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# ABSTRACT

## BACKGROUND

The 2007 Mozambique Malaria Indicator Survey reported used a multistage cluster design to collect information related to malaria prevention and prevalence. This paper demonstrates how large multistage cluster surveys can be designed to capture local LQAS analyses without sacrificing the accuracy of macro-level point estimates of malaria indicators.

## METHODS

We emulate a collection of LQAS surveys using data obtained during the 2007 Mozambique Malaria Indicator Survey to determine whether adequate bed net coverage has been reached within each enumeration area (EA). We then aggregate the EA-level data to obtain provincial and national coverage estimates. To assess whether similar coverage estimates can be arrived at with a smaller sample of clusters, we next emulate a Large-Country LQAS (LC-LQAS) application on the dataset.

## RESULTS

Provincial-level estimates obtained using the LC-LQAS sub-sample and the complete LQAS sample are similar for possession of any bednet (provincial discrepancy: $\leq$ 4%) and ITN possession (provincial discrepancy: $\leq$7%), and the national indicator estimates are within a single percentage point. Furthermore, LQAS analyses reveal significant local variation in performance otherwise hidden by the aggregate measures.

CONCLUSIONS

Our findings support the use of LQAS and LC-LQAS subsamples for making inference about malaria outcome indicators. These methods track coverage and provide important information simultaneously for local and national malaria control programs managers.

## INTRODUCTION

The tremendous burden of malaria has led to a massive international effort to greatly increase control measures. The past ten years have brought important advances in malaria research, as well as increases in funding by bilateral and international organizations to support malaria control efforts (1). This support has aided endemic countries to increase coverage with malaria interventions, including insecticide treated bednet (ITN) distribution, indoor residual spraying, and effective antimalarial drugs (2). This scale-up has led to increased emphasis on improving national monitoring and evaluation systems for malaria programs (3).

Multi-stage cluster-sample surveys such as the Demographic and Health Survey (DHS) and Malaria Indicator Survey (MIS) provide the current standard for estimating malaria outcome and impact indicators at the national level (4, 5). However, the complexity, costs, and time needed for the execution of these surveys preclude frequent outcome monitoring of malaria control programs (6).

More frequent assessments of program outcomes at a decentralized or sub-national level would permit program managers to use results-based information while bringing programs to scale, as well as to satisfy donor reporting requirements. Failure to monitor outcomes on a regular basis at a decentralized level can hide fundamental program inadequacies and inequities, delay necessary action to improve effectiveness, and lead to wasted opportunities (6). As countries scale-up coverage of key malaria interventions, sub-national monitoring is essential for resource allocation and priority setting. Managers need local level information to effectively steer and guide their programs.

Complementary methods are available to regularly monitor outcomes of malaria control programs. Lot Quality Assurance Sampling (LQAS) is one such method that has been used to classify geographical areas based on whether a specified coverage target has been reached (7). A major advantage of LQAS is that the classification requirements result in sample sizes that are typically smaller than those required to perform other estimation analyses (8). Another is that LQAS provides important information at the local level, where program managers can take corrective action (9). While LQAS has been used previously to assess the efficacy of antimalarial drugs (10) and to estimate malaria prevalence (11), there are few published examples of LQAS to assess malaria outcome indicators, and certainly not at the local level (12).

This paper uses MIS data from Mozambique (13) (2007) to accomplished three tasks (1). By emulating an analysis using the LQAS method, we demonstrate how to determine whether adequate bednet coverage levels have been reached within each enumeration area (EA) of the Mozambique MIS sample (2). We validate that LQAS EA-level data, when aggregated, produce provincial and national coverage estimates that are similar to those produced by the MIS (3). We show that similar coverage estimates are obtained, with sufficient levels of precision, with a smaller number of clusters in each province than is typically used by the MIS. We do this by emulating a Large-Country Lot Quality Assurance Sampling (LC-LQAS) application on the Mozambique MIS dataset (12).

