Healthy Sierra Leone (HEAL+SL)
National Mortality Study


www.comsasl.org
Ministry of Health and Sanitation
Njala University, University of Toronto

COMSA Supported by the Bill and Melinda Gates Foundation, Queen Elizabeth Scholarships and CIHR, Canada
Conclusions

- The Healthy Sierra Leone (HEAL+SL) 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.

SEE: WWW.COMSASL.ORG

Text “Join” to COMSA WHATSAPP +232 74800575
“for sanitary purposes it is indispensable to know the relative mortality in small and, as far as possible, well-defined tracts to ascertain the death rates in each of these communities; to see how far this arises from preventable causes; and to apply the remedies”

Sanitary Commissioner of the Government of India, 1869
Nationwide Mortality Studies: Indian Million Death Study (MDS)

1. Visit 1.4 M homes (“true snapshot” of India) in the “SRS” with a recent death & ask standard questions and get a local language narrative (*adapted* WHO tool)

2. 900 non-medical surveyors (now electronic entry + GPS)

3. Web-based double coding by 400 doctors (guidelines, + adjudication and other strict quality control)

4. Study all diseases, work with RGI/census dept, keep costs <$1 per home

5. Indian totals to date: ~0.8M deaths

Statistical Alliance for Vital Events (SAVE) to expand to Sierra Leone, Ethiopia, Mozambique and elsewhere

Gomes et al, Health Affairs, 2017
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
Sharmila* was 23. She was very weak. Before the delivery she was admitted to the Government Hospital Jamsdpur. On experiencing difficulty, they advised that she should be taken to Lucknow because they could not cope with it. The family did not have money to take her to Lucknow. So he brought her home. A professional Dai (midwife) came. The baby could not come out because of mother's weakness. The Dai pulled baby out with her hands together with the placenta. Excessive bleeding took place and Sharmila became unconscious. The child died about five minutes after the delivery and the mother died about half hour later.

* All names and locations changed
Low ill defined deaths with MDS VA

- Low ill-defined rates (<5%) up until older age groups
- At 70 years and above 18% of all ill-defined cases
- Both lower than before VA introduced

![Bar chart showing age-specific ill-defined death rates](chart.png)

- MDS: 2001-03

- 5-69 age group: 13%
- 62%
- 4%

- 70+ age group: 62%
- 18%
Similar cause of death distributions (adult) by lay, non-medical staff versus physician interviews at the household

Jha et al, BMC Med 2019
MILLION DEATH STUDY: selected results
(M=Millions, K=thousands). BOLD=ACTIONS TAKEN

• 6-14M girls aborted before birth since 1980 (1/2 of these since 2000)
• 1M smoking deaths (more than expected) and 0.1M alcohol deaths
• Maternal death rate FALLING 1997-2020 (not rising earlier as feared)
• 200K malaria deaths: WHO predicted only 15K
• 100K HIV deaths: UNAIDS predicted 400K
• 60K pedestrian traffic deaths: Police estimate=9K
• 50K snakebite: WHO worldwide estimate=50K
• 1.3M vascular deaths in middle age (cardiac rates rising)
• Each common disease is rare somewhere in India, & hence is largely avoidable

Gomes et al, Health Affairs, 2017
HEAL+SL 2018-2020
Procedure

Census enumerated areas=678 villages or urban blocks
Persons enumerated=343,123

Death below age 70 years during 2018-20 (9033)

Electronic Verbal Autopsy (with automated range checks, 5% random resampling and other quality control steps) by one of 61 trained field staff

Field reports uploaded daily to server

Exclude 475 records without an eVA=8558 records randomly assigned anonymously and independently to two of 11 trained physicians

Unable to code 184 records due to missing data

Both physicians agreed on cause of death

Initial disagreement by two physicians

Anonymous reconciliation by physicians leading to agreement

Persisting differences of two physicians adjudicated anonymously by senior physician

Final ICD-10 code (underlying causes) for 8374 deaths
Map of Sierra Leone showing enumeration areas and numbers of study deaths by regions (currently 4 but expanding to 5 regions in HEAL+SL).

