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Analysis of the Sentinel Site Nutrition Surveillance System in Mozambique

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Abbreviations and Acronyms

AIDS	Acquired Immunodeficiency Syndrome
APE	Agente Polivalente Elementar (frontline health worker)
CCR	Consulta da Criança em Risco (at-risk child consultation)
CCS	Consulta da Criança Sadia (well-child consultation)
DHS	Demographic and Health Survey(s)
FANTA	Food and Nutrition Technical Assistance III Project
HFA	height-for-age
HIS	health information system(s)
HIV	human immunodeficiency virus
MICS	Multiple Indicators Cluster Survey(s)
MISAU	Ministério da Saúde (Ministry of Health)
PAMRDC	Plano de Acção Multissectorial para a Redução da Desnutrição Crónica em Moçambique (Multisectoral Action Plan to Reduce Chronic Undernutrition in Mozambique)
SUN	Scaling Up Nutrition
U.S.	United States
USAID	U.S. Agency for International Development
WFA	weight-for-age
WFH	weight-for-height
WHO	World Health Organization

1 Background

This report was written following an assessment of the Mozambican nutrition sentinel site surveillance system conducted between April 28 and May 9, 2014. The assessment was led by the Ministry of Health (*Ministério da Saúde* [MISAU]) and the World Health Organization (WHO) with technical assistance from the Food and Nutrition Technical Assistance III Project (FANTA).

1.1 History of the Sentinel Site System

In 2009, MISAU introduced a nutrition surveillance system based on a network of sentinel sites located in a selection of health clinics in district capitals to address factors that MISAU felt could lead to increases in malnutrition, namely drought, food insecurity, and HIV and AIDS (MISAU, 2006).

The **overall objective** of the system was to "perform a descriptive and analytical diagnosis of the nutritional situation of the country, helping to identify the nature and magnitude of problems directly related to nutrition, identifying geographical areas, social sectors and population groups at greatest risk."

The **specific objectives** of the system provide an overall understanding of the goals identified by MISAU in the field of nutrition surveillance. These specific objectives were to:

- Monitor the rates of malnutrition and overweight through measurements of weight-for-height (WFH), an indicator of wasting or acute malnutrition; height-for-age (HFA), an indicator of stunting or chronic malnutrition; and weight-for age (WFA), an indicator of underweight; in children 0–59 months attending the Sentinel Nutritional Surveillance
- Evaluate, through monitoring of key indicators of nutritional status, the result of the impact of interventions
- Identify potential risk areas in order to draw specific policy plans
- Identify potential threats to the nutritional status of the population over time
- Facilitate sharing of information regarding the nutritional situation in the integrated health activities
- Improve the quality of services provided to the population
- Ultimately, contribute to the reduction of morbidity and mortality in children associated with nutritional problems

In 2012, MISAU decided to expand the system to at least half of the country's 128 districts by 2015 and to introduce a digital system using computer software, such as WHO ANTHRO.[1] In preparation for the expansion, MISAU, WHO, and FANTA undertook an assessment to analyze the performance of the current system and provide recommendations for improving it. The assessment also raised the question of the relevance of the system, i.e. whether it was the best system to monitor nutrition given Mozambique's context. The WHO assessment report focuses more on the system's performance whereas this report focuses more on the system's relevance in the broader picture.

[1] ANTHRO is a computer program that is used to process anthropometric data. The program can be found at http://www.who.int/childgrowth/software/en/.

1.2 Current System Set-Up

1.2.1 Indicators

The sentinel sites report on three indicators: WFH, WFA, and HFA.

1.2.2 Daily Sampling of Children

The sentinel site surveillance system consists of daily measurements of weight and height for the first 30 children attending the well-child consultation (*Consulta da Criança Sadia* [CCS]), where immunization and growth monitoring services are delivered in a selection of health clinics. One clinic is selected per district and is located in the district capital. This selection was based on practical considerations, as district capital health clinics are better staffed and equipped than more remote ones, and, therefore, have a higher chance of being able to sustain the surveillance system. To date, 58 clinics are supposed to be operational sites within the sentinel site surveillance network.

1.2.3 Site Data Collection and Analysis

Every day, a dedicated form is filled in with the age, sex, weight, and height of the first 30 children attending the CCS. Three extra columns are available on the form where personnel are supposed to record the nutritional status of each child as underweight, wasted, or stunted (Table 1). Some sites use the WHO growth curve percentiles, while others use z-scores.

Table 1. Illustrative Data Collection Form, Mozambique Sentinel Site Nutrition Surveillance

Child number	Date of birth	Age in months	Weight in grams	Height in cm	Weight-for-height	Height-for-age	Weight-for-age
1							
2							
3							
4							
5							
6							

Data are to be sent on a weekly basis to district health staff who compile district-based data and forward them to province health staff, who in turn compile the data at the provincial level and forward them to MISAU for national analysis. For the time being, as only one site exists per district, the role of the district health staff is limited, but their role will become more important if the number of sites is increased following the objectives of MISAU.

Table 2. Example of Weekly Compilation Conducted at District and Provincial Levels, Mozambique Sentinel Site Nutrition Surveillance