Therefore, this paper compares LQAS to the standard methods to demonstrate the validity and utility of LQAS results and then shows how LC-LQAS methods can be used to decrease costs of traditional sampling designs.

## DATA AND METHODS

### DATA SOURCE

The Mozambique MIS was conducted by the National Malaria Control Program in partnership with national and international organizations. The survey (carried-out: June and July 2007) included a sample drawn from a subset of enumeration areas (EAs) included in a population proportionate sample from the 1997 National Census (13).

A two-stage sampling approach was used with census EAs as the primary sampling unit and households as the secondary sampling unit. In the Mozambique MIS sample, 15 households per rural EA and 20 households per urban EA were selected from the updated household listing for each EA. A total of 346 EAs with 5990 households were selected from the 1510 EAs in the sampling frame. After data cleaning, a total of 345 EAs and 5745 household records were available for analysis (13).

### LQAS METHODOLOGY

LQAS is typically implemented as part of a stratified random sampling design in which small samples are selected from all strata or <u>lots</u> in a given area (8, 10, 14, 15). In each lot, the sample determines whether coverage by a health intervention reaches a specific target by using a statistically determined decision rule. The decision rule is the minimum number of individuals in the sample that should have received the intervention. Each lot is then classified as acceptable or unacceptable vis-a-vis the target (16). In health systems, decision rules are often selected to determine whether a population coverage target for an intervention has been reached, such as 80% polio vaccination coverage among children under 5-years of age. If the decision rule is reached the lot is classified as acceptable (17). A lot typically consists of a catchment area for a health facility or district management team (10). In this analysis lots are EAs.

**WHAT-IF ANALYSIS**

In the Mozambique MIS, 345 EAs were sampled and the data used to estimate provincial and national coverage for various indicators (13). In the original report, no EA-level analysis was conducted. We perform a what-if analysis by applying the LQAS method to assess whether intervention coverage targets have been reached in each EA of the MIS sample. This analysis is classified as a what-if since EAs do not correspond to a management unit such as a health facility catchment area.

The indicators we investigated using LQAS include household possession of any bednet, and household possession of any ITN. For this analysis, we aim to identify EAs with coverage significantly below 70%, in accordance with the Year-1 target of the Mozambique President's Malaria Initiative for bednet possession (18). The α-error, or provider risk, is defined to be ≤10% (α/β errors and provider/consumer risks are discussed elsewhere (15, 19)).

## LC-LQAS METHODOLOGY

Because LQAS is based on random sampling, results from EA samples can be aggregated to estimate provincial and national-level coverage. During our second level of analysis, provincial and national estimates are calculated and compared to those reported in the MIS Mozambique 2007 summary report (13).

We next investigate the possibility of taking only a sub-sample of the EAs included in each province to calculate the provincial and national coverage estimates (12). This second aggregation is done to compare the estimates obtained using a smaller sample (220 EAs) to those estimates resulting from the full sample (345 EAs). This sub-sample was created based on random selections of 10 urban EAs and 10 rural EAs listed in the MIS cluster roster for each province. An additional 20 EAs were also sampled from Maputo City. We choose to include 220 EAs in the sub-sample. Since this is a *what-if* analysis and we did not intend to optimize the sample size, we did not explore further this choice of 220 EAs. The LC-LQAS method is used to calculate the coverage estimates for the sub-sample of EAs (12). In order to determine the coverage proportion and associated variance for each province, and subsequently for the entire nation, we applied formulas based on cluster sampling methodology (20).

# RESULTS

## LOCAL LEVEL BEDNET COVERAGE

The Mozambique MIS Household Survey Questionnaire includes questions regarding household possession of <u>any bednet</u> and household possession of <u>any ITN</u>. Table 1 summarizes the responses and LQAS results pertaining to the first indicator, obtained in the province of Manica. While the estimated provincial coverage proportion is 42.7%, Table 1 displays 10 of 28 EAs classified by LQAS to have sufficient coverage. Therefore, within the province, slightly less than half of the areas are not significantly below the coverage target, and these are interspersed with those having severely inadequate coverage. Table 2 also provides information on household possession of ITNs from respondents residing in Manica. Despite having a provincial coverage estimate of only 36.8%, Manica contains three EAs with adequate ITN coverage.

