Simplified Lot Quality Assurance Sampling
Evaluation of Access and Coverage (SLEAC)
Overview of the method

The **SLEAC** method classifies program coverage for a service delivery unit such as a health district.

A **SLEAC** survey identifies the category of coverage (e.g. “low coverage” or “high coverage”) that describes the coverage of the service delivery unit being assessed.

The advantage of this approach is that relatively small sample sizes (e.g. $n = 40$) are required in order to make an accurate and reliable *classification*.

**SLEAC** can estimate coverage over several service delivery units.

Coverage is still classified for individual service delivery units.

Data from the individual service delivery units are combined and coverage for this wider area is *estimated* from this combined sample.
SLEAC survey sampling design

*SLEAC* uses a *two-stage sample*

A sample of villages in the survey area is taken first (*stage one*)

This should be a spatial sampling method that yields a reasonably even spatial sample from the survey area.

Methods used here are *CSAS* and systematic spatial sampling

Then a “census” sample of current and recovering SAM cases is taken from each and every one of the selected villages (*stage two*).

This sample design is the same as that used in all the methods we will discuss at this workshop.
**SLEAC survey sample size**

A target sample size of forty \((n = 40)\) cases from each service delivery unit in which coverage is to be classified is usually large enough for most *SLEAC* applications.

In certain situations it is possible to use a smaller target sample size without increasing error.

In settings where the service delivery units are small and / or the prevalence of SAM is low, it may be difficult or even impossible to find forty \((n = 40)\) cases.
# SLEAC survey sample size

<table>
<thead>
<tr>
<th>Total number of cases in the service delivery unit</th>
<th>Target sample size for ...</th>
<th>50% standard</th>
<th>70% standard or 30% / 70% class thresholds</th>
</tr>
</thead>
<tbody>
<tr>
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<td>20</td>
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</table>
**LQAS classifier: Binary or two-tier classification**

*SLEAC* uses the same simplified LQAS classification technique that is used in *SQUEAC* small-area surveys.

The simplified LQAS classification technique provides *binary* or *two-tier* classifications.

*For binary or two-tier classifications classify coverage as either being above or below a single threshold \((d)\) based on a coverage proportion \((p)\) standard*
LQAS classifier: Operating characteristic curve

- Zone of indecision
- Maximum error
- Low error
- Swing point

Probability of HIGH Classification vs. Coverage (%)

- 0.0
- 0.2
- 0.4
- 0.6
- 0.8
- 1.0
LQAS classifier: Binary or two-tier classification

The differences between how the simplified LQAS classification technique is used in SQUEAC and SLEAC are:

The SLEAC survey sample is designed to represent the entire program area.

A target sample size for SLEAC surveys is decided in advance of data-collection.

SLEAC surveys may classify coverage into three or more classes.
LQAS classifier: Three-tier classification

The method may be extended to provide more granular classifications. Three classes are sufficient for most SLEAC applications.

For three-tier classifications there are two coverage proportions:

- \( p_1 \): The upper limit of the “low coverage” tier or class
- \( p_2 \): The lower limit of the “high coverage” tier or class

The “moderate coverage” class runs from \( p_1 \) to \( p_2 \). For example:
LQAS classifier: three-tier probability of classification

![Diagram showing the probability of classification and coverage percentage]

- Zone of indecision
- Maximum error

Coverage (%) vs. Probability of Classification

Legend:
- L
- M
- H
LQAS classifier: Three-tier classification

Two classification thresholds \((d_1\) and \(d_2)\) are used and are calculated as:

\[
d_1 = \left\lfloor n \times \frac{p_1}{100} \right\rfloor \quad d_2 = \left\lfloor n \times \frac{p_2}{100} \right\rfloor
\]

Classifications are made using the following algorithm:

1. Sample
2. Number of covered cases exceeds \(d_2\)?
   - Yes: Classify as high coverage
   - No: Proceed to next step
3. Number of covered cases exceeds \(d_1\)?
   - Yes: Classify as moderate coverage
   - No: Classify as low coverage
LQAS classifier: Three-tier classification

Here is an example of the calculations required:

Sample size \((n)\) : 40

\(p_1\) : 30%

\(p_2\) : 70%

\[d_1 : \left\lfloor \frac{n \times p_1}{100} \right\rfloor = \left\lfloor \frac{40 \times 30}{100} \right\rfloor = 12\]

\[d_2 : \left\lfloor \frac{n \times p_2}{100} \right\rfloor = \left\lfloor \frac{40 \times 70}{100} \right\rfloor = 28\]
**LQAS classifier : Three-tier classification**

A three-tier classification method is particularly useful for identifying very high coverage service delivery units and very low coverage service delivery units.

