Countrywide Mortality Surveillance for Action (COMSA) Sierra Leone: Lessons from year 1/2, plans for year 3 and transition planning for sustainability

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www.comsasl.org

Ministry of Health and Sanitation

Njala University, University of Toronto

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MINISTRY OF HEALTH AND SANITATION
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OBJECTIVES FOR TODAY

- Key results from COMSA Round 1 (Lancet Global Health Paper) and key achievements to date in capacity building- Prof. Ansumana
- Operational approaches, challenges for COMSA Round 2 and preparation for Round 3- Mr. Assalif
- Healthy Sierra Leone (HCS) Dried blood spot study results in urban Bo- Dr. Swaray
- COVID Serology results- Prof. Jha

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- Dr. Ansumana Presentation

Key messages (1): Substantive

- The Sierra Leone Sample Registration System (SL-SRS) provides reliable ongoing nationally representative cause of death data for Sierra Leone
- 63% of people in Sierra Leone die prematurely before age 70 years from preventable or treatable causes
- In 2020, 22% of all deaths in Sierra Leone were due to malaria, which was the leading cause of death for all age groups except neonates
- About 1300 maternal deaths occurred with MMR of 510 (vs 1120 from WHO) per 100,000 livebirths and hemorrhage as the leading cause of death
- Efforts are needed to reduce stillbirths

DETAILS IN LANCET GLOBAL HEALTH PAPER

Background & rationale

- Sierra Leone's life expectancy at birth was among the lowest in the world at 54 years in 2019
- High under-5 Child (122/1000 livebirths) and estimated maternal mortality (1120/100,000 livebirths) rates in Sierra Leone expose the burden of premature deaths (death before age 70 years) in the country, but cause-specific death rates mostly unknown
- Only 25% of all deaths are reported through a centralized vital statistics system
- Many deaths occur outside health facilities (mostly at home) without medical attention or documentation of cause of death

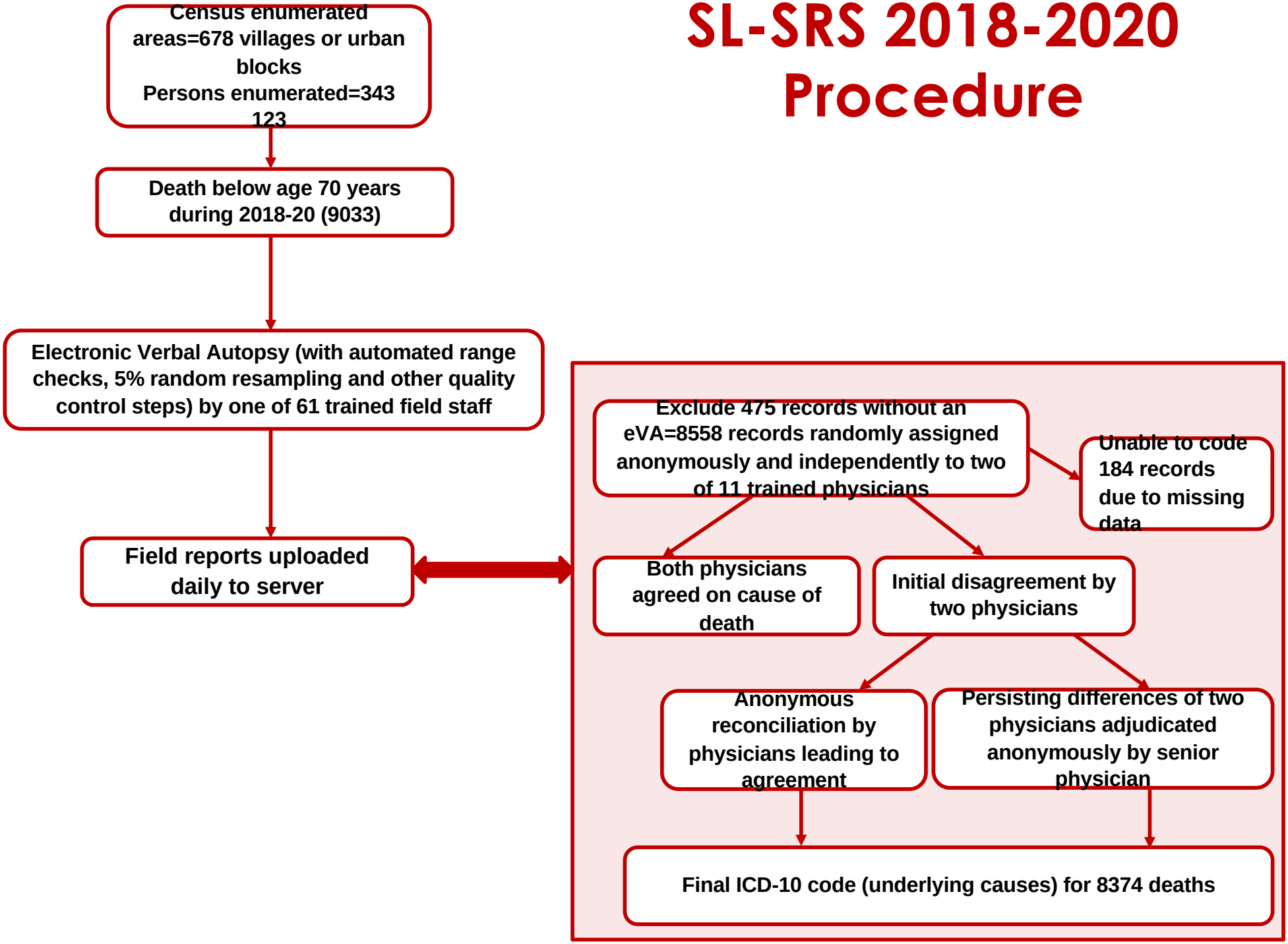
Methodology

- SL-SRS covers about 5% of the total population with regional, district and urban/rural level representativeness using **678 census** enumeration areas with total population of **343,000**

- The SL-SRS instrument has three modules:
  - Enumeration – collects demographic and vital data
  - Electronic Verbal Autopsy - to investigate signs, symptoms and events preceding a death in the enumerated household
  - Re-sampling – random re-check for quality assurance/accuracy

- Two stage survey:
  - sample enumeration
  - e-VA phase in households with reported deaths below age 70