(Tables 1-2 here)

Table 3 gives provincial coverage estimates for any bednet and the corresponding 95% confidence intervals for each proportion estimate. It also summarizes the number of EAs within each province classified as having adequate coverage of any bednet, followed in parentheses by the total number of EAs sampled. While the highest provincial coverage estimate is just above 50%, all of the provinces contain several EAs classified with adequate coverage. Figure 1 depicts the geographical distribution of EA performance on this indicator. Table 4 contains the provincial coverage estimates for the ITN household possession indicator. Three of 11 provinces contain any EAs with adequate levels of ITN coverage.

(Tables 3-4 here)

(Figure 1 here)

**LC-LQAS COVERAGE ESTIMATES**

The LC-LQAS method was next used to obtain provincial and national estimates from a sub-sample of EAs within each province. This was performed to assess the accuracy of the point estimates and confidence intervals obtained for the sub-sample using LC-LQAS (Tables 5 and 6) by comparing them to those obtained for the full sample using the traditional LQAS approach (Tables 3 and 4).

(Tables 5-6 here)

The LC-LQAS generated sub-sample coverage estimates for household possession of any bednet and any ITN are summarized in Tables 5 and 6. In all cases, the provincial coverage estimates of household possession of any bednet are very similar to those reported in Table 3. Further, the sub-sample estimates of possession of any ITN are comparable to those reported in Table 4. However, two provinces display differences in coverage of 5-7%. The expected widening of the confidence intervals corresponding to the sub-sample estimates is also evident; however, the widths remain very close to the generally accepted range of ±10 percentage points for large-scale household surveys.

The LC-LQAS sub-sample coverage estimates are compared to the full LQAS sample estimates in Table 7. In this table, we also compare the provincial and national coverage estimates, obtained using the regular LQAS method, to those reported in the Mozambique MIS Report. We make this comparison to determine whether the slight variation in sampling weights used in each case had a noticeable impact on the provincial estimates obtained. LQAS estimates derived from the full sample correspond very closely to the

MIS figures, indicating that the slight variation in weights does not have a large impact on the final estimates obtained.

(Table 7 here)

The last row of Table 7 gives the national coverage estimates for each indicator, calculated by applying the LC-LQAS point estimator and variance formulas (12). The national coverage estimates based on the sub-sample differ only slightly from those based on the full LQAS sample. Possession of any bednet varies by 1%; possession of any ITN varies by less than 0.5%.

The national figures corresponding to the LC-LQAS sub-sample and the complete LQAS sample are provided in Table 8, accompanied by the 95% confidence intervals for each of the four proportion estimates. As the MIS report did not include confidence intervals for cluster-sample results, they are not included. Once again, we observe a slight widening of the confidence intervals for the sub-sample estimates, as expected. However, the 95% confidence intervals for both indicator estimates remain well within the generally acceptable range of ±10 percentage points (± 0.035, ±0.028, respectively).

(Table 8 here)

## DISCUSSION

To determine whether LQAS can be used to effectively measure malaria outcome indicators, one could carry out a field test; however, we emulated the application of LQAS by applying this method to an existing dataset. By analyzing MIS data from

Mozambique (2007) with the LQAS method, we determine which EAs of the MIS sample are performing adequately based on 70% bednet coverage targets. We find variation in the performance of EA that is masked by a single point estimate for the province. Further, the aggregate results from the LQAS activity, both in the full dataset and the sub-sample for LC-LQAS yield similar results.

Currently, the national and provincial level estimates reported in large household survey publications indicate whether overall program targets are being reached in a broad geographical area; however, they do not indicate whether program targets have been reached within local areas. In this <u>what-if analysis</u> EAs simulate program areas. By identifying program areas that fall significantly below the 70% target, provincial program managers could focus limited resources on those areas with greatest need. Such action would allow for a more efficient and effective distribution campaign, and could not be taken if only provincial coverage estimates were available.