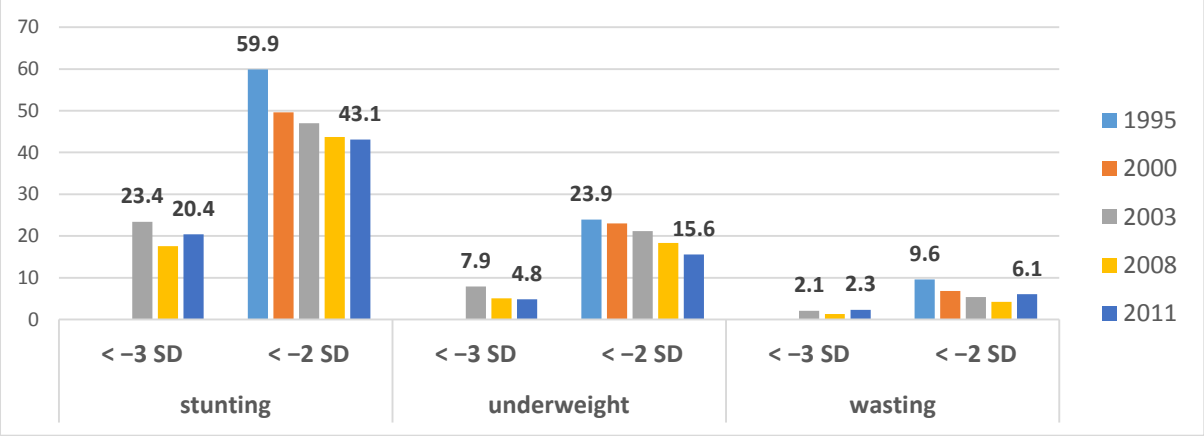
Site	Week 1			
	WFH < p3	WFH ≥ p3 and < p97	WFH ≥ p97	Total
Province of SOFALA	**54**	**863**	**36**	**953**
BEIRA	16	131	3	**150**
CHEMBA	4	82	–	**86**
CHIBABAVA	19	241	14	**274**
DONDO	8	120	–	**128**
GORONGOSA	–	45	–	**45**
MARROMEU	6	95	19	**120**
NHAMATANDA	1	149	–	**150**

Section 1.2 provides an analysis of stunting (HFA), wasting (WFH), and underweight (WFA) trends in Mozambique over the last decade, as analyzing the relevance of a nutrition surveillance system requires at least a minimum understanding of the situation of various forms of malnutrition in the country.

1.3 Malnutrition Trends in Mozambique

An analysis of Demographic and Health Surveys (DHS) conducted between 1995 and 2011 and adjusted to WHO 2006 growth standards[2] shows that all forms of malnutrition have been declining consistently over that time period. The decrease can be considered slow and steady, and slower for the most severe form of each type of malnutrition (z-score < −3) than for the moderate form (z-score < −2, which encompasses both [z-score < −3] and [z-score ≥ −3 and < −2]). Severe wasting is even seen on the rise during the same period, but these figures should be taken cautiously as 95% confidence intervals would likely show that the variation of severe wasting is statistically insignificant.

Figure 1. Trends in Malnutrition, Mozambique, 1995–2011



A closer look at the distribution of various forms of malnutrition between provinces and between urban and rural settings shows that the nutrition situation in Mozambique is heterogeneous, with certain regions bearing higher prevalence rates than others, and higher prevalences in rural versus urban areas: 46% stunting in rural areas and 35% in urban areas.

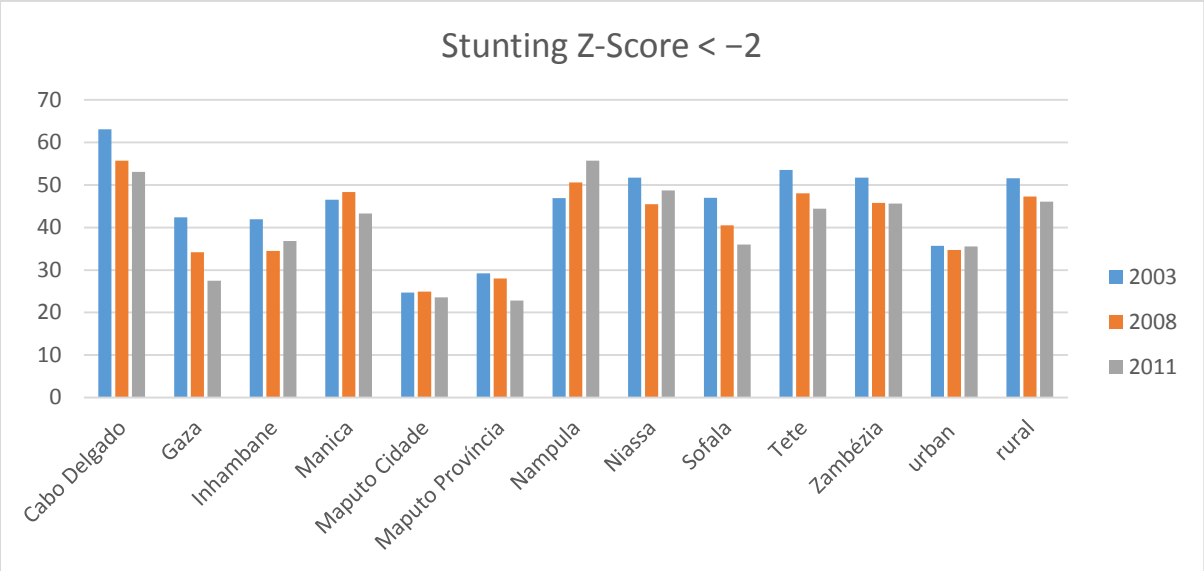
1.4 Stunting by Region

Prevalence of stunting is high in most provinces, but appears to be higher in the northern provinces, such as Niassa, Nampula, and Cabo Delgado, than in the southern provinces of Maputo, Inhambane, and Gaza. Northern provinces register prevalence stunting rates of more than 50% of children under 5, though the prevalence still exceeds 20% in the better-off southern provinces.

The prevalences of stunting between 2003 and 2011 also show varying trends between provinces and between rural and urban settings. All regions have registered a small decrease in prevalence of stunting between 2003 and 2011, with the exception of Nampula province, where a significant increase was seen. Rural settings have shown a decrease during the same period, but still remain well above stunting levels seen in urban ones.

[2] WHO. 2014. "Global Database on Child Growth and Malnutrition: Mozambique – Child malnutrition estimates by WHO Child Growth Standards." http://www.who.int/nutgrowthdb/database/countries/moz/en/.