Three-tier classifications require two sampling plans / decision rules. These are created using the rule-of-thumb formula used for binary classification scheme.
**Development of the method**

*SLEAC* was developed from *CSAS* and initially meant as an add-on method to *SQUEAC* to provide coverage mapping and an overall/headline coverage estimate.

The use of Bayesian techniques in *SQUEAC* seem to have rendered *SLEAC* obsolete.

However, recent applications of *SLEAC* have revived the method giving it renewed usefulness and purpose:

- As a *quick and simple way* of investigating coverage in service delivery units.
- As a *screening tool* to identify service delivery units meet or fail to achieve coverage targets.
- As a *coverage mapping tool* over wide areas in district, regional, and national surveys.
- As a *coverage estimator* over wide areas in district, regional, and national surveys.
Quick and simple method of coverage investigation

*SLEAC* is a low-resource method for classifying and estimating the coverage of selective feeding programs over many service delivery units.

A *SLEAC* survey will usually be very much quicker and very much cheaper than a *CSAS* survey of the same area.

A *SLEAC* survey can be quicker and cheaper than a *SQUEAC* of the same area.

However, the cost efficiency of *SLEAC* as compared to *CSAS* and *SQUEAC* is exemplified best by coverage assessments over multiple service delivery units and over wide areas.
Screening tool to target complementary SQUEAC investigation/s

Using SLEAC to identify service delivery units failing to achieve coverage targets and conducting SQUEAC investigation to inform program reforms.
Screening tool to target complementary SQUEAC investigation/s

Using SLEAC to identify service delivery units successfully meeting and failing to achieve coverage targets and conducting SQUEAC investigation to inform program reforms.
SQUEAC and SLEAC are designed to complement each other

<table>
<thead>
<tr>
<th>SLEAC</th>
<th>SQUEAC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SLEAC</strong> is a <em>wide-area</em> method that could be used to classify and map the coverage of CMAM service at district, national, or regional levels.</td>
<td><strong>SQUEAC</strong> is a <em>local method</em> used to identify factors influencing program success and failure at the local (i.e. district or clinic) level.</td>
</tr>
<tr>
<td><strong>SLEAC</strong> provides a <em>coarse overview</em> of program coverage (i.e. coverage class) with only <em>limited information on barriers</em>.</td>
<td><strong>SQUEAC</strong> provides a <em>detailed view</em> of program coverage and <em>detailed information on barriers</em>.</td>
</tr>
</tbody>
</table>
Coverage mapping tool

Because **SLEAC** can be done in each service delivery unit within a wide-area, coverage classifications can be reported for each of these service delivery units. This approach enables the identification of low coverage and high coverage service delivery units which in turn could be presented as a map:

![Coverage Map]

- Low
- Moderate
- High

Labels:
- Ngombe
- Kanyama
- Chipata
- Mumbwa
- Kalingalinga
- Chawama
- Matero
- Makeni
- Mtendere
- Lusaka

Scale:
10 km
Coverage estimator

Using results of the *SLEAC* surveys in each of the service delivery units, it is also possible to estimate overall coverage across these service delivery units.

The number of SAM cases will vary between service delivery units in the program area. This means that the results from any one service delivery unit should be *weighted* by the number of cases in that service delivery unit.

The *weighting factor* for each survey is:

\[
w = \frac{N}{\sum N}
\]

Where:

- \( N \): Estimated number of cases in a service delivery unit

Estimates of \( N \) are based on estimates of *local population size*, *population structure*, and the *prevalence of SAM*.
**Coverage Estimator**

*Coverage* is estimated as:

\[
\text{Coverage} = \sum \left[ w \times \frac{c}{n} \right]
\]

where:

- \(w\): weighting factor \( w = \frac{N}{\sum N} \) for each survey (see above)

- \(c\): number of covered cases found in each survey

- \(n\): sample size in each survey

A 95% confidence interval on the estimated coverage can be calculated using the following formula:

\[
95\% \, CI = \text{Coverage} \pm 1.96 \cdot \sqrt{\sum \frac{w^2 \cdot c}{n} \cdot \left(1 - \frac{c}{n}\right)}
\]
Coverage Estimator

It should be remembered that it is usually only sensible to report an overall coverage estimate if:

The overall sample size is greater than about 96. This sample size is usually sufficient for a 95% confidence interval of ± 10 percentage points or better.

