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Creating a Humanitarian Dashboard for Malnutrition Health Facility Monitoring in Northeast Nigeria: A Special Studies Project

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Abstract

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Background An ongoing complex humanitarian emergency in northeast Nigeria has contributed to global acute malnutrition rates in children exceeding emergency threshold in Borno and Yobe states. Combatting malnutrition is complicated by internal displacement and instability due to ongoing military activity, as well as outbreaks of cholera and measles. Community-based Management of Acute Malnutrition (CMAM) programs, supported by the Nigerian Government, UNICEF, and other non-governmental partners provide therapeutic support for children with severe and moderate acute malnutrition through outpatient services. While supervision of these programs is robust compared to most humanitarian settings, use of the supervision data is limited.

Purpose This special studies project aims to create a dashboard of supportive supervision data that helps project managers identify poorly performing health facilities engaged in acute malnutrition management.

Methods Sample data included all supportive supervision survey results from Borno and Yobe CMAM facilities that were sent to UNICEF between March 2018 and May 2019. Survey results were filtered so that only the newest entry for each facility was represented in the dashboard. Variables from the supportive supervision survey were then synthesized into key indicators that fell into four primary domains of CMAM improvement: supportive supervision and provider motivation, resource availability, firm operational structures, and training. A composite Health Facility score was assigned to each facility based on how it performed across these domains. Facilities that scored in the top fifth and bottom tenth percentiles were flagged in two graphs. Ten additional graphs were generated to explore the above domains individually, depicting where facility assessments occurred; supply of anthropometric equipment, medicines and ready-to-use therapeutic food (RUTF); WASH-related needs; skill- and knowledge-based training needs; and facility morale scores. All graphs, as well as the survey variables used to generate them, were organized into seven screens on a dashboard using Tableau. The dashboard was shared and feedback was elicited from UNICEF nutrition officers.

Results A total of 2,782 entries for facility-level data were used in the dashboard project with a median of five entries (IQR 2-9) per PHC. Upon filtering duplicate entries, 350 unique facilities were represented, 186 in Borno and 164 in Yobe. Overall Yobe had over half (57.1%) of all bottom-performing facilities, despite the conflict being centered in Borno. Data in the *supportive supervision* domain indicated that 11.1% of facilities had not been visited in over seven months, and large areas of Borno and Yobe were missing facility reports. Regarding the *resource availability* domain, data suggest that height board status was unknown or unavailable in most (81.4%) facilities, whereas other anthropometric equipment (scale, MUAC tape, thermometer and CMAM manual) was available in the majority (90.4%) of facilities. Over half of multi-item medicinal stockouts were in Yobe. Facilities with ready-to-use therapeutic food (RUTF) stockouts commonly reported medicinal stockouts as well, despite facilities receiving RUTF and medicine from separate sources. Data in the *operational structures* domain indicate over two hundred facilities (60.0%) were in need of WASH-related support with 45.8% reporting lack of

running water. *Training* data suggested that provider knowledge was generally adequate, however 31.6% reported some form of skills training need, most commonly physical examination. Within the *morale* domain, 11.6% of facilities were identified as critically low morale, with poorer scores in Borno than Yobe, especially near the capital Maiduguri. The dashboard's first draft received generally positive feedback from UNICEF nutrition officers in terms of identifying areas that required attention and understanding the dashboard's organization. Suggestions for improvement included the need to clarify how Health Facility scores and training needs were tabulated, the need to restrict and make clear the data reporting timeframe, and the need to indicate facilities that reported data as a percent of total number of CMAM facilities.

Discussion The dashboard revealed important insights into the state of CMAM operations in Borno and Yobe. Within the *supportive supervision* domain, areas of Borno and Yobe that were missing facility reports reflected the limitation that supportive supervision data was only being collected in the facilities that were primarily supported by UNICEF. The dashboard will need to be modified to indicate all CMAM facilities, which will require more broad use of the supportive supervision tool by non-UNICEF facilities. In the *Adequate Resources* domain, children are being triaged and managed within CMAM services using MUAC cutoffs alone, rather than in combination with WHZ scores. MUAC measurement alone may miss a significant number of children in need of nutritional support. Additionally, shortages of CMAM supplies frequently span multiple supply sources, indicating that such facilities are facing broader challenges such as security and funding. The *operational structures* domain indicated challenges to resourcing clean water. In the *Training* domain, lacking skills assessments indicate need for refresher training with particular focus on the physical exam. Results from the dashboard itself revealed that this unique tool is an important step toward CMAM process monitoring which is likely to be more user-friendly than data outputs that existed prior. It allows nutrition managers to rapidly identify gaps in CMAM programming and prioritize limited resources to where they are needed most. It will be necessary to validate the indicators that were developed for this dashboard, assess supportive supervision data quality and validity, perform continual evaluation and refinement of the dashboard, and secure buy-in from all partner organizations in the Nutrition Sector to maximize the utility of the dashboard as a monitoring tool.