Figure 2. Trends in Stunting by Province, Mozambique, 2003–2011

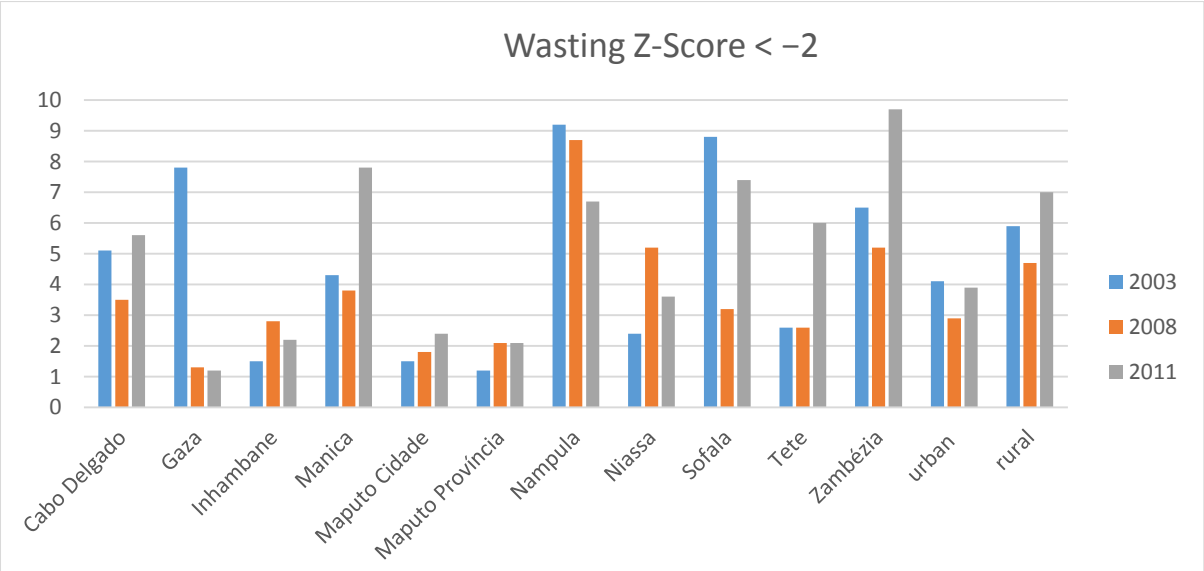


Wasting by Region

Wide variations can be seen between provinces when it comes to wasting. As with stunting, southern provinces show lower prevalences than northern ones, but the prevalences in all provinces are below 10%. Some variations between 2003 and 2011 might deserve further investigation, as several provinces show decreasing trends while others, such as Manica and Zambézia, show an increase in prevalence. Analysis of 95% confidence intervals might reveal that these variations are insignificant.

As with stunting, rural areas are more affected by stunting than urban ones.

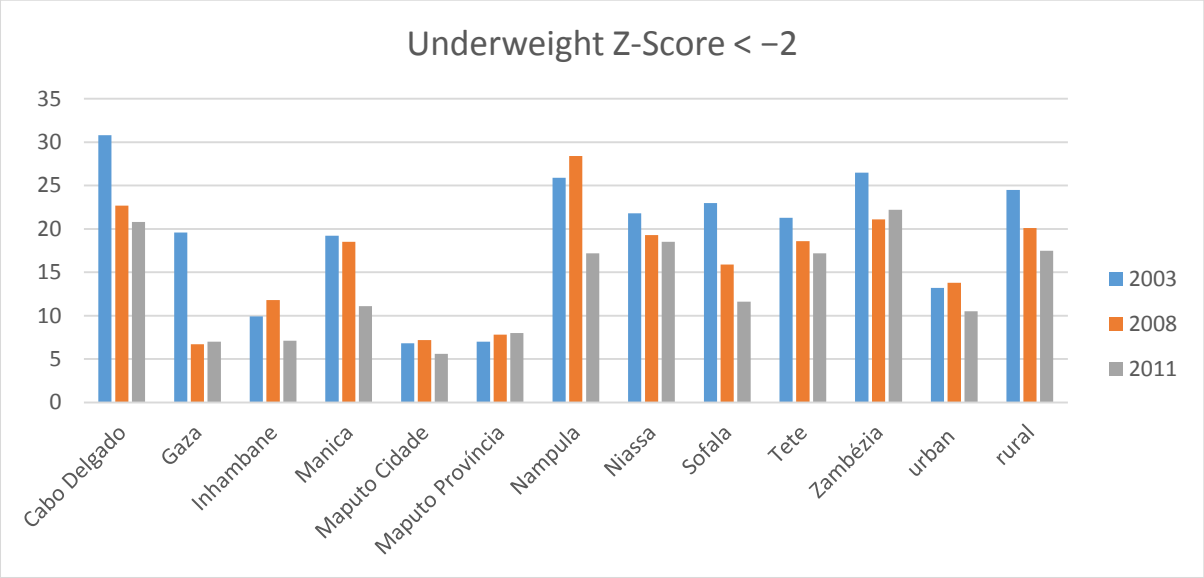
Figure 3. Trends in Wasting by Province, Mozambique, 2003–2011



Underweight by Region

Underweight trends have similar patterns as stunting trends, with northern provinces the most affected, showing a prevalence between 15% and 20% in 2011, whereas southern provinces generally remain below 10%. Underweight declined in all provinces and in both rural and urban settings between 1997 and 2011. Once again, rural areas have the highest prevalence.

Figure 4. Trends in Underweight by Province, Mozambique, 2003–2011



This overview of the malnutrition situation in Mozambique points out two main findings:

- The situation is worse in northern provinces and in rural settings than in southern provinces and urban settings.
- The prevalences of all forms of malnutrition are decreasing, but stunting remains a challenge in Mozambique in most provinces and settings.

2 Findings of the Assessment

The sentinel site surveillance system assessment in Mozambique focused on two aspects: analyzing the functioning of the system and analyzing the relevance of the system.

2.1 Assessment of the Functioning of the System

The analysis of the functioning of the system is detailed in a separate report prepared by the WHO consultant. The main findings are summarized below.