Coverage is not patchy (i.e. coverage is broadly similar in each of the areas surveyed).
Case Study:

Using SLEAC to assess national coverage of CMAM in Sierra Leone
Background

CMAM was piloted in four districts of Sierra Leone in 2008.

Program was expanded to provide CMAM in selected health centres in all 14 districts of the country in 2010.

About a year after, program implementers and partners wanted to get an idea of the coverage reached by the program as a result of its expansion into national scale.

A national coverage survey was planned and implemented in the first half of 2011.
Information needs of program implementers and partners

Coverage levels reached by each of the 14 districts as the national CMAM was managed and implemented at the district level

An overall national coverage estimate

List of factors that impact on coverage

Specific information on how program can be improved and as a result improve coverage
Survey design

Given these information needs,

A spatially exhaustive set of *SLEAC* surveys (i.e. a *SLEAC* survey performed in every health district),

With one or two targeted *SQUEAC* investigations

would provide the information needed by program implementers and partners in Sierra Leone.

This approach exemplifies the complementarity of *SLEAC* and *SQUEAC* and the usefulness of *SLEAC* as a screening or targeting tool / method for in-depth *SQUEAC* investigations
Survey stage one sampling – systematic spatial sample

Step 1: Determine sample size \((n)\) for each district survey

Using local estimates of population size, population structure and prevalence of SAM, total number of SAM cases per service delivery unit is estimated.

\[
N = \left\lfloor \frac{\text{population of service delivery unit}_{\text{all ages}} \times \frac{\text{percentage of population}_{6-59 \text{ months}}}{100} \times \frac{\text{SAM prevalence}}{100}}{100} \right\rfloor
\]

Sample sizes \((n)\) are then determined using the sample size table shown earlier given the estimates of SAM cases per service delivery unit.

For the Sierra Leone SLEAC, a target sample size of \(n = 40\) current SAM cases was used in both rural and urban districts. This is the standard SLEAC sample size for large populations.
Survey stage one sampling – systematic spatial sample

Step 2: Determine number of villages ($n_{villages}$) to survey

The number of villages ($n_{villages}$) needed to reach the target sample size in each district was calculated using estimates of average village population and SAM prevalence using the following formula:

$$
 n_{villages} = \left\lceil \frac{n \times \text{percentage of population}_{6-59 \text{ months}} \times \text{SAM prevalence}}{\text{average village population}_{all \text{ ages}} \times 100} \right\rceil
$$
Survey stage one sampling – systematic spatial sample

Step 3: List villages sorted by administrative area

A: Rural districts

- District
  - Chiefdom
    - Village
    - Village
    - Village
  - Chiefdom
    - Village
    - Village
    - Village

B: Urban and peri-urban districts

- District
  - Section
    - City Block
    - City Block
    - City Block
  - Section
    - City Block
    - City Block
    - City Block
Survey stage one sampling – systematic spatial sample

Step 4: Determine sampling interval

\[ \text{Sampling Interval} = \left\lfloor \frac{\text{Total number of locations}}{\text{Number of locations to sample}} \right\rfloor \]

Step 5: Select a random starting village

A random starting village from the top of the list was selected using a random number between one and the sampling interval.
**Survey stage one sampling – systematic spatial sample**

**Step 6: Select next villages using sampling interval**

For example, for Bombali district with a sampling interval of 20 and a random start of 16th village, selection of villages was done as shown:

<table>
<thead>
<tr>
<th>No.</th>
<th>CHIEFDOM</th>
<th>SECTION</th>
<th>VILLAGE</th>
</tr>
</thead>
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<tr>
<td>1</td>
<td>Biriwa</td>
<td>Bumban</td>
<td>Kasena</td>
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<tr>
<td>2</td>
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<td>Bumban</td>
<td>Kasenge</td>
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<td>3</td>
<td>Biriwa</td>
<td>Bumban</td>
<td>Kamarike</td>
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<tr>
<td>4</td>
<td>Biriwa</td>
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<td>Bumban Mahenda</td>
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<td>Kasankorke</td>
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</tr>
<tr>
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<td>Bumban</td>
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<td>Kukuahun</td>
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<td>Kamakorhe</td>
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<td></td>
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<td>41</td>
<td>Biriwa</td>
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<td>Makafay</td>
</tr>
<tr>
<td>42</td>
<td>Biriwa</td>
<td>Bumbandain</td>
<td>Kamatolokoh</td>
</tr>
</tbody>
</table>