SL-SRS 2018-2020 Procedure



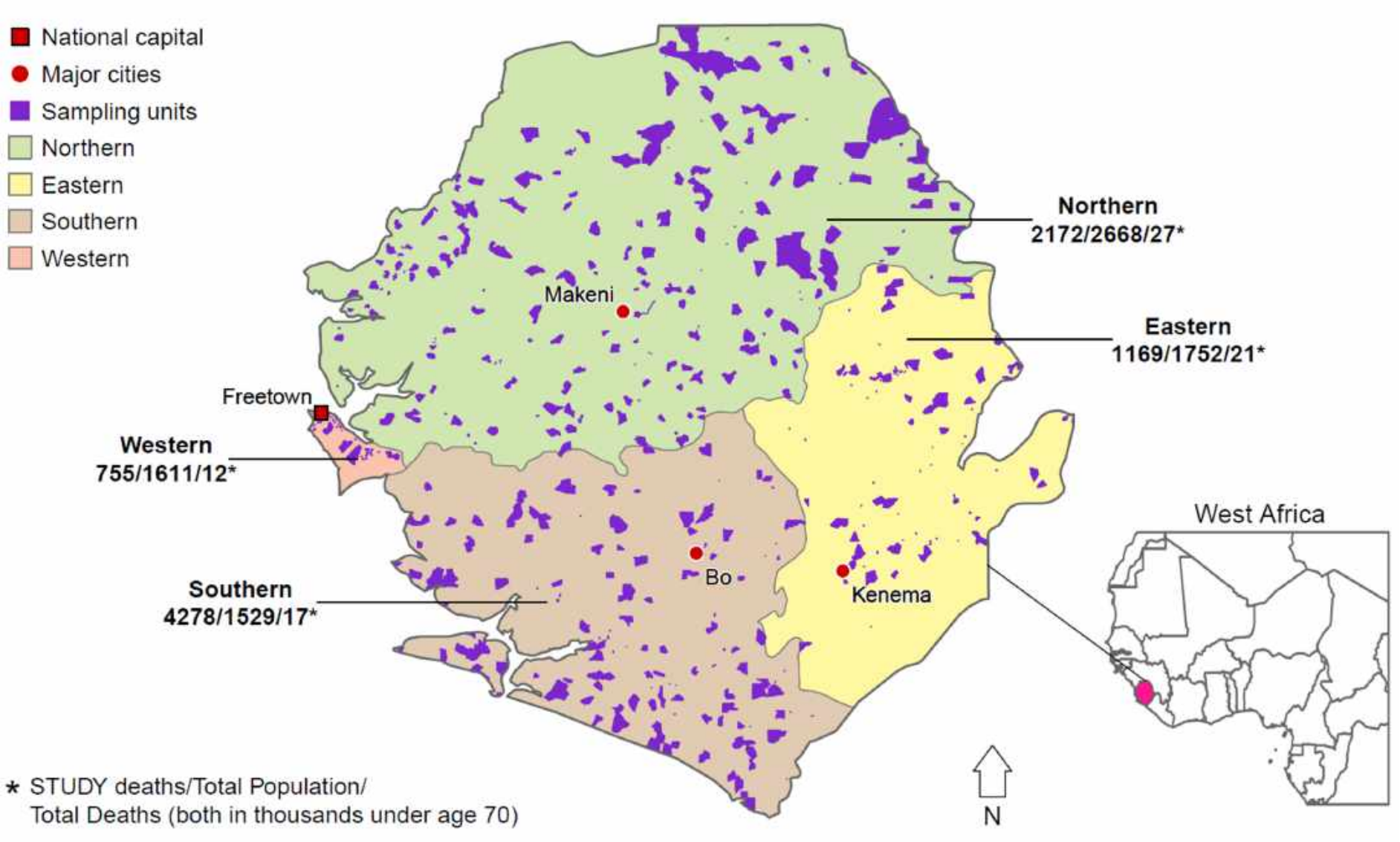
What is a Verbal Autopsy?

- Investigation of signs, symptoms and events that led to a person's death (based on the 2016 WHO instrument)
- Structured interview with a respondent who lived with the deceased
- Surveyor gathers clear and reliable details and writes a narrative of the events

National livebirths and deaths

- Sex-specific national absolute deaths and livebirths were derived using two five-year (2015-19 and 2020-24) estimates from the 2019 UN World Population Prospects
  - Children
    - Neonates using UNICEF 2019 neonatal mortality rate
    - 1 month to 4 years
    - 5 to 14 years
  - Adult
    - 15 to 29 years
    - 30 to 69 years

Map of Sierra Leone showing enumeration areas and numbers of study deaths by regions (currently 4 but expanding to 5 regions in COMSA 2)



National maternal deaths in Sierra Leone

Maternal deaths in COMSA	141
% of annual female deaths (15-49 years)	9.6%
National annual female deaths (15-49 years)	13 660
Livebirths (2020)	258 100
Maternal mortality ratio (95% CI)	**510** (483-538) *
Absolute total maternal deaths (95% CI)	1317 (1247-1389) +
Leading causes of death	**%**
Hemorrhage	25%
Infection and sepsis	15%
Hypertensive disorders	9%

* WHO estimate of MMR in 2017: **1120**

+ eIDSR/maternal facility-based data **~580 maternal deaths in 2018/19**

Avoidable mortality estimates for three regions compared to the Western region for children age under 5 years and for ages 5 to 69 years

Leading causes of death for neonates and stillbirths in Sierra Leone, 2018-2020

415 neonatal deaths in COMSA	National annual deaths (%)	Risk of death %
Birth asphyxia/birth trauma	2550 (32)	1%
Sepsis and other infections	2418 (30)	0.9%
Prematurity and low birthweight	1596 (20)	0.6%
Non-communicable causes	531 (7)	0.2%
Pneumonia	267 (3)	0.1%
Total neonatal deaths	**8018 (100)**	**3.1%**
154 stillbirths in COMSA		
Stillbirths	4104 (34)	

Leading causes of death for children 1-59 months in Sierra Leone, 2018-2020

2322 deaths at 1-59 months in COMSA	National annual deaths (%)	Period risk %
Malaria	7417 (38)	2.9%
Other infectious and parasitic	5545 (28)	2.1%
Pneumonia	1481 (7)	0.6%
Diarrhea	1606 (8)	0.6%
Non-communicable causes	697 (4)	0.3%
Injuries	697 (4)	0.3%
Meningitis/encephalitis	319 (2)	0.1%
Measles	243 (1)	0.1%
Total 1-59 months	**19704 (100)**	**7.6%**

Leading causes of death among children 5-14 years in Sierra Leone, 2018-2020

754 deaths at 5-14 years in COMSA	National annual deaths (%)	Period risk %
Malaria	2119 (34)	1.0%
Infections and parasitic causes	1464 (23)	0.7%
Non-communicable causes	643 (10)	0.3%
Injuries	652 (10)	0.3%
Diarrhea	496 (8)	0.2%
Pneumonia	221 (4)	0.1%
Sickle-cell disorders	285 (5)	0.1%
Meningitis/encephalitis	128 (2)	<0.1%
Total 5-14 years	**6227 (100)**	**2.9%**