2.1.1 Data Collection and Management

Field Level

- Data collection and transformation into nutrition indicators (WFH, WFA, and HFA) represents a significant added workload for health personnel who are already busy with many other activities. Transformation of weight and height data into indicators of wasting, stunting, and underweight takes a lot of time, e.g., one health worker reported spending 3 hours per week, due to manual calculation and the use of percentile curves instead of the z-score tables commonly used.
- The quality of measurements is very poor, with mistakes being made by personnel in both weight and height measurements.
- There was evidence of falsification of the daily record forms. Personnel were found to be using forms that had been previously filled in; they only changed the date of the form to fulfill the monthly reporting requirement.
- Many supplies were either missing or of poor quality, e.g., lack of job aids and hanging scales that are not accurate.

District/Provincial Level

- The division of tasks between field, district, and provincial teams is not clear, as in some instances clinic-based personnel are the ones compiling daily data in weekly reports, while in other cases it is the district monitoring and evaluation personnel. The same issues were noticed between district and provincial teams. Provincial teams are supposed to send monthly compilations to the national team, but they sometimes do it only on a quarterly basis and sometimes not at all.
- The amount of work to compile data at the provincial level is minimal and should not be considered as a major bottleneck.

National Level

- The national-level personnel in charge of collecting and analyzing the data were able to show yearly compilations for the data that were obtained, as well as calculations of percentages for each indicator for each site. However, reporting rates were low and data quality was questionable.

2.1.2 Information Flow

The flow of information from the field to provinces is inconsistent at best.

- Reporting rates were not available at the provincial level, but when national data were analyzed it was found that only 25 of 58 sites reported data in 2013. Within these 25 sites, reporting rates varied from 0% (some sites sent compilations filled with zeroes) to 98%, with an average of around 50%.

- Analysis conducted at the national level was not shared with provinces, and compilations conducted by provinces were not reported back to the clinics.
- No analysis of the data was conducted at the clinic, district, or provincial level.
- Clinic teams mentioned that they did not know why they were collecting the data.
- It was reported that, at both the clinic and provincial levels, transmission of the data was expected to be done with personnel's own money for Internet and phone top-ups: Clinic personnel were supposed to send mobile phone messages compiling weekly data every Tuesday to provinces, and provinces were supposed to send emails with compilations for all sites on a monthly basis.

2.2 Assessment of the Relevance of the System

The assessment considered the following aspects of the surveillance system to determine whether it was successful in monitoring the evolution of the nutritional situation in Mozambique:

- Approach, sampling, targeting, frequency, data, and indicators of the system
- Production of the system
- Sustainability of the system
- Connectedness of the system

2.2.1 Approach: Facility-Based Sentinel Site Surveillance System

Sentinel site systems have been used for surveillance in a number of contexts for achieving a number of objectives. The use of the word "sentinel" refers to the fact that the main characteristic of these systems is that they establish a fixed location for data collection throughout the life of the system, whereas for other systems, such as those using cross-sectional surveys, the source of the data collection changes for each round of surveillance.

Sentinel sites can be anything from schools (Lenaway and Ambler 1995) to villages (Caleo et al. 2012) to health facilities (Yukish et al. 2014). The principle behind the sentinel approach is that the "sentinel" sites are meant to produce proxy indicators that monitor trends of certain indicators of interest (UNICEF, 2011). Sentinel sites, in many instances, are not representative of the total population that they are monitoring, such as the representative snapshot produced by surveys, but instead produce trends.

Sentinel sites have typically been used for two objectives.

- **As early warning systems.** Communities or facilities located in the areas most vulnerable to the problem under surveillance are purposefully selected. These entities are selected because it is assumed that if the event under surveillance (e.g., deterioration of the nutrition situation or resurgence of a disease) occurs, they will be the first to be affected. Establishing the surveillance in such "frontline" entities therefore acts as an early warning system that allows for the identification of the problem as soon as it occurs. An example can be found in Grellety et al. (2013) for a community-based system aimed at early detection of variations of acute malnutrition.
- **For disease-specific surveillance.** Sentinel surveillance systems have been used for monitoring the evolution of the prevalence of a disease by purposefully selecting the facilities located within the population most vulnerable to the disease. The system may seek to identify whether a vaccine is effective or whether a disease recurs after a period of disappearance. An example can be found in Sserwanga et al. (2011) of a facility-based system aiming at monitoring the evolution of malaria.

Considerations for Mozambique

Monitoring the evolution of the nutritional situation in Mozambique should consider, for each form of undernutrition: the type of surveillance system required; the direction in which a change is expected; and the frequency and intensity of variations to be expected. Mozambique is not a setting where unexpected nutritional emergencies have been recurrent, and DHS figures covering the last 15 years show small variations in all forms of malnutrition. The wide and rapid variations of acute malnutrition that can be seen in emergency situations do not occur in Mozambique.

In addition, the main malnutrition problem in Mozambique is stunting. Stunting is a condition that develops slowly in children and is difficult to reverse once it has occurred. Interventions aimed at improving the stunting prevalence do not aim to treat it, but focus more on preventing it, thereby reducing its trends in the most vulnerable groups of the population. Reduction of stunting at the population level is a slow process, and monitoring it should factor into this process (Solarsh et al. 1994).

Another aspect to consider is that the country shows a heterogeneous situation with regard to malnutrition. Significant variations exist mainly between rural and urban contexts and, to a lesser extent, between geographical areas.

For these reasons, it is more appropriate to conduct surveillance through the use of non-emergency approaches. A population-based representative surveillance system, such as the one used in regular surveys, is better suited to the Mozambican context than a short-frequency sentinel site system placed in district capital health centers to monitor the nutritional situation of the country. The fact that stunting is widespread throughout the country also calls for a system that provides a representative monitoring of the prevalence of stunting instead of a sentinel approach that uses purposive sampling of a relatively well off population of children attending immunization services.