Previous implementation of LQAS for local program monitoring has demonstrated that this tool can be used frequently, rapidly, and cost-effectively to provide information for allocating resources. LQAS also requires small sample sizes and minimal training. These favorable attributes encourage the use of LQAS for local malaria program monitoring and evaluation. Further, the results presented in this paper show that by using LQAS, one can not only obtain important local coverage information, but also aggregate the district-level data to obtain provincial and national coverage estimates needed for a broader assessment of program success and which are frequently required by donor agencies. Consequently, reporting responsibilities can be fulfilled while local-level benefits are simultaneously being reaped.

Since this analysis was conducted using a pre-existing dataset, certain limitations are inherent to this study. For example, EAs included in the MIS sample do not correspond to specific health districts in Mozambique, and therefore the local-level results are not directly applicable to operations on the ground because they do not correspond to a specific local manager. This lack of correspondence necessitated that a what-if analysis be conducted; however, if LQAS was implemented in the field, EAs could be chosen during the survey design phase to align with health districts.

Had this method been field-tested, a slightly larger sample size would also have been chosen for certain EAs. Those EAs consisting of only 15 households would have been designed instead to include a number closer to 19, the sample size traditionally used for LQAS to achieve desirable levels of power (15). However, considering that this study is intended to demonstrate the potential applicability of LQAS, we are not concerned with the specific level of misclassification ($\beta$ error) associated with each EA-level coverage estimate.

The provincial-level estimates obtained using the LC-LQAS sub-sample and the complete sample are very similar for the indicator measuring possession of any bednet, with the greatest discrepancy being equal to less than 4% coverage. However, in certain provinces the sub-sample estimates of ITN possession are associated with differences of

5-7% coverage as compared to estimates obtained using the complete sample. The extreme differences observed for this indicator, attributable to the extremely low ITN coverage in some provinces, may increase the variance of the estimator.

Despite the lower ITN coverage estimates obtained for certain provinces, the national percent coverage estimated using a subset of 220 EAs is still reassuringly close to that obtained using the full-sample. The same is true of the national coverage of the any bednet indicator estimated using the sub-sample. Both estimates are within a single percentage point of those obtained using the complete sample. We did not investigate other, smaller sub-sample sizes during this analysis. With fewer than 220 clusters, the width of the confidence intervals would of course increase; to what extent it should be permitted to increase depends on the quality of the inference required by policy makers.

Our findings indicate that reducing the number of clusters sampled from 345 to 220 results in no meaningful loss of precision at the provincial or national level. These results demonstrate that comparable coverage estimates can be obtained at both provincial and national levels with approximately two-thirds the amount of resources required. Such findings indicate that LC-LQAS can provide an accurate and efficient means of assessing bednet coverage achieved by malaria control programs.

## CONCLUSIONS

These results suggest that LQAS is a suitable method to measure malaria intervention coverage during the current phase of program scale-up. LQAS has been used on a regular basis for monitoring HIV/AIDS and child health programs (7, 9). Similarly, LQAS can be used to monitor malaria control programs and to complement and extend large-scale household surveys.

This analysis was initially conducted in order to investigate the feasibility of the use of LQAS to estimate malaria indicators currently assessed using MIS results. The demonstrated methods could play a tangible role in the field where there is a growing interest in obtaining coverage estimates for small geographic units, in addition to provincial estimates. There are two immediate strategies to allow local LQAS classification for malaria programs in the field. The first is to include considerations for LQAS during the design of MIS surveys, in essence by ensuring sufficient sample sizes at the EA level for classification as described by classic LQAS. Further, using the MIS cluster design and defining the cluster by health program catchment area allows the LQAS classification to translate directly into actionable results in program areas. This strategy is applicable to programs needing district-level data, but do not require a coverage estimate for each district. Since the total sample size needed to obtain point estimates for each district could be extremely large using traditional MIS methodology, managers may prefer to use LQAS to obtain a pass/fail result for each district or LC-LQAS to obtain results for a sample of districts. Such information is not currently available from an MIS.

