VITAMIN A SUPPLEMENTATION PROGRAM

Multiple use of the Lot Quality Assurance Sampling (LQAS) methodology for Vitamin A supplementation services

1. What is VAS?

The World Health organization (WHO) recommends that all children aged 6 to 59 months be supplemented every six months with high dose of vitamin A (100,000 IU for 6 to 12 months old and 200,000 IU for 12 to 59 months old children). The recommendations are associated with the evidence that when twice-yearly vitamin A supplementation (SVA) covers at least 80% of the children aged 6 to 59 months; it contributes to reducing the under-five mortality rates by up to 24%.

VAS is delivered, in most countries, through twice-yearly national campaigns. These events combine polio immunization, routine immunizations (such as measles) as per the country's immunization calendar, vitamin A supplementation and deworming. In some countries, additional services such as detection of wasting or family planning are also integrated in the package delivered. The campaigns are organized as door-to-door events where health workers visit each household or as fixed strategies where caregivers are invited to bring their children to the nearest health facility (or outreach site when combined with fixed facility delivery) to receive the services.

Alternative to the event-based delivery of VAS is their integration into routine services: a six-month contact point is commonly integrated within countries vaccination calendars at exactly 6 months of age. In addition, when increased coverage of facility based routine immunization and eradication of polio render campaigns unnecessary, VAS is integrated as a routine service provided in health facilities.

2. What is LQAS?

LQAS was originally developed in the 1920s to control the quality of industrially produced goods. During the mid-1980s, health system evaluators explored the applications of this approach to assess health workers performance. LQAS received considerable attention as a potentially cost effective and easy-to-use method for assessing local health systems and their performance in developing-world settings.
LQAS is used to assess whether quality falls between the following options: acceptable or unacceptable. In an industrial setting, the method was used to validate the acceptability of entire lots of produced goods by only having to assess a small number of them. In the health sector, LQAS allows for classifying entire administrative areas based on their performance with use of much smaller samples than are usually required in monitoring or research settings. It can be used to assess the coverage of VAS after a national Vas campaign took place.

For instance, the most common sampling for LQAS in public health consists in surveying 19 individuals or households in 5 supervision areas, so a total of 95 questionnaires to be administered to provide a representative picture of the zone assessed. A common cross-sectional survey used for monitoring health programs usually requires between 600 and 900 questionnaires to yield representative results.

3. Objectives

3.1. Objectives of the guides

This guide aims at showing managers in charge of VAS programs how the LQAS methodology can be used efficiently and at a low cost to monitor the performance of the services they support and identify areas of low performance. It is not intended to provide detailed guidance on how to prepare and conduct an LQAS survey, for which detailed guidance documents already exist and references are provided in Annex 1.

3.2. Objectives of LQAS

LQAS uses a cross sectional survey approach and can support VAS services in various ways:

- to identify priority areas for improving coverage: areas not reaching an established performance benchmark for coverage (i.e. <80% coverage of VAS) are identified;
- to measure coverage at an aggregate level (e.g. program catchment area or district or national level);
- To assess the quality of care of routine VAS delivery (comparing a random sample of facilities to a quality of care benchmark);
- To evaluate the level of awareness or knowledge of caregivers after a social mobilization campaign (and identify areas of low performance);
- To measure the performance of field activities (either outreach delivery or social mobilization or even door-to-door distribution campaigns).

4. Principles

Because of its small sample, LQAS does not provide very accurate measures of prevalence or of proportion of the population having access to specific services. It however allows classifying between targeted areas which one exhibits a sufficient access and which one does not.

4.1. Some definitions

Some definition are essential to understand LQAS:

- Lot

The lot represents the group of supervision areas for which the coverage of VAS is to be measured. The lot is therefore the overall area where programs are being implemented or where monitoring is meant to take place. It should be a coherent homogeneous administrative entity.

- Supervision area

The supervision area (SA) is the smallest administrative unit in the targeted area where a decision capacity exists. For instance, sub-counties in Kenya, LGA's in Nigeria or Zones de Santé in DRC. The survey will classify each SA between passing or failing the test and is meant to help targeting which SA's to focus more efforts on. So the SA should respect the following criteria
    - Decisions can be taken at that level
    - The indicators assessed are homogeneous throughout the SA

The number of SAs ranges between 4 to 7, with the recommended number 5 in a catchment area allowing a coverage sample size of 95 which provides for a statistical confidence interval that will always be ±10%. Smaller sample size would make the district coverage estimation less precise.

- Benchmark and decision rules

Benchmarks represent the level for which the classification is set.