2.2.2 Sampling: Children Attending Immunization in Selected Health Facilities

As already mentioned, due to the specificity of the Mozambican nutritional situation, a representative sampling such as the one used for cross-sectional DHS is more appropriate than the current sentinel site system.

Sentinel sites are meant to be organized around a combination of purposive and random sampling. Purposeful sampling is usually the first stage of sampling: Communities or facilities are selected based on their features in relation to the indicators being monitored. For early warning systems, the most vulnerable communities are selected, a process that requires an in-depth analysis of a community's status in terms of malnutrition and its root causes. For facilities, the purposive selection follows the same objectives, with facilities being selected that cover the communities most exposed to the events to be monitored. Randomization then intervenes at the second stage: For malnutrition, children in the selected communities or attending facilities are randomly selected from the whole population of children.

Caleo et al. (2012) report on such a system in Central African Republic. The system detailed in this paper shows multiple layers of randomization and is complex to manage, which may only be suitable in an emergency setting where timely, accurate data are critical. The level of analysis required beforehand to ensure that the communities or facilities selected will be representative of the whole population is complex, and the comparative evolution of the sites and the whole population may require that the process be repeated on a regular basis, rendering the system both impractical and expensive. Grellety et al. (2013) show that repetition of data collection in purposively selected sentinel sites has an effect on the status of the sites by contributing to the reduction of the prevalence of undernutrition, and they should be changed on a regular basis to avoid such bias.

Considerations for Mozambique

Regarding the sampling system currently used for the sentinel site surveillance system, the following aspects should also be considered.

- Children selected from immunization services represent a sample that is significantly skewed toward younger children (children 1 year or under), as they are most targeted for immunization and frequency of immunization reduces after 1 year (Bilukha et al. 2012). As shown in the DHS, stunting is lower for children 1 year old or under than for children 1–5 years old, while wasting and underweight are higher for children 1 year old or under. This bias creates a risk for underestimating stunting while overestimating wasting and underweight.
- Selection of children from the immunization services also creates a bias because these children are not representative of the population attending the health clinic. A risk exists for an over-representation of healthy children. During the assessment, the team confirmed that most children present were healthy children who only came for immunization and follow-up growth monitoring. Because of questions of opportunity cost, a risk exists as well for mothers attending the immunization clinic to be both wealthier and more educated, creating another bias toward healthier children. When asking mothers what motivated them to attend the immunization services in the clinic, all mentioned having been counseled and referred by health personnel when they delivered in the health facility. However, according to the Multiple Indicators Cluster Survey (MICS) conducted in 2008, 45% of deliveries did not take place at the health facility, and it is not known whether mothers who delivered at home had access to sensitization. Similarly, although coverage of the Bacillus Calmette-Guérin vaccination at birth was as high as 87% in 2008, coverage of subsequent immunizations dropped significantly and reached only 64% for measles (median age is 9 months for the measles vaccination) despite active vaccination campaigns through child health days. These figures illustrate the low representativeness of the population attending vaccination services in the clinics. UNICEF reports that "children in poor households are half as likely to be fully vaccinated as children in best-off households."[3]
- Urban vs. rural sites. The sentinel site system focuses, for the time being, on urban areas, as it is implemented in health clinics located in district capitals. As prevalence of all forms of malnutrition is higher in rural than urban settings, it is likely that data collected in the sentinel sites will produce lower prevalence rates compared to the true prevalence of each form of malnutrition. In terms of attendance to immunization services between rural and urban settings, UNICEF indicates that "74% of children living in urban areas are fully immunized against only 55% in rural communities."[4]
- Variability from one week to the next is also very high because the sample is not representative. Daily non-representative samples may vary widely, with more undernourished children coming on random days for random reasons (specific population groups may come on specific days, such as market days for instance). These variations limit the possibility to analyze the data and extract usable information. This variability could potentially be smoothened when analyzing the data over larger periods of time, but the focus on a specific non-representative group limits this possibility.

The sampling issues mentioned above are reflected in the data collected. Prevalence of malnutrition shown by the sentinel site (Table 3) confirms the wide difference between representative data and the sentinel sites data. Although the low quality of the data collected may have a strong impact on the prevalence, the focus on children under 1 year of age may explain why wasting rates were high while

[3] UNICEF. n.d. "Mozambique: Child Survival – Immunisation: Progress in immunization coverage**."** http://www.unicef.org/mozambique/child_survival_2944.html.

[4] Ibid.

stunting and underweight rates were low. The focus on urban and peri-urban sites may also explain the low rates of malnutrition showed by the data. Nnyepi et al. (2011) have documented similar issues with the same system implemented in Botswana, showing how the system provided unreliable data that suggested that malnutrition was decreasing significantly when the reality was very different.

Table 3. Prevalence of Malnutrition Identified in the Sentinel Sites System in Mozambique (2013) and the DHS (2011)

	Wasting		Stunting		Underweight	
Province	Sentinel site 2013	DHS 2011	Sentinel site 2013	DHS 2011	Sentinel site 2013	DHS 2011
Inhambane	4.6	2.2	4.5	36.0	5.5	6.9
Manica	3.2	6.7	8.7	41.9	4.9	10.8
Maputo	3.2	2.1	12.4	22.7	5.8	7.4
Sofala	6.7	7.4	12.1	35.7	7.6	11.3
Tete	2.6	5.6	16.6	44.2	23	17
Niassa	4.0	3.7	8.0	46.8	4.0	18.2

2.2.3 Frequency

The frequency of data collection is an important aspect of surveillance systems and can range from daily, such as in the system in Mozambique, to every several years, as with DHS.

To select the frequency of data collection, it is necessary to consider the temporal variability of the indicator being measured. In areas where acute malnutrition is subject to wide and rapid variations, such as in emergency settings, a short frequency is required and usually averages about 1 month. Where no variations are anticipated, longer periods of time can be used, mainly if the indicator being monitored, such as stunting, evolves slowly within a population. Golden (1994) showed that for a 12-month-old child who grows at only a 30% rate of normal growth, it would take 10 months to become stunted and that this duration increases as the children get older.