- National capital
- Major cities
- Sampling units
- Northern
- Eastern
- Southern
- Western

Freetown: Western 755/1611/12*
Makeni: Northern 2172/2668/27*
Bo: Eastern 1169/1752/21*
Kenema: Southern 4278/1529/17*

* STUDY deaths/Total Population/ Total Deaths (both in thousands under age 70)
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)
#1 End of day transfer to cloud

#2 Dual coding (physician or senior nurse) + reconciliation (online or offline)

#3 Final data, cleaned, available on dashboard

Adjudication if needed

FULLY ELECTRONIC FIELD WORK

Goal: field work to final COD in <15 days
Dashboard (team/overview)

**COMSA (SL)**

- **Dashboard**
- **My Performance**
- **Resources**
- **Profile**
- **FAQs**
- **Ticket**

**Dashboard**

- **EAs Covered**: 357
- **Households**: 29295
- **Population**: 184973

- **VAs Done**: 2819
- **VAs Coded**: 2791
- **Progress**: 54% completed
Quality assurance is key to results remaining credible

<table>
<thead>
<tr>
<th>IT-based quality assurance</th>
<th>Field-based quality assurance</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ GPS tracking (and updating maps from Census 2021)</td>
<td>✓ Field spot checks (ensure all team members present, confirm number of houses, observe data collection)</td>
</tr>
<tr>
<td>✓ Interview recordings: central audio review (every surveyor per week, random)</td>
<td>✓ Random re-sampling of team work and sample timeframes</td>
</tr>
<tr>
<td>✓ Monitor work loads and pace of work using dashboard</td>
<td>✓ Narrative reviews</td>
</tr>
<tr>
<td></td>
<td>✓ Weekly experience sharing meetings</td>
</tr>
</tbody>
</table>
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”
### National maternal deaths in Sierra Leone

#### Maternal deaths in HEAL+SL

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of annual female deaths (15-49 years)</td>
<td>9.6%</td>
</tr>
<tr>
<td>National annual female deaths (15-49 years)</td>
<td>13,660</td>
</tr>
<tr>
<td>Livebirths (2020)</td>
<td>258,100</td>
</tr>
<tr>
<td>Maternal mortality ratio (95% CI)</td>
<td>510 (483-538) *</td>
</tr>
<tr>
<td>Absolute total maternal deaths (95% CI)</td>
<td>1317 (1247-1389) +</td>
</tr>
</tbody>
</table>

#### Leading causes of death

<table>
<thead>
<tr>
<th>Cause</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemorrhage</td>
<td>25%</td>
</tr>
<tr>
<td>Infection and sepsis</td>
<td>15%</td>
</tr>
<tr>
<td>Hypertensive disorders</td>
<td>9%</td>
</tr>
</tbody>
</table>

* WHO estimate of MMR in 2017: 1120
  + eIDSR/maternal facility-based data ~580 maternal deaths in 2018/19
Leading causes of death among adults 15-29 years in Sierra Leone, 2018-2020

<table>
<thead>
<tr>
<th>Cause</th>
<th>National annual deaths (%)</th>
<th>Period risk %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria</td>
<td>2483 (20)</td>
<td>1.6%</td>
</tr>
<tr>
<td>Other infections</td>
<td>1311 (11)</td>
<td>0.9%</td>
</tr>
<tr>
<td>Injuries</td>
<td>1181 (10)</td>
<td>0.8%</td>
</tr>
<tr>
<td>Road traffic accidents</td>
<td>797 (6)</td>
<td>0.6%</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>664 (5)</td>
<td>0.5%</td>
</tr>
<tr>
<td>Acute pneumonia</td>
<td>533 (4)</td>
<td>0.3%</td>
</tr>
<tr>
<td>All vascular causes</td>
<td>473 (4)</td>
<td>0.3%</td>
</tr>
<tr>
<td>HIV/AIDS and STIs</td>
<td>474 (4)</td>
<td>0.3%</td>
</tr>
<tr>
<td><strong>Total 15-29 years</strong></td>
<td><strong>12254 (100)</strong></td>
<td><strong>7.9%</strong></td>
</tr>
</tbody>
</table>
Leading causes of death among adults 30-69 years in Sierra Leone, 2018-2020