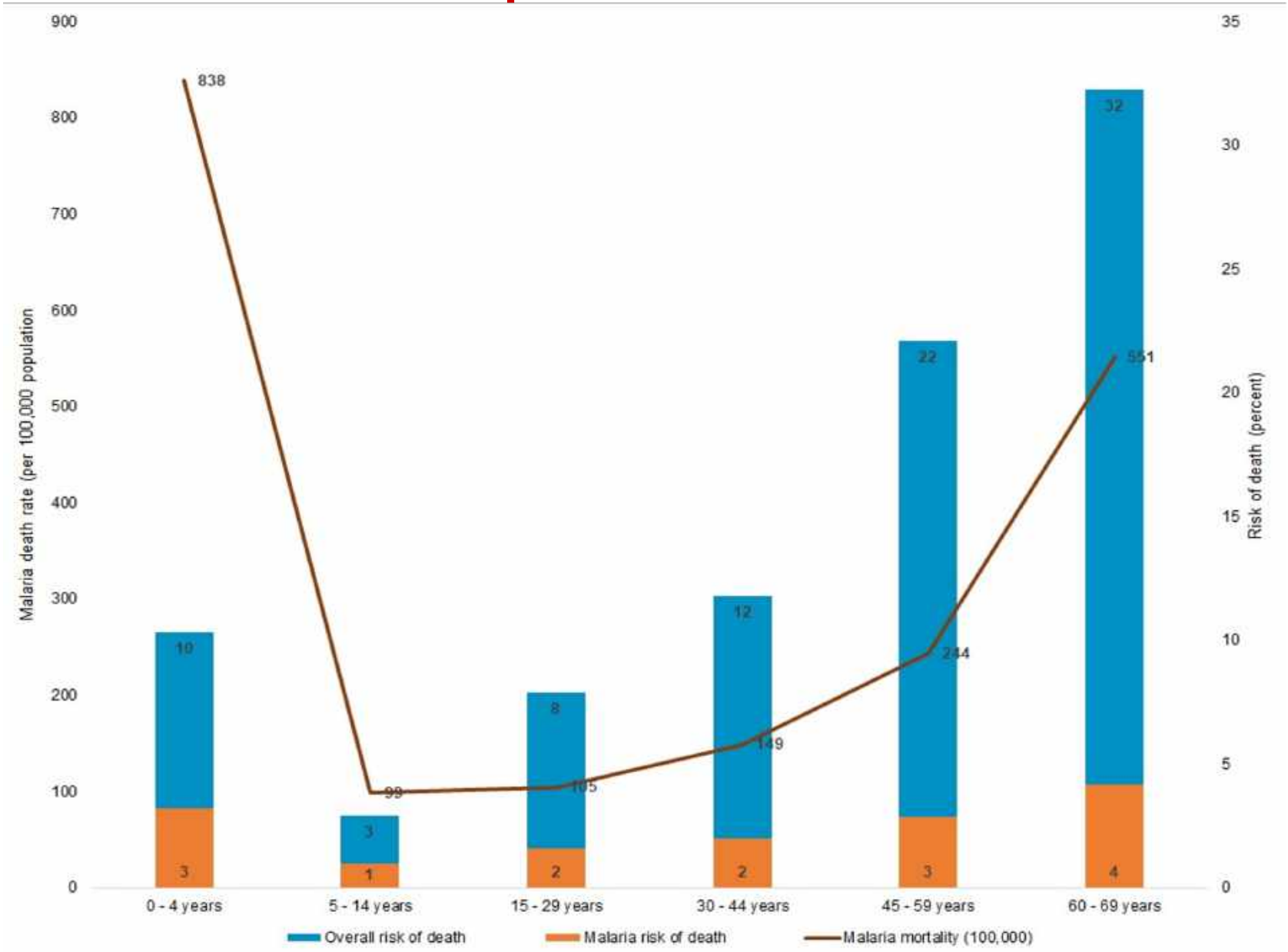
Leading causes of death among adults 15-29 years in Sierra Leone, 2018-2020

1192 deaths at 15-29 years in COMSA	National annual deaths (%)	Period risk %
Malaria	2483 (20)	1.6%
Other infections	1311 (11)	0.9%
Injuries	1181 (10)	0.8%
Road traffic accidents	797 (6)	0.6%
Diarrhea	664 (5)	0.5%
Acute pneumonia	533 (4)	0.3%
All vascular causes	473 (4)	0.3%
HIV/AIDS and STIs	474 (4)	0.3%
Total 15-29 years	**12254 (100)**	**7.9%**

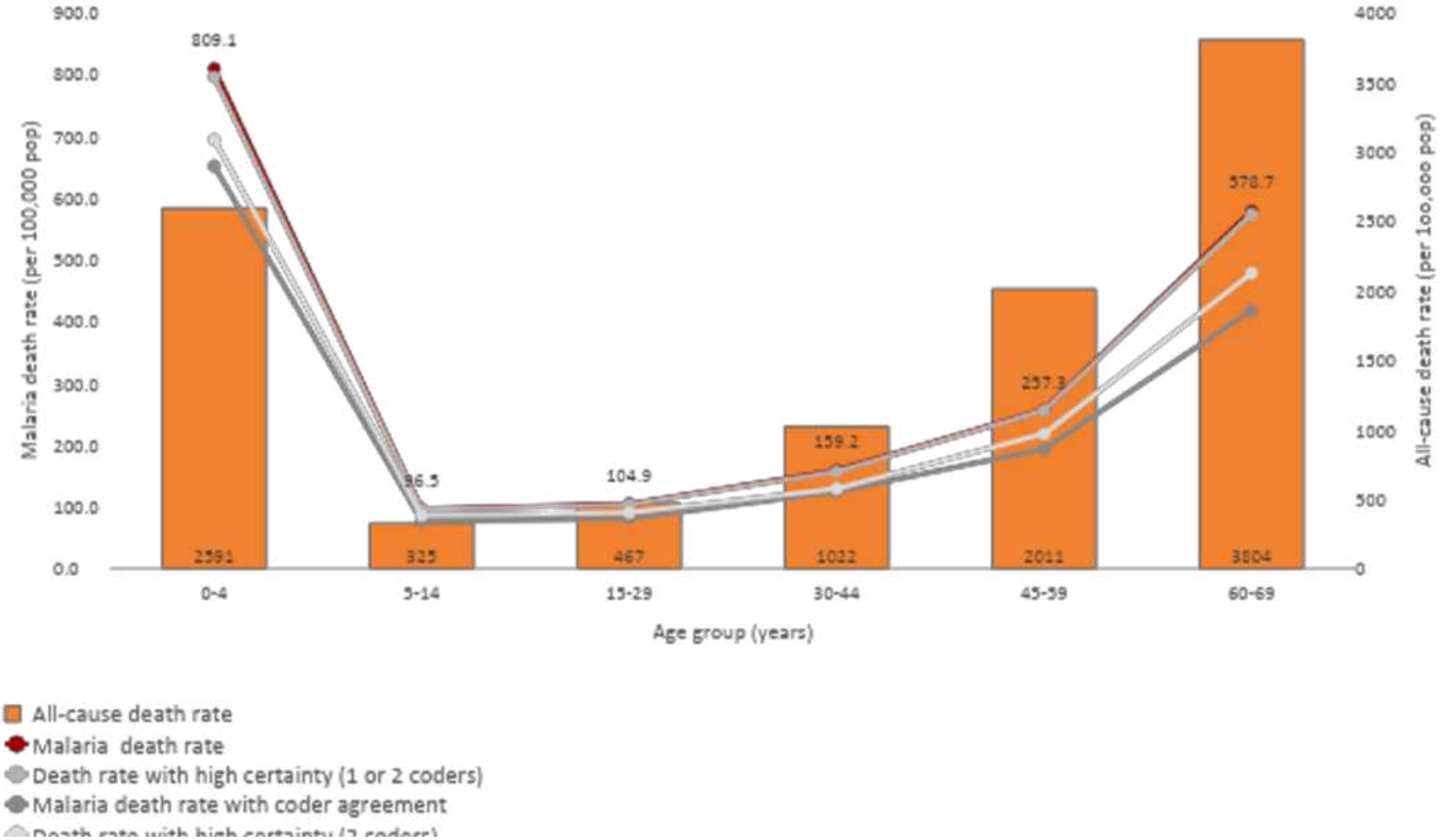
Leading causes of death among adults 30-69 years in Sierra Leone, 2018-2020

3536 deaths at 30-69 years in COMSA	National annual deaths (%)	Period risk %
Malaria	4392 (14)	7.6%
Cardiac/other vascular causes	3121 (10)	5.3%
Digestive diseases	3295 (11)	5.9%
Stroke	2503 (8)	4.3%
Injuries	1920 (6)	3.2%
Other infections	2294 (8)	4.3%
Diarrhea	1814 (6)	3.2%
Acute pneumonia	1487 (5)	2.7%
Total 30-69 years	**30736 (100)**	**53.5%**