Therefore, collecting data on a daily or continuous fashion, as well as producing monthly information on the prevalence of malnutrition, seems to be unnecessary for Mozambique.

2.2.4 Data and Indicators

Sentinel site systems often offer the possibility for collecting various indicators, although the higher the number of collected indicators, the higher the risk of personnel in charge of data collection and transformation being overburdened and therefore the higher the risk of lowering the quality of the data collection.

The current system focuses on the three main indicators of malnutrition, which are relevant to the stated objectives of the system, although, as discussed in this report, the system itself may not be the best way to monitor these indicators.

2.2.5 Outputs of the System

The objective of a surveillance system for monitoring a nutritional situation can be achieved only if the data collected are transformed adequately and help produce relevant and reliable information. The best designed and implemented surveillance system is of limited use if a communication and information sharing system is not implemented. The mode of communication can take various forms, from the frequent updating of a dashboard available online to the dissemination of bulletins on a monthly or quarterly basis.

The current system does not yet produce any information that is disseminated to relevant stakeholders and policy makers, despite the fact that the system seeks to inform nutrition policies.

2.2.6 Sustainability of the System

The requirements for sustainability of a surveillance system largely depend on its initial purpose. Emergency setting early warning systems need to be maintained only as long as an emergency situation exists or the risk of an emergency remains high.

On the other hand, systems devoted to the long-term monitoring of a nutritional situation should be designed with the objective of lasting for very long periods of time. The sentinel site system meets this objective by being integrated within the health system and run by health system personnel without requiring significant costs associated with the recruitment of additional personnel or with the renting of vehicles for field surveys.

Sustainability is, however, not only a financial concern. The low level of integration of the system in the routine activities of health system personnel hampers the capacity to sustain a system of high quality. Health personnel, due to gaps in briefing on the purpose and functioning of the surveillance system, see it as an additional activity that has no link with their routine practice. The system is also not integrated within the health information system (HIS).

2.2.7 Connectedness of the System

Nutrition surveillance systems should aim, if possible, to provide more than nutrition information. They should seek to provide explanations about the causes of malnutrition and therefore help anticipate future malnutrition trends in order to inform design of interventions (Mason 2010).

This can be achieved by connecting the surveillance system with other information systems relevant to nutrition. Root causes of malnutrition are well documented in most countries: Feeding practices of infants and young children, access to potable water, sanitation of the living environment, availability of and access to food, and equitable access to quality health services are some of the main determinants of malnutrition and are also commonly monitored.

Population-based representative cross-sectional surveys may help to (a) identify direct associations between determinants of malnutrition and/or groups of determinants and malnutrition itself, and (b) create inferences on the most critical determinants of increased malnutrition.

On the other hand, non-representative sampling, as is currently done, does not allow for such associations.

3 Recommendations

3.1 Surveillance System Structure

3.1.1 Frequency

In a context where the prevalence of acute malnutrition is limited and where the focus of attention from nutrition stakeholders is on stunting, it is questionable to maintain a continuous sentinel site nutrition surveillance system that, even if improved to the level where data collection, analysis, and transmission reaches acceptable quality, will never provide the representative monitoring of the nutrition situation that is needed in Mozambique.

Programs devoted to reducing chronic malnutrition are implemented in Mozambique and answer the objectives of the Multisectoral Action Plan to Reduce Chronic Undernutrition in Mozambique (*Plano de Acção Multissectorial para a Redução da Desnutrição Crónica em Moçambique* [PAMRDC]). The PAMRDC recognizes the significance of the problem of stunting in Mozambique and aims to reduce it to maximum of 20% of children under 5 by 2020. Such time frames are both common and relevant, as interventions seeking to reduce stunting must be long term because stunting can be addressed only through systematic multi-year interventions.

Monitoring stunting can then efficiently be conducted following similar time frames. Provision of population-based representative surveys to produce prevalence of all forms of malnutrition every 2–3 years is therefore the most appropriate approach to nutrition surveillance in Mozambique. DHS can serve as a monitoring tool and provide prevalence of malnutrition every 5 years. Better coordination between UNICEF MICS and DHS could offer the possibility for alternating the two rounds of surveys on a 2–3 years basis if provision of prevalence data on a 5-year basis is deemed insufficient.

3.1.2 Type of System

The current sentinel site surveillance system presents major flaws. The population sampled is biased toward children 1 year old or under who have been delivered in hospitals and reside in urban or peri-urban settings. Moreover, the sampling does not allow for a representative picture of the malnutrition situation in the population.

As the main objective of the Government of Mozambique is to reduce stunting, the objective of the surveillance system is to monitor the evolution of the nutrition situation to ensure that programs and interventions implemented show the impact they are supposed to and, if necessary, make the necessary adjustments to ensure that these interventions' impact is maximized. However, the design of the system, even if data quality was improved significantly, would likely fail to achieve this objective. Most interventions implemented to address stunting target a different population than the one targeted by this surveillance system. Trends exhibited by an enhanced sentinel site system would therefore be unlikely to provide a representative estimate of how successful or unsuccessful interventions have been. The risk then exists for programmatic decisions to be taken based on inaccurate trends; this would be counterproductive in the countries efforts to reducing stunting.

Possible system improvements include:

- Determining the high-risk areas that are more likely to experience an increase in acute malnutrition because of shocks and analyze the parameters of the shocks, e.g., the location, seasonality, and vulnerable groups.
- Include more sentinel sites within selected districts, rather than one site per district, to have better coverage of the most vulnerable areas. The sites should be selected purposively to represent characteristics of the district, e.g., rural, urban, developed, less developed. However,

it is not clear how practical this recommendation would be if there is no capacity for health personnel in rural clinics to take on new activities.