<table>
<thead>
<tr>
<th>Causes</th>
<th>National annual deaths (§)</th>
<th>Period risk %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria</td>
<td>4392 (14)</td>
<td>7.6%</td>
</tr>
<tr>
<td>Cardiac/other vascular causes</td>
<td>3121 (10)</td>
<td>5.3%</td>
</tr>
<tr>
<td>Digestive diseases</td>
<td>3295 (11)</td>
<td>5.9%</td>
</tr>
<tr>
<td>Stroke</td>
<td>2503 (8)</td>
<td>4.3%</td>
</tr>
<tr>
<td>Injuries</td>
<td>1920 (6)</td>
<td>3.2%</td>
</tr>
<tr>
<td>Other infections</td>
<td>2294 (8)</td>
<td>4.3%</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>1814 (6)</td>
<td>3.2%</td>
</tr>
<tr>
<td>Acute pneumonia</td>
<td>1487 (5)</td>
<td>2.7%</td>
</tr>
<tr>
<td><strong>Total 30-69 years</strong></td>
<td><strong>30736 (100)</strong></td>
<td><strong>53.5%</strong></td>
</tr>
</tbody>
</table>
Annual malaria mortality rate by age group in Sierra Leone – malaria was a leading cause of death in all age groups except neonates.
More than half of malaria deaths occurred in a hospital or after hospitalization

<table>
<thead>
<tr>
<th></th>
<th>Non-malaria deaths</th>
<th>%</th>
<th>Malaria deaths</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Died in a hospital or health facility</td>
<td>2740/6473</td>
<td>42.3</td>
<td>891/1901</td>
<td>46.9</td>
</tr>
<tr>
<td>Died after discharge from a health facility</td>
<td>235/6473</td>
<td>3.6</td>
<td>158/1901</td>
<td>8.3</td>
</tr>
<tr>
<td>Had a malaria test</td>
<td>428/5617</td>
<td>7.6</td>
<td>566/1808</td>
<td>31.3</td>
</tr>
<tr>
<td>Any treatments received</td>
<td>4468/6457</td>
<td>69.2</td>
<td>1614/1899</td>
<td>84.9</td>
</tr>
<tr>
<td>Oral rehydration salts (n, % of treated)</td>
<td>1206/4468</td>
<td>27.0</td>
<td>690/1614</td>
<td>42.8</td>
</tr>
<tr>
<td>Intravenous fluids</td>
<td>2253/4468</td>
<td>50.4</td>
<td>801/1614</td>
<td>49.6</td>
</tr>
<tr>
<td>Blood transfusion</td>
<td>358/4468</td>
<td>8.0</td>
<td>159/1614</td>
<td>9.9</td>
</tr>
<tr>
<td>Injectable antibiotics</td>
<td>2234/4468</td>
<td>50.0</td>
<td>814/1614</td>
<td>50.4</td>
</tr>
</tbody>
</table>
Spatial distribution of malaria death risks (age<70 years) in Sierra Leone, 2018-20
Improvements in HEAL+SL 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 HEAL+SL 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)
• Add dried blood spot based studies in Bo district
www.cghr.org/training

- **ACDC** for facility deaths- tested on 140 doctors; expanding to Ethiopia, India, Mozambique for ICD-10, taught by Njala University
- **Field VA** training modules- used by 1200 staff, expanding to Ethiopia and Mozambique
- **Physician Coding** for eVA- 450 trained (download, ready now) for **any ICD-10**
- **Death 101**: Ed-X/U of T free course- 1200 students from 150 countries
- **Operations manuals**: Entire MDS and HEAL-SL
Solution: train, correct X 50

Completing WHO form correctly is like a medical procedure e.g. Venipuncture.

Applied Course on Death Certification (ACDC)

Train → Repeat x 50 → Feedback

ACDC → 50 Death Certificate Exam (70% to pass) → Certification
Conclusions

• The Healthy Sierra Leone (HEAL+SL) 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

JOIN AFRICA MORTALITY SYMPOSIUM- FREETOWN, NOV 29-30, www.comsasl.org
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