Annual malaria mortality rate by age group in Sierra Leone – malaria was a leading cause of death in all age groups except neonates



Annual malaria mortality rates in Sierra Leone – similar age distribution when physician coders have agreement or high certainty in diagnosis



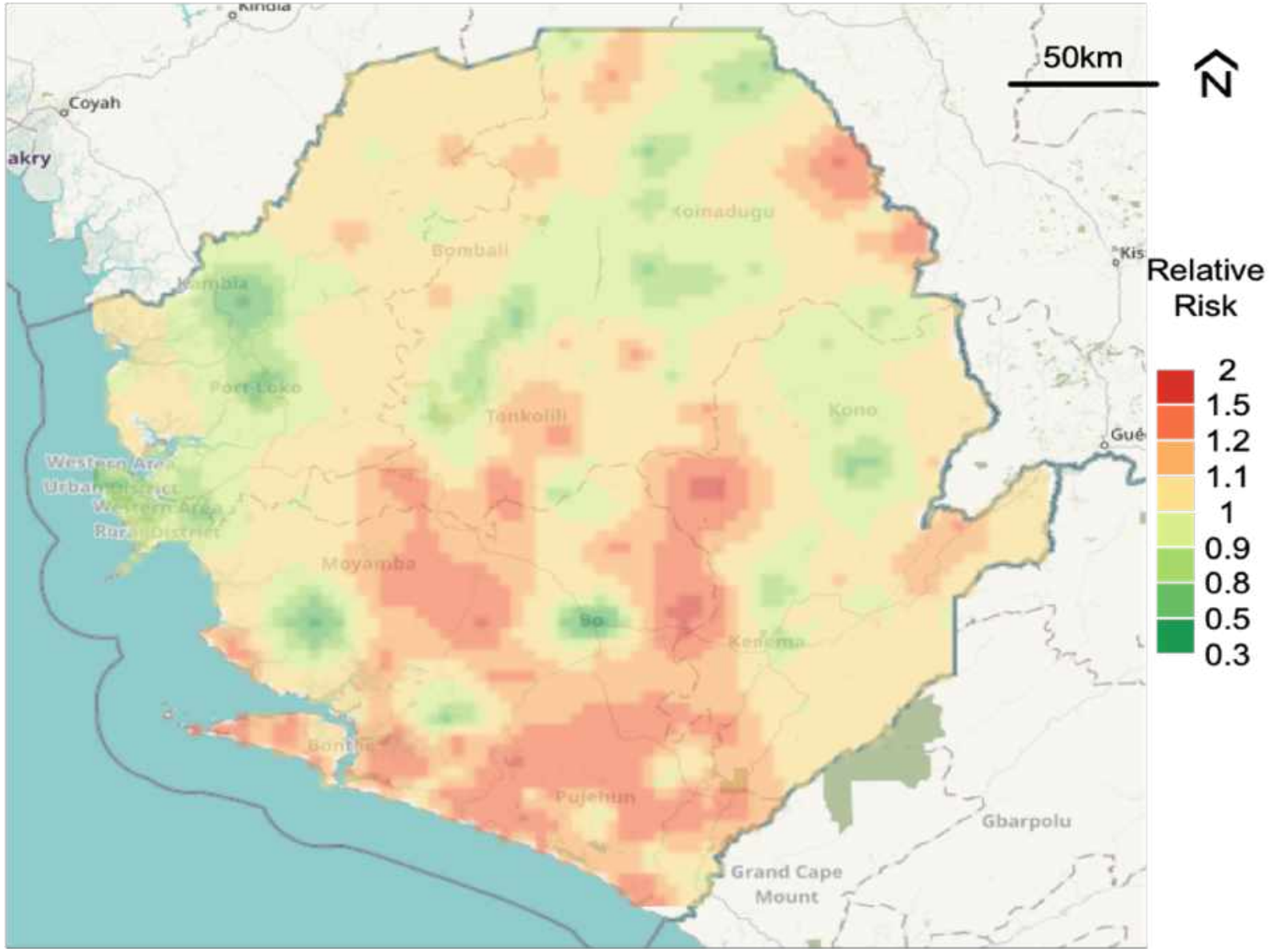
More than half of malaria deaths occurred in a hospital or after hospitalization

	Non-malaria deaths	%	Malaria deaths	%
Died in a hospital or health facility	2740/6473	42.3	891/1901	**46.9**
Died after discharge from a health facility	235/6473	3.6	158/1901	**8.3**
Had a malaria test	428/5617	7.6	566/1808	31.3
Any treatments received	4468/6457	69.2	1614/1899	84.9
Oral rehydration salts (n, % of treated)	1206/4468	27.0	690/1614	42.8
Intravenous fluids	2253/4468	50.4	801/1614	49.6
Blood transfusion	358/4468	8.0	159/1614	9.9
Injectable antibiotics	2234/4468	50.0	814/1614	50.4

Other COMSA achievements

- Partnership with CHAMPS- ~200 child deaths underwent MITS at Bo Hospital (plus earlier Makeni site), now moving to ~200 adult deaths in Bo
- Full round 1 data on www.comsasl.org, including individual data (Level 2), with efforts planned for use by MPH/other students
- Working groups on maternal/child health and malaria established, new group on COVID and injuries + COMSA newsletters and WhatsApp group launched
- National training capacity established at Njala University, ~ 80 staff trained in e-VA and DBS methods
  - Advanced Course on Death Certification (facility-based cause of death) completed by ~150 CHOs/MDs
  - COMSA MPH Fellowship program to be launched in Sept 2022
  - National Mortality Symposium in Nov 2022
- Global Fellowships- including D.Ph. to Dr. Marsh from Mastercard Foundation at U of Toronto
- Partnerships with World Bank on Healthy Longevity and Gender projects
- COMSA/HCS will be core training platform for Njala School of Public Health and Njala Center for Health Research and Implementation

Spatial distribution of malaria death risks (age<70 years) in Sierra Leone, 2018-20



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THANK YOU

- Mr. Assalif Presentation

Major timelines for COMSA Round 2 / 3

- COMSA Round 2 launched in April 2021
  - TO DATE 351/661 sampling units done, >3800 deaths dually coded
- July 1 Dashboard fully operational
- Sept 15 Round 2 COMSA completed
- Oct 1 Review of field worker quality, and physician coding
- Oct 1-31 Reappointment training and refresher training
- Nov 1 Launch of COMSA Round 3/release of COMSA round 2
- June 1/23 COMSA Round 3 work completed
- July 1/23 COMSA Round 3 data on www.comsasl.org
- Dec 31/23 End of BMGF support, start of COMSA Round 4

Quality assurance is key to results remaining credible

IT-based quality assurance

- GPS tracking (and updating maps from Census 2021)
- Interview recordings: central audio review (every surveyor per week, random)
- Area resampling
- Monitor work loads and pace of work using dashboard