For VAS coverage, passing the test means reaching the target coverage rates of 80% of children 6 to 59 months.

More than one benchmark are used: an upper one and a lower one (also called upper and lower thresholds). The SA is considered as having passed the LQAS test if the results are above the upper benchmark. It is failing it if it is below the lower benchmark, and it is in a mixed status if in between both benchmarks. It is recommended that 30% be considered between the upper and lower benchmarks.

Table 1. Examples of design for LQAS surveys of various indicators for VAS

Type of measure	Benchmarks	Meaning	Associated action	Sampling	Decision rule
VAS coverage	High ≥80%	acceptable performance	No action	Cluster sampling[1] - 6 SA's of 10 children interviewed	≥ 52 covered
	Mixed >50% and <80%	mixed performance	Secondary priority		≥ 39 - < 52 covered
	low ≤50%	unacceptable performance	First priority		< 39 covered
Awareness of VAS delivery mechanisms	High ≥80%	acceptable performance	No action	SRS[2] sampling - 5 SAs of 19 measures	≥ 13 covered
	Mixed >50% and <80%	mixed performance	Secondary priority		≥ 7 - < 13 covered
	low ≤50%	unacceptable performance	First priority		< 7 covered
Performance of VAS routine services	High ≥60%	acceptable performance	No action	SRS sampling - 5 SAs of 19 measures	≥ 9 covered
	Mixed >30% and <60%	mixed performance	Secondary priority		≥ 3 - < 9 covered
	low ≤30%	unacceptable performance	First priority		< 3 covered

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[1] Cluster sampling consists in sub-dividing the population into clusters, usually representing communities, as an intermediary step before selecting individuals.
[2] SRS stands for simple random sampling, consisting in selecting the individuals to be surveyed directly without any stratification.

- Alpha and beta errors

LQAS judgments about supervision areas have a percentage of error, namely, the probability of misclassifying an SA as either having achieved the benchmark or not having achieved it. In standard statistical nomenclature, they correspond to alpha (α) and beta (β) errors.

The α error is the likelihood of rejecting a sample incorrectly-in this case, of falsely determining that the desired level of performance had not been met when it reality it had (specificity). The β error is the likelihood of accepting an SA as performing adequately when it falls short of the expected performance (sensitivity).

- Sample size

In general small samples of 19 interviews / questionnaires per SA provide an acceptable level of error for making management decisions; at least 92% of the time, it identifies correctly if the SA is above the upper benchmark or below the lower one.
Samples larger than 19 have practically the same statistical precision as 19. They do not result in better information, and they cost more.
Annex 1 illustrates the associations between sample size, benchmarks and α and β errors and shows that the 19 value corresponds to α and β errors <10%. It also provides decision rules values in relation to benchmarks and sample size.

- Decision rules

The decision rule is the translation of the benchmark into concrete absolute measures.
As shown in Annex XXX, for a sample of 19 and a benchmark of 65%, the decision rule is 10. This means that out of the 19 measures, if less than 10 are positive (i.e. received a service or are aware of it), then the SA fails the test. For a coverage of VAS with a benchmark of 80%, the decision rule would be 13.

4.2. When to use LQAS

LQAS can be used for a number of purposes. It can serve
- As a programmatic needs assessment tool to evaluate which SA's need the most urgent support;
- As a baseline to measure coverage of VAS or levels of knowledge or practices of a target population;
- As a monitoring tool at any point in the life of a program (LQAS is commonly used immediately after national immunization campaigns to measure the coverage reached for specific vaccines);
- As a final evaluation tool at the end of a program.

4.3. Who should use LQAS?

Any actor involved in public health who needs a cost effective estimate of the performance of an area or a program / service should consider using LQAS. Government actors, INGO's, UN agencies can all use LQAS for multiple purposes.

5. Process

The LQAS methodology applied to the health sector uses the same sampling approach as cross sectional surveys.

5.1. Define the objective

Objectives of the LQAS are numerous. In many cases, LQAS can be integrated in the programmatic activities and add, on top of the activities, a representative picture of an associated indicator.

- For instance, it is common to send teams of monitors observe the performance of field teams during door-to-door VAS events. Using an LQAS sampling could provide a quantitative measure of whether the field distribution was done according to protocols.
- Following an event, LQAS can combine the monitoring of the coverage of VAS with use of a small sample and also measure the level of awareness of caregivers on VAS, the event, or any other relevant topic.
- In a program devoted to the scale up of the 6-month contact point for VAS, or any routine VAS service, LQAS can be used to identify the proportion of facilities that meet minimum standards of implementation and/or quality of services.
- During social mobilization exercises, LQAS can measure whether the exercise has been effective at reaching its target population, and whether the population has retained the information provided (awareness measures)

For each objective, sampling, benchmarks and decision rules will have to be calculated specifically, as highlighted in table 1.