**Random starting position** - 16th village from top of the list

**Sampling interval of every 20th village**

Continue to next column
Survey implementation

Timeframe
The whole process was completed in *eight weeks* (about 44 working days) staffed by fifteen mid-level health management staff and a principal surveyor provided by VALID International Ltd.

Survey teams
Three survey teams with five members each were used. Teams were divided into two sub-teams. A survey team was headed by a “captain” in charge of managing the sub-teams, organising travel, survey logistics, and co-ordinating survey activities with the principal surveyor.
Survey implementation

Survey organisation
Each district was divided into 3 segments. Segmentation was informed by logistics with each segment being served by a road (when possible).

Each survey team started in the farthest village and then moved to the next-farthest and so-on.

At the end of each day, the survey teams lodged in health centres, local guesthouses, or in villagers' homes. They restarted case-finding on the following day. This continued until all the villages had been sampled.
Survey implementation

Data collation and analysis

The survey teams came together at the district headquarters for data collation and analysis and results shared with district-level health management staff.

Upon completion, the survey team was able to:

- Classify coverage in each district
- Map coverage by district for the whole country
- List barriers to coverage ranked by their relative importance
### Tally-sheet of survey results

<table>
<thead>
<tr>
<th>CHIEFDOM</th>
<th>IN</th>
<th>OUT</th>
<th>REC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nongowa</td>
<td>0</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Tunkia</td>
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<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Gaura</td>
<td>5</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Dama</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Koya</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Lower Bambara</td>
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<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Malegohun</td>
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<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Dodo</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Kandu Lappiama</td>
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<td>0</td>
</tr>
<tr>
<td>Gioerama Mende</td>
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<td>0</td>
</tr>
<tr>
<td>Wandor</td>
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<td>0</td>
<td>0</td>
</tr>
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<td>Small Bo</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Nyawa</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Simbaru</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>8</td>
<td>26</td>
<td>4</td>
</tr>
</tbody>
</table>

### LQAS analysis of survey results

1. **Point Coverage**
   
   \[ d_1 = \ln(0.2) = \ln(0.2) = 6 \]
   
   \[ d_2 = \ln(0.5) = \ln(0.5) = 17 \]

2. **Period Coverage**
   
   \[ d_1 = \ln(0.2) = \ln(0.2) = 7 \]
   
   \[ d_2 = \ln(0.5) = \ln(0.5) = 19 \]

3. **Classify Coverage**
   
   - **Point**:
     - \( c > d_1 \) → Yes
     - \( c > d_2 \) → No → Moderate Coverage
   
   - **Period**:
     - \( c > d_1 \) → Yes
     - \( c > d_2 \) → No → Moderate Coverage
QUESTIONNAIRE:
Q1: Non-recognition of MN  
Q2: No awareness of programme
Q3: Reason 1
   Reason 2
   Reason 3
   Reason 4

PARETO CHART (QUESTIONNAIRES)  

<table>
<thead>
<tr>
<th>Reason</th>
<th>Freq</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-recognition of malnutrition</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td>No awareness of programme</td>
<td>17</td>
<td>2</td>
</tr>
<tr>
<td>RUTF not available</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Mother dead &amp; caregiver</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Too busy</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>RUTF too little given, require quant</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Waiting for health worker</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>
Map of coverage by district

Legend
- Low (< 20%)
- Moderate (20% to 50%)
- High (> 50%)

[Map showing coverage by district with color coding for low, moderate, and high coverage areas.]
Conclusion

**SLEAC** provides:
A quick and simple method for classifying coverage in program service delivery units

Limited (i.e. reasons for non-attendance collected from a single informant type using a single method with a small sample size) but useful data on barriers to service uptake and access.

**SLEAC** offers:
Program managers a method of targeting more intensive and expensive **SQUEAC** investigations when gathering evidence to inform program reforms.

Offers regional and national program managers a reasonably quick and simple method for mapping coverage over very wide areas.