Field-based quality assurance

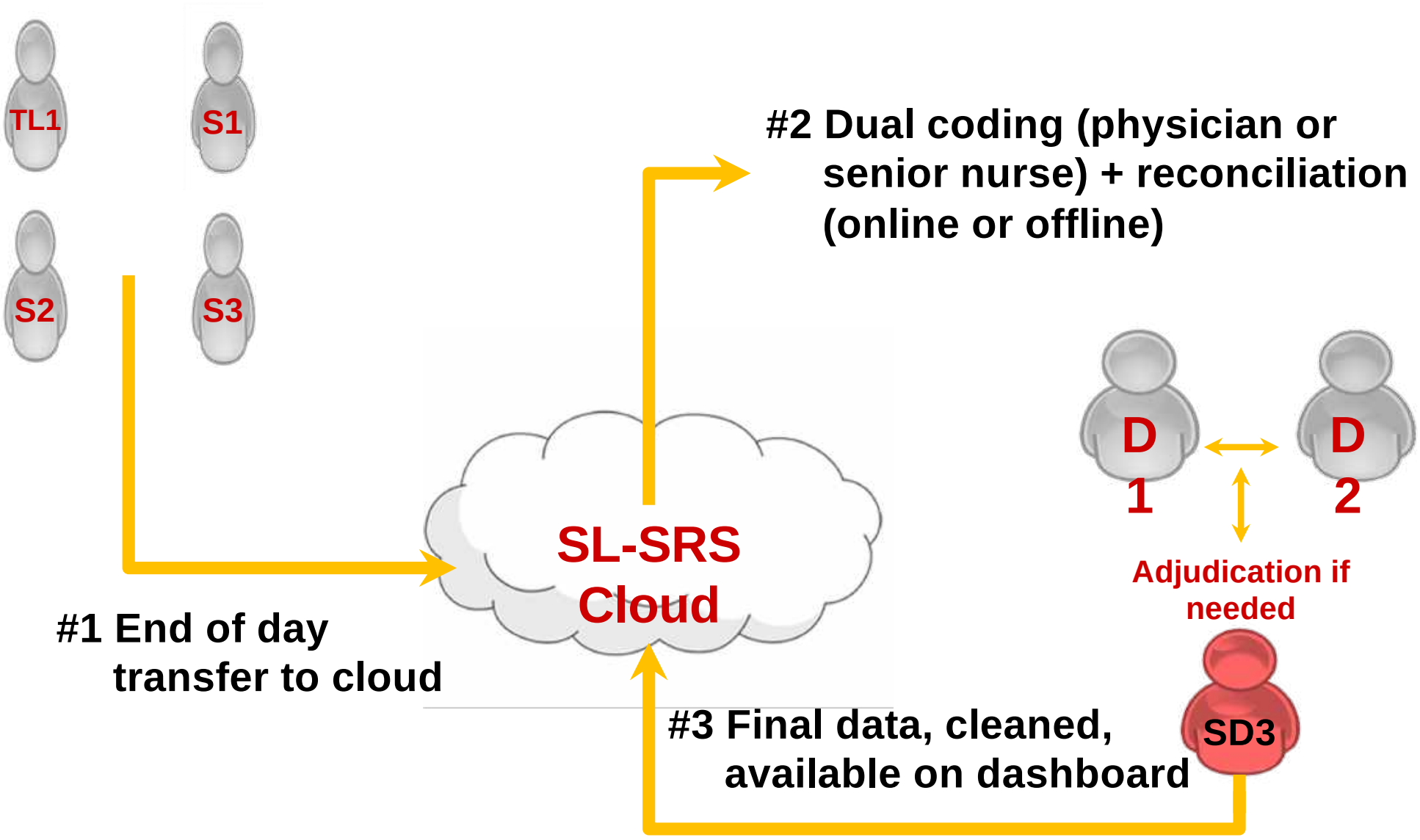
- Random field spot checks (ensure all team members present, confirm number of houses, observe data collection)
- Narrative reviews
- Weekly experience sharing meetings

Improvements in COMSA in Phase 2

- More focused teams- 45 field staff versus 60
- Re-survey areas with problematic enumeration: establish stable baseline, tested via rigorous demographic profiling, for COMSA Round 3 onward
- Include deaths >70 years, partly to capture COVID
- Automate/semi-automate the Dashboard key quality assurance steps
- Pilot addition of algorithms to physician coding panel has begun to add to Round 3 (Robot-assisted Physician Initiated Diagnoses or RAPID)

Typical timeline for each survey team of 4

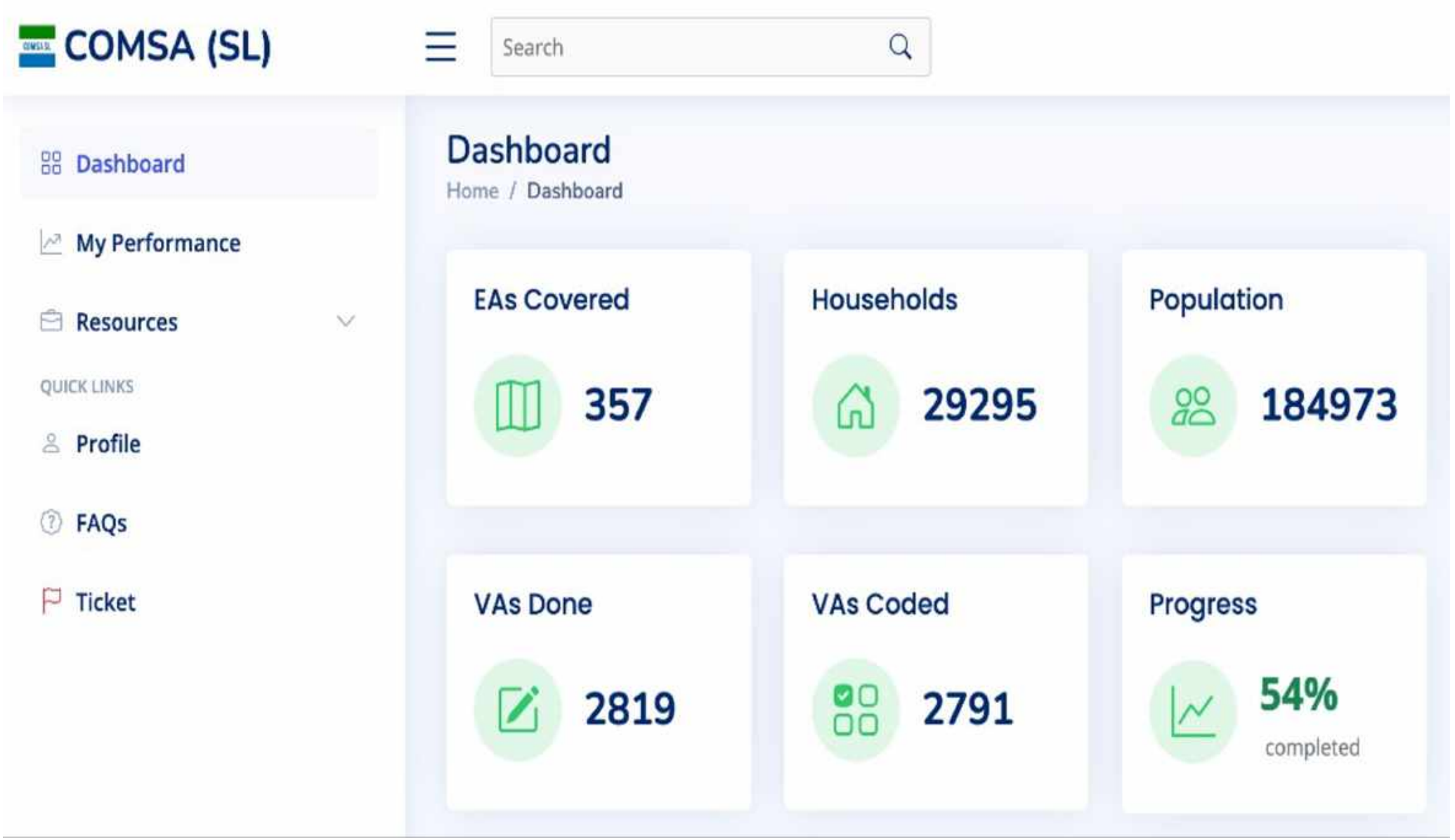
- 680 EAs to cover; on average each EA will take 4 days to finish
- With **11 teams of 4,** each team would take **~40** weeks of continuous field work to cover whole country
- **Optimal schedule in each EA (village) or urban EA**
  - **Day 1- sensitize local leaders/draw maps**
  - **Day 2 & 3 - Enumerate 100 households (18-25 each surveyor), do VA - about 1-5 per surveyor**
  - **Day 4- Resampling (1-2 per surveyor- i.e. 100% to start) plus mop-up of closed areas (locked houses)**