5.2. Preparation of the LQAS survey

As for any other type of survey, preparation includes designing of questionnaires, field-testing of the questionnaires and methodology, training of field workers and management of the data collected.

It is advisable to keep LQAS questionnaires as short as possible. The interest of the methodology consists in its small sample that allows for data collection to be done rapidly and at low cost.

For a sample of 5 SAs and 19 questionnaires per SA, the survey can be conducted by five teams of 2 surveyors in a five days period. Depending on the distance between communities, modes of transport and structure of the communities, the data collection can be reduced to 2 or 3 days or may have to be extended.

5.3. Methods of data collection

Data collection is to be organized in a similar way as for post event coverage surveys or any other traditional cross sectional survey. The steps to consider are:

- Selecting the SA's: if the objective is to measure the coverage of VAS over an area where more than 5 SA's exist, then SA's have to be randomly selected with use of probability proportionate to size (PPS) approach. The total population of the SA's and a sampling interval composed of the number of SA's to be selected are used for this initial selection.
- Selecting the communities: if the number of SA's is equal or lower than the design recommends (6 for coverage, 5 for other measures), then all SA's are surveyed independently. Within each SA, the selection of the communities where the interview will take place is also conducted with PPS and a list of call communities. The sampling interval is the number of interviews that should take place in each SA: 10 only in the case of coverage, up to 19 for other needs. The sampling interval is calculated by dividing the total population of the SA by the number of interviews to be conducted.
- Selecting the households: as for any survey, random selection from a list if simple random sampling can be done, otherwise use the segmentation approach to randomly select the household to be interviewed.

6. Parallel sampling for LQAS

In order to make the survey more cost effective and answer more than one indicator, LQAS can be used for multiple surveys at a time. For instance, it is possible to conduct an LQAS survey on coverage of VAS and at the same time investigate on caregivers awareness on VAS.
It is also possible to target different age groups with different questionnaires. The only important aspect to consider is that the sample should be respected for each questionnaire selected.[3]

7. Cluster LQAS versus LQAS

A cluster design is proposed for LQAS surveys when a large intra-cluster variance is expected for the indicator to be surveyed. This is the case when the indicator is not distributed homogeneously in the SA, as is the case for immunization or under nutrition, for instance. For both indicators, pockets of children exhibiting similar status may be found in communities. The organization of the LQAS survey in a cluster design reduces the risk of misclassification associated with this intra cluster variance.

8. Example

The most common assessments conducted for VAS are associated with coverage of VAS among children 6 to 59 months after a supplementation campaign and estimates of the awareness level of the population on VAS or the campaigns.

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[3] Core group, 2008, *Lot Quality Assurance Sampling (LQAS) - Protocol for Parallel Sampling*, Core group / USAID, available from:
http://www.coregroup.org/storage/documents/Workingpapers/LQAS_Protocol_for_Parallel_Sampling.pdf

It should be noted that the identification of the main reasons for children not to be covered is not practical with an LQAS design because children not covered could only be found easily without surveying a large number of households if the Vas coverage is very low.
The following example proposes a parallel sampling for a survey aiming at identifying both the coverage and awareness on the VAS campaign.

8.1. Target groups

The target group for the coverage estimates usually divides children in 2 groups: 6 to 11 months old and 12 to 59 months old, as the first group is more likely to be missed during campaigns.

The target group for the reasons for not being covered focuses on children 6 to 59 months not covered by supplementation

8.2. Sampling

The sampling for coverage, as shown in table 1, uses 6 clusters of 10 children. For differences between cluster – LQSA and traditional LQAS sampling, refer to section 7.
To integrate the two age groups, the surveyors will proceed similarly as for a traditional survey. However, the survey will only be completed once the number of children of each group is reached. This means that for all initial households selected, both groups are considered, until one of the sample is reached. As there are more children from the 12-59 months group in the population than children from the 6-11 months group, once the surveyors have reached 10 older children in their cluster they will continue surveying households using the same random selection approach and only focus on children of the first group, until 10 children of this age group are found as well.

For awareness of the VAS campaign, the sampling is supposed to be different: 5 SAs are to be randomly selected, and 19 children are to be surveyed in each SA. In order to be able to combine both surveys together, it is proposed that the same sample be used for both questions, a cluster LQAS sample of 6 x 10. Otherwise, survey teams would need to visit up to 25 locations to fulfil the two samples requirements (19 for awareness and 6 for coverage), which would increase significantly the heaviness of the data collection exercise.