- Extending the population targeted to all children under 5 attending the clinics to reduce the bias linked with the focus on children under 1. However, to do so, children would have to be selected from the "triage" services of the clinics where no measurement of height is planned. Also, to improve the representativeness of the sample, children under 5 should be randomly selected from each site, instead of selecting the first 30 to come to the clinic every day. For this randomization to be done, weight and height should be registered for all children under 5, which would be impractical in terms of workload for health personnel.
- Strengthen community-based screening and referral through the frontline health worker (*Agente Polivalente Elementar* [APE]) (frontline health worker) to increase the likelihood that the most vulnerable children will use health services, thereby reducing the bias of a system that is based in a health center and not in the community.[5]

Other types of systems could be designed to replace the existing one. Systems that rely on small sample surveys have been instrumental in providing representative pictures of the nutrition situation on a regular basis, but they are more suitable in emergency settings.

As mentioned already, the best system to be recommended is the one that provides nationally representative monitoring of malnutrition, as is already conducted by DHS- and MICS-type surveys. One weakness of these surveys is that they do not allow for disaggregation of the results below the provincial level, while planning and budgeting are increasingly taking place at the district level. Allowing for the disaggregation of information to match planning levels is important and would require the sample for national surveys to be increased significantly with random selection of a higher number of clusters per district. The cost of this increase could be considered as acceptable when compared with the invaluable benefit of getting district-level data on malnutrition and its causes.

3.2 Monitoring and Evaluating Interventions

Monitoring is a critical step in the program management cycle. Interventions are designed based on population-based representative data on malnutrition and its determinants and so should be the monitoring of their impact.

Before measuring impact, however, several critical steps should be taken at the same level of impact monitoring. Interventions designed and implemented under the umbrella of the PAMRDC essentially consist of evidence-based ones, which means that if they are adequately designed and implemented, their likelihood of having the expected impact on stunting is high. Adequate design and implementation is not always guaranteed, however, and should be monitored closely.

This monitoring should be standardized and systematized under the coordination of the Government of Mozambique. For this monitoring to be implemented successfully, initiatives such as the Scaling Up Nutrition (SUN) movement and UN REACH should also be considered as an essential support.

The monitoring of interventions aimed at reducing stunting should encompass the following aspects.

- **Inputs.** All actors should be accountable for the cost-effectiveness of the interventions they support. Monitoring inputs implies collecting and sharing information on financial, human, and in-kind resources employed to carry out the interventions. Efforts aimed at optimal cost efficiency should be demonstrated by all actors. Transparency is at the core of any monitoring system.

[5] The APE is responsible for screening for acute malnutrition in his/her community and making referrals to the nearest health center.

- **Outputs.** Data on what population is targeted and the number of individuals, communities, and institutions reached by the intervention should be monitored on a regular basis and shared with the relevant stakeholders. The performance of the interventions should also be monitored.

Beyond the routine monitoring of interventions, formal evaluations should also be conducted at midterm or at the end of an intervention's life. Evaluations consider the bigger picture, to see how the intervention fits into the broader programmatic landscape and to assess if its design was adequate. Practically, evaluations should look at the following aspects.

- **Relevance.** Are the objectives of the intervention in line with the problem it is supposed to solve? Is the intervention design likely to help achieving the objectives? Are the assumptions made to design the intervention adequate, realistic? Are there better ways that could have been used to achieve the same results?
- **Efficiency.** Did the implementation of the intervention allow for the transformation of the inputs into outputs?
- **Effectiveness.** Are the expected outputs likely to create the expected impact?
- **Impact.** What are the benefits of the intervention? Do they match or contribute to solving the initial problem identified?
- **Sustainability.** Will these benefits last?

3.3 Strengthening the National Health Information System

Health is one of the most significant determinants of malnutrition and many interventions to reduce stunting and wasting take place within the health system. Direct associations between undernutrition and morbidities such as diarrhea (and many of its etiologies), HIV/AIDS, measles, and tuberculosis are well documented, but so are associations between undernutrition and antenatal care, birth spacing, and inadequate health and hygiene behaviors, for which interventions often take place within health facilities' routine functions.

An effective monitoring of health information is therefore an important aspect of the monitoring of risks and threats leading to malnutrition.

Because HIS are complex and involve a wide range of actors at every level of the health system, it is important, before taking any action, to identify where the main bottlenecks in the health system that limit the efficiency of the HIS are found. No intervention can single-handedly address all the weaknesses of an HIS, and some prioritization would be needed.

Some general recommendations can be proposed that are likely to benefit the effectiveness of the system.

- At the facility level, a focal person should be appointed to be in charge of the HIS. This is also true for a clinic-based surveillance system.
- In addition to the focal person, adequate training should be provided to other members of the clinic team, to ensure that support is provided to the focal person when needed, and to ensure that when the focal person is absent, the data can still be provided to the district level in a timely fashion.
- New technologies could be a useful addition to the system. Smart phones or tablets can provide templates for data to be entered easily and for their quality to be checked immediately upon entry and can facilitate the transmission and follow-up process.

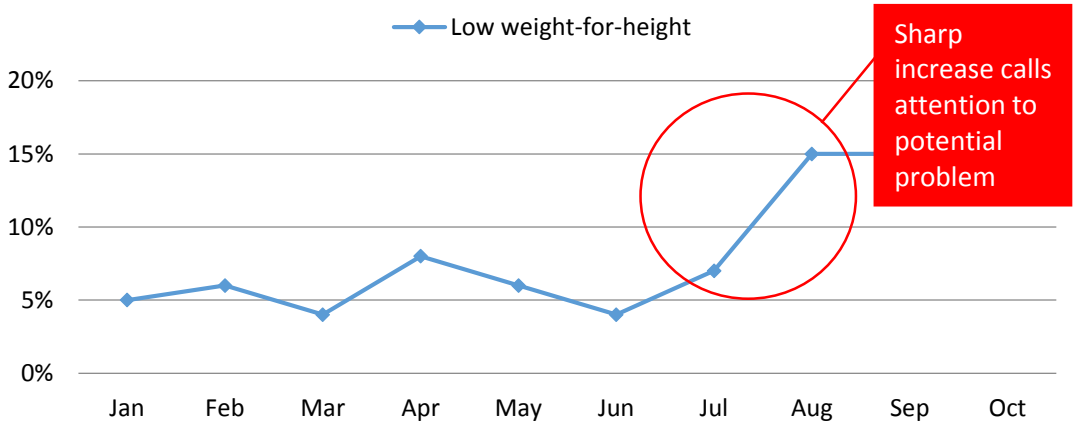
Beyond the use of the HIS for monitoring interventions, consideration should also be given to using it to monitor trends in acute malnutrition. The at-risk child consultation (*Consulta da Criança em Risco* [CCR]), where sick children receive medical care, currently reports monthly on the percent of