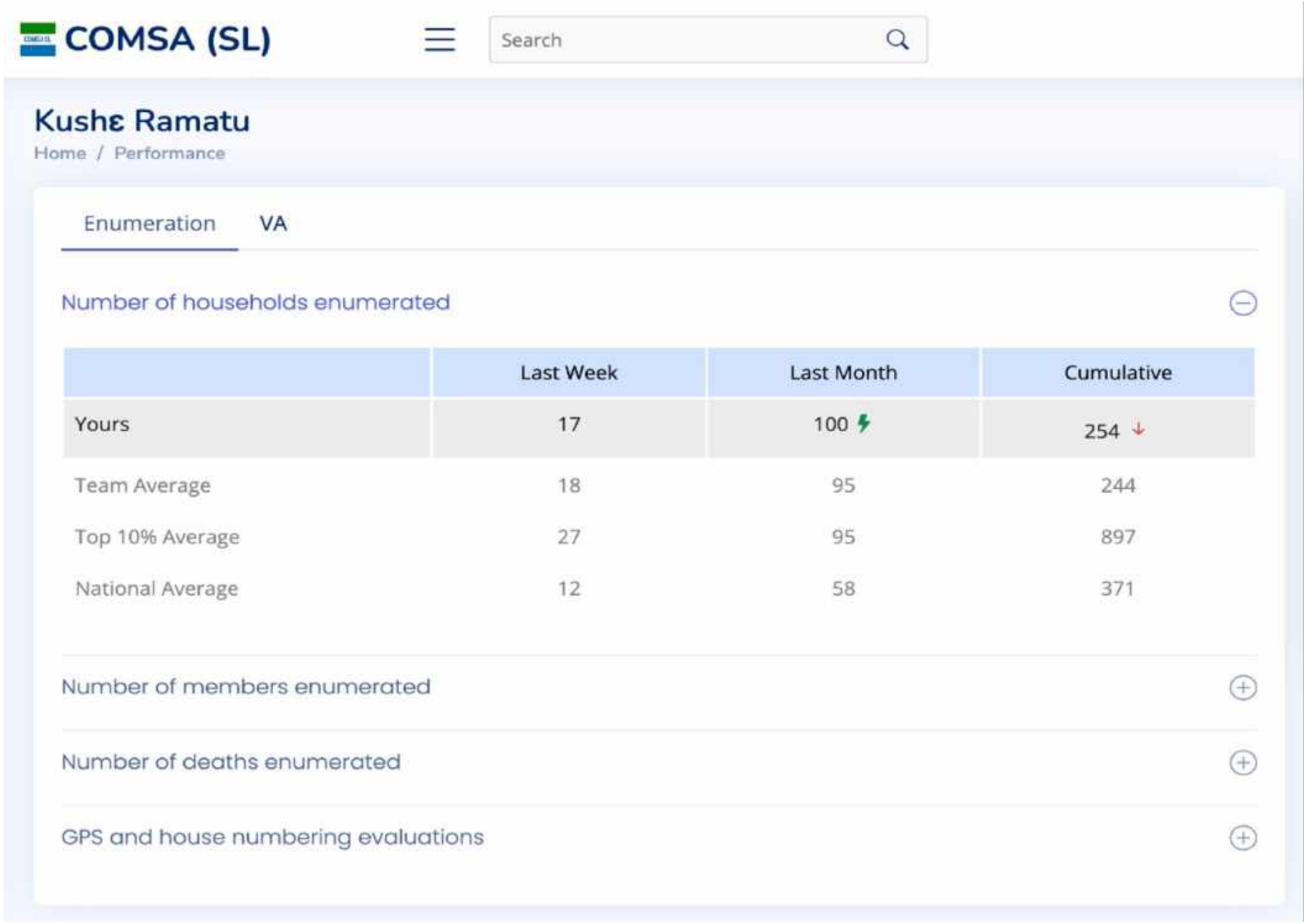
FULLY ELECTRONIC FIELD WORK

Goal: field work to final COD in <15 days

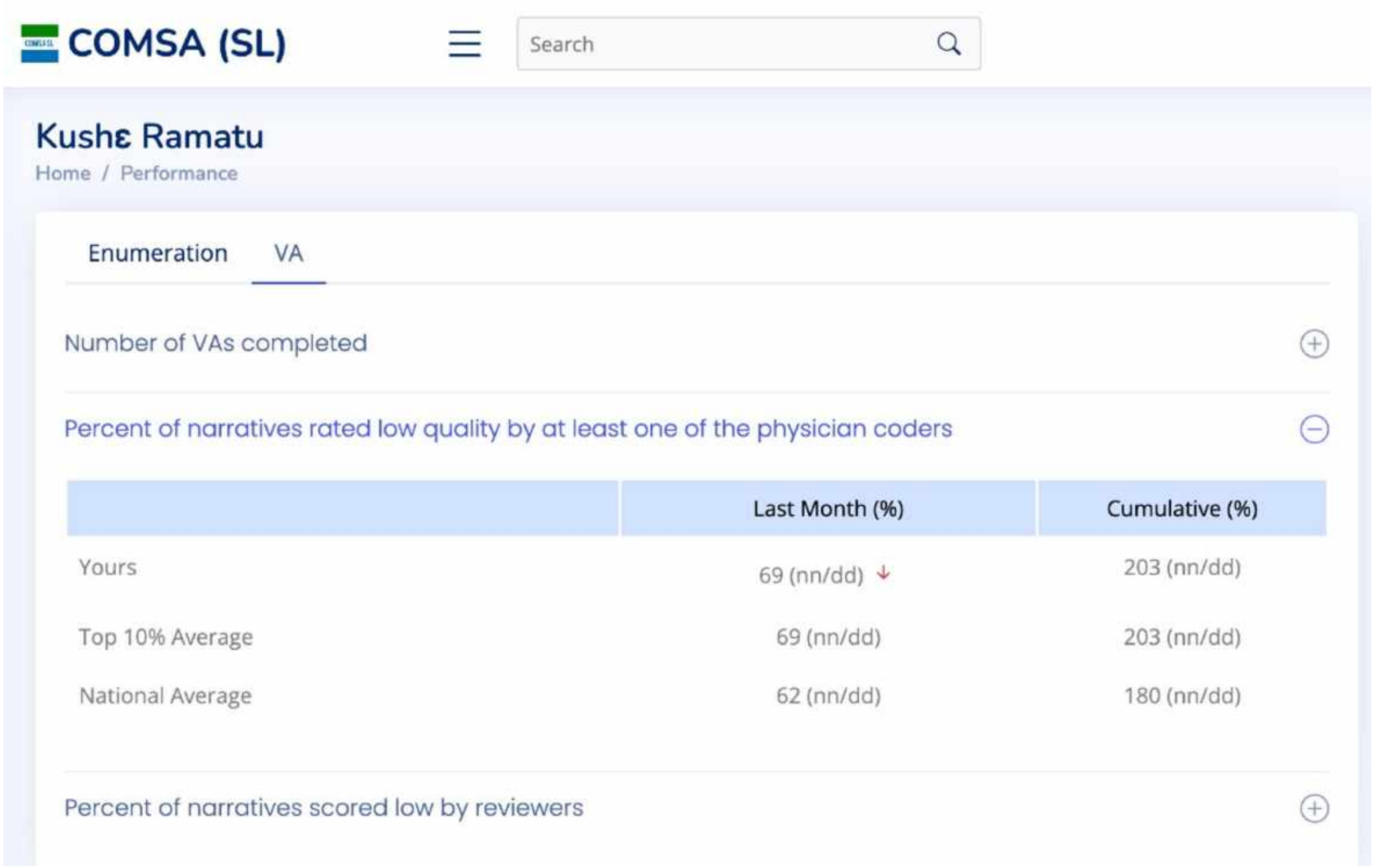
Dashboard (team/overview)