8.3. Questions

The question about coverage is simply whether the child has received VAS during the recent campaign.
The question on awareness should be carefully selected. Multiplying the questions as commonly done in large sample cross sectional surveys such as the PECS is impractical as it will increase significantly the time spent in each household and reduce the benefits of using a small sample survey. The survey team should therefore identify in advance the most likely cause for children not being covered, and build the question accordingly. Most common reasons are that caregivers were not aware that a campaign was taking place; that caregivers were absent during the campaign; or that the campaign did not take place in their area of living (most common in campaigns were distribution is organized from scattered health facilities).

8.4. Findings

Table 2 provides an example of how the findings could be summarized and presented.

Three samples are considered; therefore, three sets of data should be communicated. It should be remembered that LQAS only provides information whether the area surveyed passed or failed the test of coverage and awareness. It is not possible with such a small sample to provide more details than proposed in the table.

It is not possible to take any conclusion on associations between coverage and awareness with the data collected. This association should be identified in larger sample surveys and be the reason why the awareness question was selected to accompany the coverage one. As shown in table 2, there may be a correlation, but not systematically, and if coverage is low while awareness is high in some districts, this means that the question selected may not have been the most relevant for this district.

Table 2. Example of presentation of LQAS findings

Type of measure	Coverage benchmarks and associated decision rule (DR)	Areas	Findings	Test	Action
VAS coverage 6-11 months	• High ≥80% = DR ≥ 52	District A	Result: 41 children covered out of 60	Failed – coverage is likely below 80% but likely above 50%	Action needed to improve coverage
		District B	Result: 51 children covered out of 60	Failed – coverage is likely below 80% but likely above 50%	Action needed to improve coverage
		District C	Result: 37 children covered out of 60	Failed – coverage is likely below 50%	Priority district for action to improve coverage
VAS coverage 12 - 59 months	• Low >50% and <80% = DR ≥ 39 and < 52	District A	Result: 41 children covered out of 60	Failed – coverage is likely below 80% but likely above 50%	Action needed to improve coverage
		District B	Result: 56 children covered out of 60	Pass – coverage is likely above 80%	None
		District C	Result: 37 children covered out of 60	Failed – coverage is likely below 50%	Priority district for action to improve coverage
Awareness of the campaign	• Very low ≤50% = DR < 39	District A	Result: 39 caregivers aware out of 60	Failed – awareness is likely below 80% but likely above 50%	Action needed to improve awareness – may be associated with low coverage
		District B	Result: 54 caregivers aware out of 60	Pass – awareness is likely above 80%	None
		District C	Result: 57 caregivers aware out of 60	Pass – awareness is likely above 80%	Action needed to identify other reasons for low coverage for this district

9. Advantages and Limitations of LQAS

Some of the advantages of LQAS are

- Low sample size needs (n=19 in most cases) that yields reliable (categorization) decisions on performance. Usual cross sectional surveys require 30 clusters of 30 children, so five districts can be surveyed for coverage with LQAS for the resources needed for one with PECS (number of clusters is the main determinant of resources for a survey, size of each cluster being secondary)
- Locally relevant results (SA and district)
- Can be utilized in strategic or periodic planning to identify priority targets
- Provide cost effective monitoring tool that provides population representative results
- Simple to apply (personnel and information) yet very specific conclusions
- Can be used by area supervisors to conduct self-evaluation
- Data can be analyzed in a short period of time.
- Can be collated and used for large area estimates e.g. district, regional or national estimates

Some of the limitations of LQAS are

- LQAS cannot be used to answer the "why?" since its role is to tell whether a lot « passes » or « fails » on a pre-defined criteria
- Because the sample size is so reduced the creation of sub groups and stratified analyses is impossible; and
- LQAS does not provide accurate quantitative measures as would do larger sample surveys (such as PECS)
- Comparability of LQAS results over time and between areas are mainly associated with the passing or the failing of the test.