A second, longer term solution is to use LQAS methodology as the cornerstone of an ongoing malaria monitoring and evaluation system. By collecting LQA samples routinely in all or a random selection of health program areas, we can estimate provincial and national level malaria indicators on a regular, ongoing and periodic basis using stratified or cluster sampling analysis. This solution requires an initial investment in training local program managers in data collection and LQAS analysis, but results in a sustainable M&E system that encourages data-driven decisions at decentralized and centralized levels.

LQAS offers an alternative to malaria control program managers who are interested in tracking coverage at a local level to improve their service delivery strategies and tactics, or to adjust priorities. As more countries aim to control malaria by scaling-up coverage, it becomes necessary to offer alternatives to the national level surveys that provide a single set of indicators for a country and do not present differences across local levels nor frequent or timely measures. LQAS, either integrated with national surveys or as a backbone of a malaria monitoring and evaluation system, is a suitable method to determine the impact and needs of programs in smaller geographic areas.

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TABLE 1. LQAS results for household possession of any bednet in Manica Province, Mozambique, 2007

**Decision Rules set for $\alpha+\beta\leq0.20$, 70% coverage target**

| EA ID | Yes | Total | Decision Rule | LQAS |
|---|---|---|---|---|
| 175 | 8 | 18 | 10 | failure |
| 176 | 14 | 20 | 12 | ***success*** |
| 177 | 9 | 20 | 12 | failure |
| 178 | 12 | 20 | 12 | ***success*** |
| 179 | 11 | 19 | 11 | ***success*** |
| 180 | 10 | 20 | 12 | failure |
| 181 | 15 | 17 | 10 | ***success*** |
| 182 | 14 | 20 | 12 | ***success*** |
| 183 | 5 | 20 | 12 | failure |
| 184 | 12 | 20 | 12 | ***success*** |
| 185 | 14 | 21 | 12 | ***success*** |
| 186 | 10 | 20 | 12 | failure |
| 187 | 13 | 20 | 12 | ***success*** |
| 188 | 7 | 16 | 9 | failure |
| 189 | 8 | 14 | 8 | ***success*** |
| 190 | 7 | 15 | 9 | failure |
| 191 | 7 | 15 | 9 | failure |
| 192 | 7 | 15 | 9 | failure |
| 193 | 2 | 15 | 9 | failure |
| 194 | 3 | 15 | 9 | failure |
| 195 | 8 | 15 | 9 | failure |
| 196 | 1 | 15 | 9 | failure |
| 197 | 8 | 15 | 9 | failure |
| 198 | 7 | 15 | 9 | failure |
| 199 | 1 | 15 | 9 | failure |
| 200 | 6 | 15 | 9 | failure |
| 201 | 5 | 15 | 9 | failure |
| 202 | 11 | 15 | 9 | ***success*** |
| **Total** | 235 | 480 | | **10 successes** |

TABLE 2. LQAS results for household possession of any ITN in Manica Province, Mozambique, 2007