Dashboard (surveyor quantity)

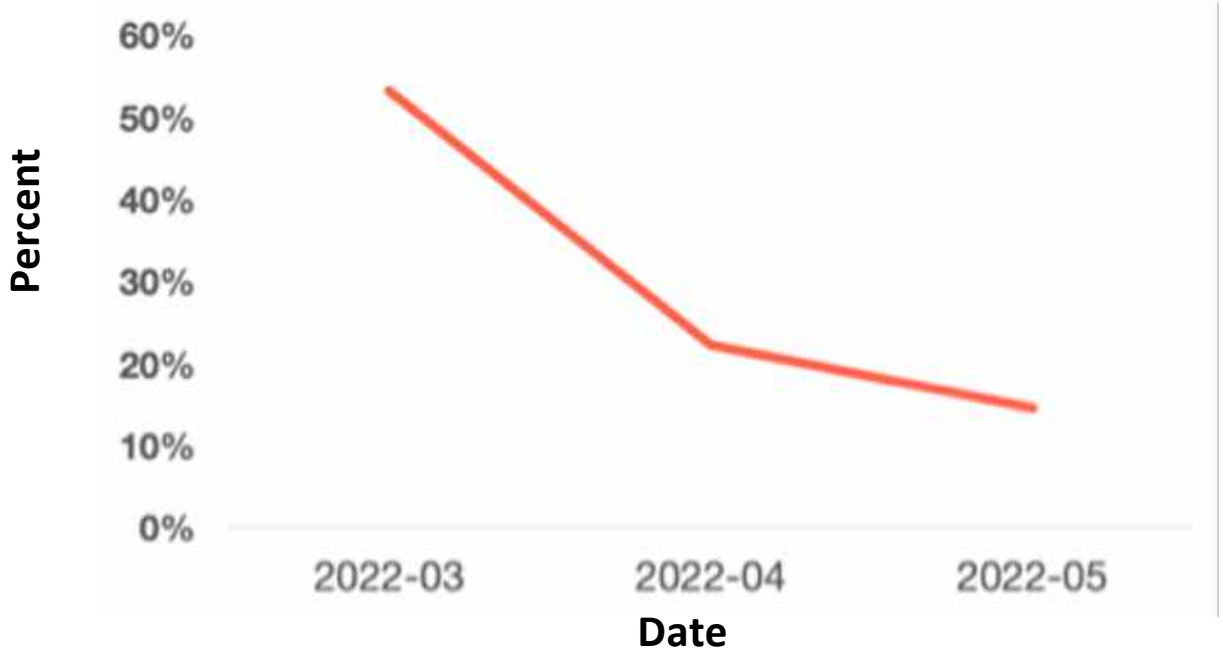


Dashboard (surveyor quality)



Have interventions implemented since early 2022 improved quality?

- Regional supervisor and regular reviews believe YES
- Change in work culture among surveyors- “shortcuts no longer acceptable and will be caught” “strong teams need all”
- **Reduction in % of e-VAs that were rated as “low quality”**



Key messages (2): Sustainability

- The SL-SRS requires continuous attention to quality (especially with changes in management or in staff)
- Stability of the sample frame over time
  - Take into account migration, changing city boundaries
  - Improve maps for use (Rely on 2021 Mid-Census) updates also
- Human resource- motivate staff to do better quality, and let go staff doing poor quality field work (hence IT systems are needed to track quality)
- Ongoing training and re-training- Establish Njala University as national/regional training center
- Financial sustainability is good- major cost is of field surveyors, with IT and infrastructure costs falling over time

- Dr. Swaray Presentation

Healthy Sierra Leone (HCS) Dried blood spot study: Goal and approach

- Investigate the prevalence of exposure (antibodies) to various pathogens including COVID-19 infection using the COMSA platform
- COMSA sample frame: 46 enumeration areas in Bo District with ~8,000 people: ~4000 urban adults, ~3000 rural adults, ~1000 kids): 17 dedicated Surveyors
- To date: all urban and 1500 rural adults completed, rest plus kids to be completed by Aug 1, 2023
- Teams of two trained field staff enumerate/consent households and implement a general health check up about current health, blood pressure, exercise, smoking, alcohol, mental health concerns, and COVID experience
- Anthropometric measurements- two x BP, height, weight, waist hip ratio, body impedance (fat) and grip strength
- Collect DBS samples (5 spots Whatman paper for central Multiplex analyses), plus anemia/diabetes instant results
- Participants representative for age, smoking, BMI, BP vs whole of Sierra Leone

Pathogens: preliminary list by priority (June 8)

Viruses	Parasites	Bacteria
High priority	**High priority**	**High priority**
SARS-CoV-2 inc. variants	Plasmodium falciparum	Treponema pallidum
Lassa fever	Plasmodium malariae	Neisseria meningitidis
Yellow fever	Plasmodium ovale	Salmonella Typhi
Monkeypox	Plasmodium vivax	**Medium-high priority**
Ebola Virus	**Medium-high priority**	Chlamydia trachomatis
Marburg virus	Wuchereria bancrofti	Vibrio cholerae
Hepatitis B/C (E?)	Onchocerca volvulus	**Medium-low/low priority**
Medium-high priority	S mansoni/S. haematobium	Clostridium tetani
Rift Valley fever virus	Strongyloides stercoralis	Corynebacterium diphtheriae
Dengue	Fasciola hepatica	Orientia tsutsugamushi
Chikungunya	Taenia solium	Tetanus toxoid
Medium-low/low priority	**Medium-low/low priority**	Diphtheria toxoid
HSV1/2	Toxocara canis	
Measles	Cryptosporidium parvum	
Varicella Zoster	Giardia lamblia	
Rubella	Toxoplasma gondii	
Epstein Barr Virus	Ascaris	
Crimean Congo hmrgic fever?		