Annex 1. LQAS decision rule and sampling

Annual Coverage Benchmarks (for Monitoring and Evaluation) - Sample or Average Coverage (Baselines, Monitoring, and Evaluation)

Sample Size	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
12	N/A	N/A	1	1	2	2	3	4	5	5	6	7	7	8	8	9	10	11
13	N/A	N/A	1	1	2	3	3	4	5	6	6	7	8	8	9	10	11	11
14	N/A	N/A	1	1	2	3	4	4	5	6	7	8	8	9	10	11	11	12
15	N/A	N/A	1	2	2	3	4	5	6	6	7	8	9	10	10	11	12	13
16	N/A	N/A	1	2	2	3	4	5	6	7	8	9	9	10	11	12	13	14
17	N/A	N/A	1	2	2	3	4	5	6	7	8	9	10	11	12	13	14	15
18	N/A	N/A	1	2	2	3	5	6	7	8	9	10	11	11	12	13	14	16
19	N/A	N/A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
20	N/A	N/A	1	2	3	4	5	6	7	8	9	11	12	13	14	15	16	17
21	N/A	N/A	1	2	3	4	5	6	8	9	10	11	12	13	14	16	17	18
22	N/A	N/A	1	2	3	4	5	7	8	9	10	12	13	14	15	16	18	19
23	N/A	N/A	1	2	3	4	6	7	8	10	11	12	13	14	16	17	18	20
24	N/A	N/A	1	2	3	4	6	7	9	10	11	13	14	15	16	18	19	21
25	N/A	1	2	2	4	5	6	8	9	10	12	13	14	16	17	18	20	21
26	N/A	1	2	3	4	5	6	8	9	11	12	14	15	16	18	19	21	22
27	N/A	1	2	3	4	5	7	8	10	11	13	14	15	17	18	20	21	23
28	N/A	1	2	3	4	5	7	8	10	12	13	15	16	18	19	21	22	24
29	N/A	1	2	3	4	5	7	9	10	12	13	15	17	18	20	21	23	25
30	N/A	1	2	3	4	5	7	9	11	12	14	16	17	19	20	22	24	26

N/A — *not applicable*, meaning LQAS cannot be used in this

Light grey cells indicate where *alpha* or *beta* errors are ≥ 10

Dark grey cells indicate where *alpha* or *beta* errors are > 15%. Other cells represent α and β <10%

Annex 2 – Resource documents and papers (non exhaustive)

<u>Guidelines</u>

- Lot Quality Assurance Sampling (LQAS) - Protocol for Parallel Sampling, 2008, Core group / USAID, available from:
  http://www.coregroup.org/storage/documents/Workingpapers/LQAS_Protocol_for_Parallel_Sampling.pdf

- LQAS frequently asked questions, 2008, Core group, available from:
  http://www.coregroup.org/storage/documents/Workingpapers/LQAS_FAQ.pdf

- A Trainers Guide for Baseline Surveys and Regular Monitoring Using LQAS for Assessing Field Programs in Community Health in Developing Countries, Valadez, Weiss, Leburg, Davis, available from: http://pdf.usaid.gov/pdf_docs/Pnacq794.pdf

- Assessing community health programs – a participants manual and workbook using LQAs for baseline surveys and regular monitoring, Valadez, Weiss, Leburg, Davis, available from:
  http://www.coregroup.org/storage/documents/LQAS/Assessing_Community_Health_Programs_A_Participants_Manual_and_Workbook.pdf

- Assessing vaccination coverage levels using clustered lot quality assurance sampling, 2012, *Version edited for the global polio eradication initiative*, available from:
  http://www.polioeradication.org/portals/0/document/research/opvdelivery/lqas.pdf

<u>Papers</u>

- Hund,L., Bedrick, E.J., Pagano, M., 2015, Choosing a Cluster Sampling Design for Lot Quality Assurance Sampling Surveys, Plos One DOI: 10.1371/journal.pone.0129564, available from:
  http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0129564

- Pezzoli, L., Andrews, N. , Ronveaux, O., 2010, Clustered lot quality assurance sampling to assess immunization coverage: increasing rapidity and maintaining precision, *tropical medicine and international health*, volume 15 no 5 pp 540–546 may 2010, available from:
  http://www.ncbi.nlm.nih.gov/pubmed/20214765

- Deitchler, M., Valadez, J.J., Egge, K., Fernandez, S., Hennigan, M., 2007, A field test of three LQAS designs to assess the prevalence of acute malnutrition, *International journal of epidemiology*, doi:10.1093/ije/dym092, available from:
  http://www.ncbi.nlm.nih.gov/pubmed/17517808

- Brown, A.E., Okayasu, H., Nzioki, M.M., Wadood, M.Z., Chabot-Couture, G., Quddus, A., Walker, G., Sutter, R.W., 2014, Lot Quality Assurance Sampling to Monitor Supplemental Immunization Activity Quality: An Essential Tool for Improving Performance in Polio Endemic Countries, *The Journal of Infectious Diseases* 210(S1):S333–40, available from:
  http://www.ncbi.nlm.nih.gov/pubmed/25316852