children who were admitted in the CCR because of acute malnutrition. This indicator could be tracked over time to monitor the trends in acute malnutrition, e.g., spikes in admission rates would indicate that a serious problem is occurring and should be investigated further, using run charts such as the example below (Figure 5). In addition, the community outreach efforts through the APE, as mentioned above, would help diminish the bias that a health center-based system inherently introduces.

It should be noted that such a system would not be representative of the population, and its analysis would be based only on trends and not on absolute figures of prevalence. Moreover, trends would have to be confirmed on the ground to make sure that they did not represent random variations linked with specific activities (such as increase of coverage after a screening event).

Figure 5 provides an example of a run chart to show fluctuations in admissions to CCR because of acute malnutrition.

Figure 5. Illustrative Run Chart Showing % of Admissions to CCR because of Low WFH



4 Conclusions

Because financial and human resources are limited within the health system in Mozambique, every decision that has implications on the use of money or that might require the addition of new activities to health personnel's workload should be made very carefully.

The nutrition sentinel site surveillance system in Mozambique is deeply dysfunctional, but could be improved with changes to the system's structure, training, supportive supervision, commitment, and equipment.

However, before considering improving and extending the system, a discussion should be organized for the main stakeholders of nutrition in Mozambique on the relevance and usefulness of the current system.

Once stunting is identified as the main problem, it may be argued that the most urgent and useful activity revolves around *monitoring interventions* as described above, instead of trying to reinforce a sentinel site surveillance system that will never produce the information it is meant for.

In the long walk toward reducing the prevalence of stunting in Mozambique, it is recommended that efforts be aimed at ensuring that all children in need receive adequate preventive interventions. To support these efforts, advanced monitoring is required, and may be seen as more urgent, cost effective, and efficient than an inadequate sentinel site surveillance system.

Interventions can even be coupled with quasi-experimental research designs and local cross-sectional surveys that would help provide evidence on the impact of interventions and supplement information provided by national surveys every few years.

Finally, surveillance systems require a complex and detailed preparation phase before they can be implemented to ensure that they answer all the needs they are meant to answer and that they can be sustained efficiently.

Whatever decision is taken in Mozambique about the current system, an in-depth analysis of the feasibility, relevance, and reliability of the options selected will have to be conducted.

Annex 1. Prevalence of Malnutrition, DHS 2003–2011

	Stunting						Wasting						Underweight					
	z-score < −3			z-score < −2			z-score < −3			z-score < −2			z-score < −3			z-score < −2		
Province	2003	2008	2011	2003	2008	2011	2003	2008	2011	2003	2008	2011	2003	2008	2011	2003	2008	2011
Cabo Delgado	35.9	21.7	27.2	63.1	55.7	53.1	2.2	0.7	1.4	5.1	3.5	5.6	9.8	5.1	6.7	30.8	22.7	20.8
Gaza	17.2	8.8	9.0	42.4	34.2	27.5	2.7	0.2	0.4	7.8	1.3	1.2	6.5	1.5	2.3	19.6	6.7	7.0
Inhambane	16.1	13.0	16.4	41.9	34.5	36.8	0.4	1.1	0.5	1.5	2.8	2.2	2.7	2.1	1.6	9.9	11.8	7.1
Manica	22.0	16.0	20.6	46.5	48.3	43.3	1.2	1.2	3.6	4.3	3.8	7.8	6.5	3.8	2.7	19.2	18.5	11.1
Maputo Cidade	9.0	6.6	8.0	24.7	24.9	23.6	0.7	0.2	0.9	1.5	1.8	2.4	1.8	1.6	2.6	6.8	7.2	5.6
Maputo Província	8.0	8.4	6.4	29.2	28.0	22.8	0.1	0.4	0.5	1.2	2.1	2.1	2.2	1.5	2.5	7.0	7.8	8.0
Nampula	23.8	29.7	30.8	46.9	50.6	55.7	4.0	3.7	3.2	9.2	8.7	6.7	10.0	11.3	6.3	25.9	28.4	17.2
Niassa	30.6	19.0	25.4	51.7	45.5	48.7	0.6	0.9	1.0	2.4	5.2	3.6	6.1	4.3	5.2	21.8	19.3	18.5
Sofala	22.3	13.8	15.0	47.0	40.5	36.0	4.8	0.8	1.6	8.8	3.2	7.4	9.5	4.1	3.4	23.0	15.9	11.6
Tete	24.9	19.1	19.5	53.5	48.0	44.4	0.9	0.9	1.9	2.6	2.6	6.0	6.5	4.6	4.5	21.3	18.6	17.2
Zambézia	31.5	18.0	21.7	51.7	45.8	45.6	2.0	1.5	4.5	6.5	5.2	9.7	12.7	5.7	6.8	26.5	21.1	22.2
urban	14.4	12.9	16.3	35.7	34.7	35.5	1.5	0.9	1.5	4.1	2.9	3.9	4.1	3.8	3.4	13.2	13.8	10.5
rural	27.0	19.5	22.0	51.6	47.3	46.1	2.3	1.5	2.7	5.9	4.7	7.0	9.4	5.6	5.3	24.5	20.1	17.5

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