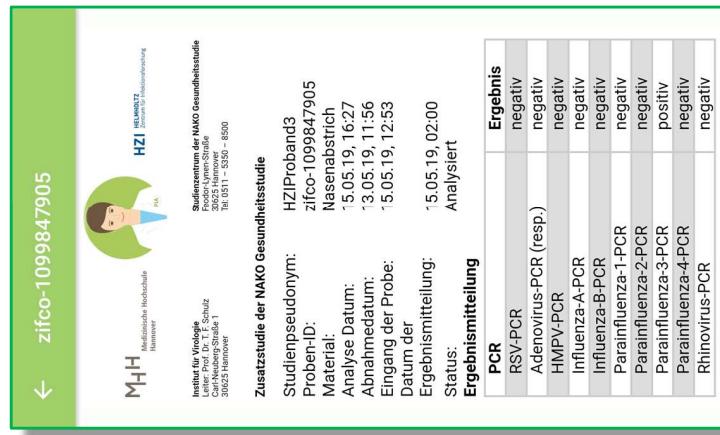
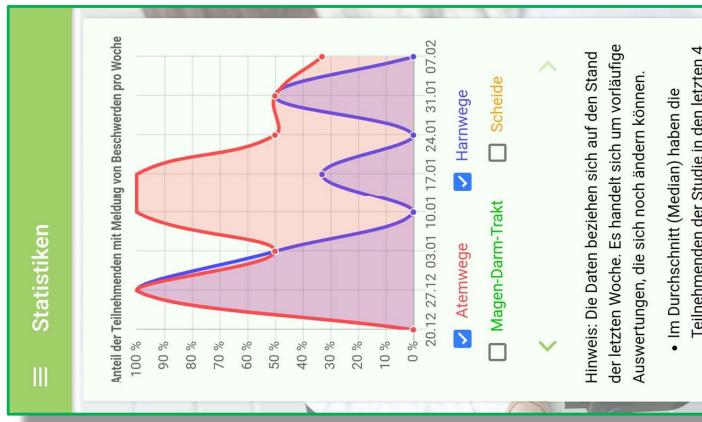


Advantages of phased integration approach

- Digital aggregate reporting already improves timeliness, while case based digitalization is being developed
- Benefiting from added value of mSERS in
 - Competency in aggregate digital reporting
 - Country wide coverage
- Benefiting from added value of SORMAS in
 - Case based reporting
 - Bi-directional information exchange
 - Response management process
 - Established data feed into DHIS2
- Redundancy reduced in phases allows back-up option
- Resources reduced for
 - Hardware (Phase 1-3)
 - Data plans (Phase 1-3)
 - Manual data transfer into Excel (Phase 2-3)
 - Software maintenance, security measures, support (Phase 3)
- Use case for alignment and integration of other digital tools

Mobile eResearch System PIA – App: Prospective Assessment of Incident Health Events

- Comprehensive data protection scheme & IT-security
- iOS, Android, Web-application
- Complex roles and specific access
- Integration of bio-samples e.g. in case of infection
- Real-time & personalized surveillance
- New topics easily implemented
- Gamification features
- Feedback for participants



Mobile eResearch System

PIA – App: Prospective Assessment of Incident Health Events