Next steps: Literature review of each, discussion of bead availability

Main laboratory goals

- Establish multiplex assays on the Luminex MagPix platform

Fig. 1: MagPix Luminex Platform
(Source: Luminexcorp.com)

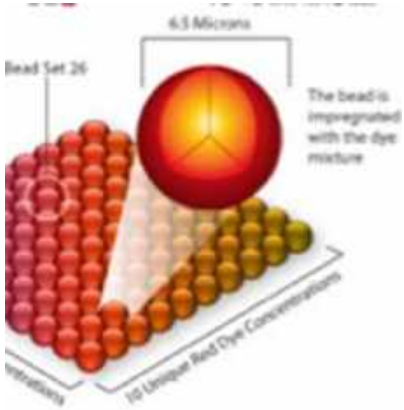
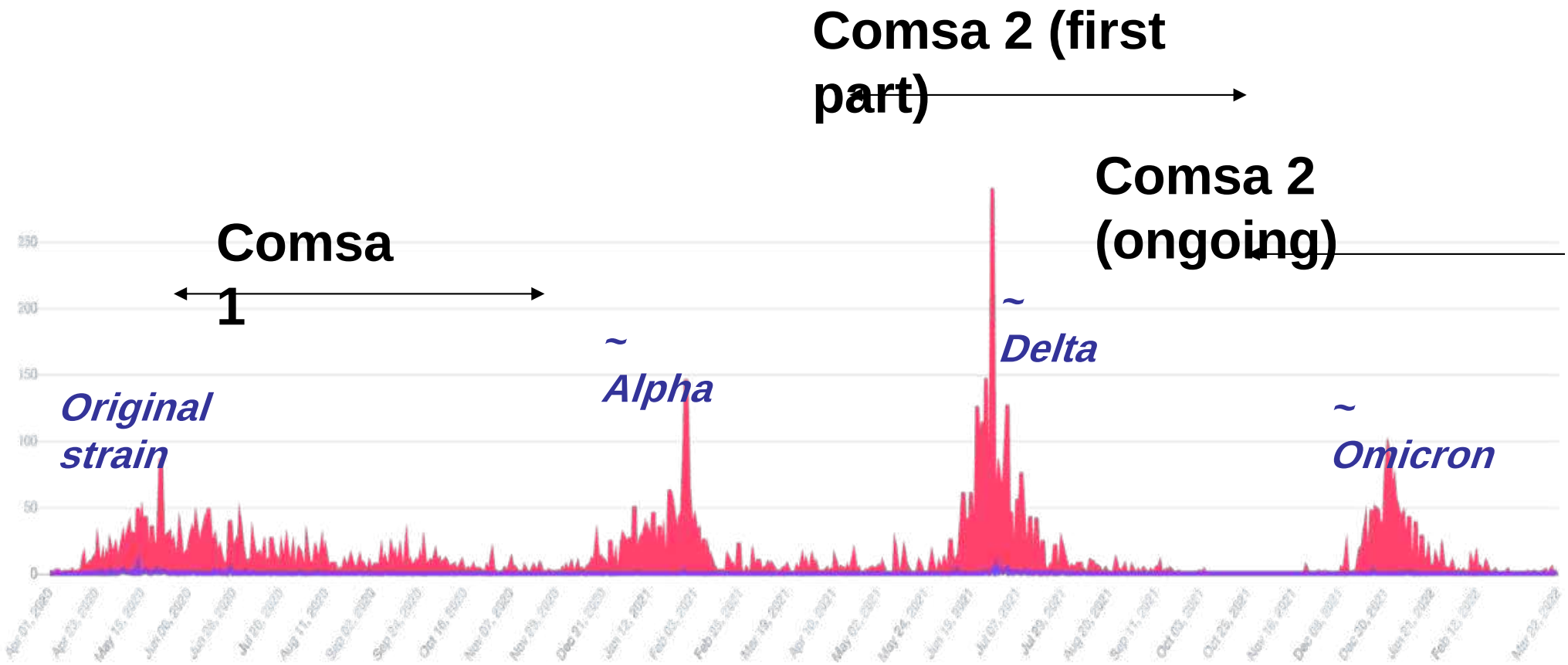


Fig. 2: Multiplex bead-based immunoassays
(Source: Biocompare.com)

- Work with LSHTM/US CDC/U of Colorado to standardize beads and training, plus cross lab quality control
- Develop Sierra Leone capacity for integrated risk factor and serosurveillance by building a learning site at Njala for possible national level training and expansion

- Prof Jha Presentation

Viral waves/strains of COVID-19 cases in Sierra Leone and COMSA sampling periods



80% of ~7500 reported cases are in Western Area Urban (Freetown) and Rural, and incoming passengers

SARS-2-CoV Serosurvey in urban Bo

- COMSA DBS study covered about 4200 adults age 18+ randomly selected from about half of Bo urban areas
- Field work was in July-Aug 2021 and was not a COVID survey but rather a “healthy lifestyle” survey.
- 224 of 4200 randomly selected for COVID antibody testing
  - High quality chemiluminescence ELISA at Sinai Labs, Toronto
  - 3 antigens- RBD, Spike and Nucleocapsid (to reduce false positives)

SARS-CoV-2 Serosurvey in urban Bo, Sierra Leone (n=224)

Antigen	Mixture Model Threshold	Canadian Negative Threshold	% Above Mixture Model Threshold	% Above Canadian Negative Threshold
RBD	0.548	0.324	45.4%	70.0%
NP	1.099	0.642	39.6%	67.4%
Spike	1.359	0.482	39.2%	90.3%
2 out of 3 Antigens			40.5%	77.9%

- This prevalence is much higher than reported in spring 2021 (urban ~4%) in a survey using a rapid, single antigen test- *Barrie et al, BMJ Global Health 2021*
- Similar high prevalences recorded in other urban African settings since later 2021

SARS-CoV-2 prevalence in urban adults

Antigen	N = 224 (collected July-Aug 2021, Delta wave)
RBD positive	**157 (70%)**
Spike positive	**202 (90%)**
RBD + Spike positive	**155 (69%)**

Of 77 samples tested, 37 (48%) had significant neutralizing response

43 Pre-Pandemic samples (2019) tested:

RBD + Spike positive: 0 (0%)

Nucleocapsid protein: 11 (26%) but did not differ by malaria parasitemia on PCR

Planned analyses:

Repeat serosurvey in same 224 adults (May 2022) to assess Omicron wave and persistence of titers

EuroImmun IGRA release assay to determine the activity of T-cells reactive to SARS-CoV-2 in 90 adults

Compare prevalence with COMSA and other mortality data

Seasonal COV assays in pre pandemic and Delta/Omicron waves?

Investigation Plan for COVID Mortality

- **High SCV2 prevalence accompanied by high hospitalization or death rates?**
  - Anecdotal: major surge in Bo hospitalizations during Delta wave
  - Systematic examination of funeral homes, mortuary and 117 (death call in number) for Bo district shows most of excess in 2020 not 2021, but perhaps wide under-reporting to 117 to avoid family quarantine?
  - COMSA verbal autopsy to include Delta peak period (June 2022)

Key messages (3): Biological sub-studies

- Intensive MITS investigation of child deaths feasible, and now will extend to 200 adult deaths
- Malaria as a cause of febrile hospital admission study underway in Bo Hospital (400 patients/year)
- Dried blood spot approaches highly feasible for the whole of Sierra Leone
- Surprisingly high SARS-CoV-2 prevalence in urban areas, which need further investigation/tracking
- Substantial efforts to strengthen laboratory capacity and data capture systems are required for biological studies, but information yield is very high
- COMSA platform has multiple uses