**Decision Rules set for $\alpha+\beta \leq 0.20$, 70% coverage target**

| EA ID | Yes | Total | Decision Rule | LQAS |
|---|---|---|---|---|
| 175 | 8 | 18 | 10 | failure |
| 176 | 11 | 20 | 12 | failure |
| 177 | 8 | 20 | 12 | failure |
| 178 | 10 | 20 | 12 | failure |
| 179 | 8 | 19 | 11 | failure |
| 180 | 8 | 20 | 12 | failure |
| 181 | 11 | 17 | 10 | ***success*** |
| 182 | 9 | 20 | 12 | failure |
| 183 | 4 | 20 | 12 | failure |
| 184 | 10 | 20 | 12 | failure |
| 185 | 11 | 21 | 12 | failure |
| 186 | 8 | 20 | 12 | failure |
| 187 | 7 | 20 | 12 | failure |
| 188 | 6 | 16 | 9 | failure |
| 189 | 8 | 14 | 8 | ***success*** |
| 190 | 6 | 15 | 9 | failure |
| 191 | 4 | 15 | 9 | failure |
| 192 | 7 | 15 | 9 | failure |
| 193 | 2 | 15 | 9 | failure |
| 194 | 3 | 15 | 9 | failure |
| 195 | 5 | 15 | 9 | failure |
| 196 | 0 | 15 | 9 | failure |
| 197 | 8 | 15 | 9 | failure |
| 198 | 7 | 15 | 9 | failure |
| 199 | 0 | 15 | 9 | failure |
| 200 | 5 | 15 | 9 | failure |
| 201 | 4 | 15 | 9 | failure |
| 202 | 9 | 15 | 9 | ***success*** |
| **Total** | 187 | 480 | | **3 successes** |

TABLE 3. Coverage proportions, confidence intervals and LQAS result summaries for household possession of any bednet in Mozambique: 2007

| Province | Coverage Proportion | 95% Confidence Interval | EAs w/adequate coverage (total EAs) |
|---|---|---|---|
| Niassa | 0.406 | (0.323, 0.489) | 10 (34) |
| Cabo Delgado | 0.376 | (0.305, 0.448) | 8 (33) |
| Nampula | 0.300 | (0.247, 0.353) | 3 (36) |
| Zambezia | 0.310 | (0.243, 0.377) | 5 (36) |
| Tete | 0.318 | (0.241, 0.394) | 7 (34) |
| Manica | 0.427 | (0.363, 0.492) | 10 (28) |
| Sofala | 0.512 | (0.445, 0.579) | 16 (34) |
| Inhambane | 0.315 | (0.253, 0.377) | 7 (34) |
| Gaza | 0.368 | (0.299, 0.437) | 6 (24) |
| Maputo Province | 0.335 | (0.281, 0.389) | 2 (32) |
| Maputo Cidade | 0.481 | (0.416, 0.546) | 5 (20) |

TABLE 4. Coverage proportions, confidence intervals and LQAS result summaries for household possession of any ITN in Mozambique: 2007

| Province | Coverage Proportion | 95% Confidence Interval | EAs w/adequate coverage (total EAs) |
|---|---|---|---|
| Niassa | 0.178 | (0.130, 0.226) | 0 (34) |
| Cabo Delgado | 0.195 | (0.134, 0.256) | 2 (33) |
| Nampula | 0.084 | (0.053, 0.116) | 0 (36) |
| Zambezia | 0.143 | (0.084, 0.201) | 0 (36) |
| Tete | 0.130 | (0.081, 0.180) | 0 (34) |
| Manica | 0.368 | (0.301, 0.435) | 3 (28) |
| Sofala | 0.228 | (0.171, 0.284) | 1 (34) |
| Inhambane | 0.102 | (0.072, 0.133) | 0 (34) |
| Gaza | 0.119 | (0.072, 0.165) | 0 (24) |
| Maputo Province | 0.067 | (0.042, 0.092) | 0 (32) |
| Maputo Cidade | 0.099 | (0.068, 0.131) | 0 (20) |

TABLE 5. LC-LQAS sub-sample coverage proportions, confidence intervals and LQAS result summaries for household possession of any bednet in Mozambique: 2007

| Province | Coverage Proportion | 95% Confidence Interval | EAs w/adequate coverage |
|---|---|---|---|
| Niassa | 0.395 | (0.272, 0.518) | 5 (20) |
| Cabo Delgado | 0.395 | (0.289, 0.500) | 4 (20) |
| Nampula | 0.316 | (0.243, 0.390) | 1 (20) |
| Zambezia | 0.318 | (0.210, 0.426) | 3 (20) |
| Tete | 0.355 | (0.224, 0.486) | 6 (20) |
| Manica | 0.447 | (0.373, 0.520) | 9 (20) |
| Sofala | 0.479 | (0.390, 0.568) | 10 (20) |
| Inhambane | 0.350 | (0.241, 0.459) | 7 (20) |
| Gaza | 0.374 | (0.295, 0.452) | 6 (20) |
| Maputo Province | 0.330 | (0.265, 0.394) | 2 (20) |
| Maputo Cidade | 0.481 | (0.416, 0.546) | 5 (20) |

TABLE 6. LC-LQAS sub-sample coverage proportions, confidence intervals and LQAS result summaries for household possession of any ITN in Mozambique: 2007

| Province | Coverage Proportion | 95% Confidence Interval | EAs w/adequate coverage |
|---|---|---|---|
| Niassa | 0.128 | (0.077, 0.180) | 0 (20) |
| Cabo Delgado | 0.222 | (0.123, 0.321) | 1 (20) |
| Nampula | 0.067 | (0.026, 0.107) | 0 (20) |
| Zambezia | 0.158 | (0.051, 0.266) | 0 (20) |
| Tete | 0.149 | (0.041, 0.257) | 0 (20) |
| Manica | 0.402 | (0.324, 0.481) | 4 (20) |
| Sofala | 0.161 | (0.108, 0.214) | 2 (20) |
| Inhambane | 0.103 | (0.059, 0.146) | 0 (20) |
| Gaza | 0.135 | (0.085, 0.186) | 0 (20) |
| Maputo Province | 0.067 | (0.034, 0.100) | 0 (20) |
| Maputo Cidade | 0.099 | (0.068, 0.131) | 0 (20) |

TABLE 7. Provincial and national coverage estimates for aggregate LC-LQAS, LQAS, and MIS cluster-samples: Mozambique 2007

| **Province** | **Any Bednet in HH** | | | **Any ITN in HH** | | |
|---|---|---|---|---|---|---|
| | LC-LQAS sub sample | full LQAS sample | MIS Cluster estimate | LC-LQAS sub sample | full LQAS sample | MIS Cluster estimate |
| Niassa | 0.395 | 0.406 | 0.422 | 0.128 | 0.178 | 0.177 |
| Cabo Delgado | 0.395 | 0.376 | 0.378 | 0.222 | 0.195 | 0.196 |
| Nampula | 0.316 | 0.300 | 0.329 | 0.067 | 0.084 | 0.087 |
| Zambezia | 0.318 | 0.310 | 0.365 | 0.158 | 0.140 | 0.178 |
| Tete | 0.355 | 0.318 | 0.317 | 0.149 | 0.130 | 0.119 |
| Manica | 0.447 | 0.427 | 0.448 | 0.402 | 0.368 | 0.369 |
| Sofala | 0.479 | 0.512 | 0.504 | 0.161 | 0.228 | 0.217 |
| Inhambane | 0.350 | 0.315 | 0.323 | 0.103 | 0.102 | 0.112 |
| Gaza | 0.374 | 0.368 | 0.373 | 0.135 | 0.119 | 0.133 |
| Maputo Prov. | 0.330 | 0.335 | 0.297 | 0.068 | 0.067 | 0.057 |
| Maputo Cidade | 0.481 | 0.481 | 0.486 | 0.099 | 0.099 | 0.102 |
| **National Coverage** | **0.365** | **0.355** | **0.375** | **0.143** | **0.145** | **0.158** |

TABLE 8. National coverage estimates and confidence intervals for aggregate LC-LQAS and LQAS samples: Mozambique 2007

| | LC-LQAS Sub Sample | | Full LQAS Sample | |
|---|---|---|---|---|
| **Indicator** | **Coverage Proportion** | **95% Confidence Interval** | **Coverage Proportion** | **95% Confidence Interval** |
| Possession of Any Bednet | 0.365 | (0.330, 0.401) | 0.355 | (0.332, 0.377) |
| Possession of Any ITN | 0.143 | (0.115, 0.171) | 0.145 | (0.128, 0.162) |

FIGURE 1. Survey Enumeration Areas with adequate or low coverage according to LQAS results: Mozambique 2007