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Chapter One: Introduction

Background

Tens of thousands of people around the world escape extreme poverty each day.[1] Many countries are on track to achieve the UN's number one Sustainable Development Goal of ending extreme poverty, but Nigeria is regressing.[1] The proportion of Nigeria's population classified as 'extreme poor' is large and growing.[1] With a seventh the population of India,[2] Nigeria has more people living in extreme poverty.[3] An estimated four more people become 'extreme poor' in Nigeria every minute.[1]

Much of this poverty is concentrated in the north-east[4] where unemployment, poor governance, and a weak justice system have led some people to radicalize. Non-State Armed Groups (NSAGs) control large territories. Since 2009 they have killed over 35,000 people in the north-east.[5]

In areas reclaimed from NSAG control, emergency surveys conducted in 2016 provided estimates of crude mortality and acute malnutrition among children above WHO emergency thresholds.[6,7] This, in addition to outbreaks of measles and wild-type poliovirus, led the Nigerian Ministry of Health to declare a public health emergency in the states of Borno, Adamawa and Yobe in June 2016.[8] Later that year the UN escalated the crisis to a grade 3 – their most severe designation.[8]

The impact of continued violence over the past ten years is felt when one compares the striking difference in malnutrition levels in the north-east to the rest of Nigeria. Major national progress

between 2013-2018 saw country-wide global acute malnutrition (GAM) fall by half, and severe acute malnutrition (SAM) by a factor of five.[9,10] However, GAM remains above the emergency threshold of 10% in Borno (11.3%) and Yobe (11.4%).[10] Stunting, an indicator of long-term malnutrition, afflicts half of all children in both states (47.0% in Borno and 51.3% in Yobe), with one in five severely stunted.[10] Under five mortality rates (U5MR) are above emergency threshold in Central Yobe.[6] These reports indicate that the north-east has not benefitted from national trends. The nutrition emergency is further exacerbated by internal displacement due to ongoing military activity, as well as outbreaks of cholera and measles.[4] Despite a robust network of Community-based Management of Acute Malnutrition (CMAM) feeding programs, the needs generated from the ongoing humanitarian emergency outweigh their capacity to deliver it.[11]

Concept of Project

Need

Given resource restraints that limit the frequency of direct field supervision of CMAM sites by program managers, there is a need to make better use of existing data on quality of program implementation to assist program managers who are involved in the nutrition response in northeast Nigeria in prioritizing underperforming facilities to ensure they receive the attention and supportive supervision needed to achieve minimum standard recovery rates.

Goal

To create a dashboard of supportive supervision data that helps project managers identify poorly performing health facilities engaged in malnutrition management of humanitarian emergency-affected communities of northeast Nigeria.

Aims

1. Create a dashboard depicting reference indicators that identify nutrition-related needs of primary health centers and local government areas, which will be updatable as new supportive supervision data become available.
2. Elicit feedback from nutrition program managers at UNICEF on the dashboard's usefulness, and how to improve it.

Significance

Using a dashboard that is designed to monitor CMAM facility performance and supportive supervision needs, nutrition managers that are engaged in the humanitarian emergency response can determine where to send support first. Top- and bottom-performing facilities will be rapidly identifiable for easy prioritization. Managers will know where the need is greatest and what type of assistance is needed, as well as the last time a facility was assessed. Dashboard outputs will reflect up-to-date information based on the most recent survey completed at each facility. This will allow managers to more quickly identify facilities that are falling behind, learn from those that are doing well, and make data-driven decisions on policy and response strategy to improve CMAM quality, ultimately making a bigger impact on malnutrition that plagues communities affected by violence in northeast Nigeria.

Chapter Two: Literature Review

CMAM Overview

The CMAM approach, developed in 2001, was designed to reduce malnutrition by reaching the most children possible.[12] With emphasis on outpatient management,[13] highly-effective ready-to-use-therapeutic food (RUTF),[14] and community health workers,[15,16] CMAM decentralizes malnutrition management and places ownership at the community level.[17] Using accepted anthropometric assessment methods,[18,19] children are triaged into Supplementary Feeding Programs (SFPs), Outpatient Therapeutic Programs (OTPs) or Stabilization Centers (SCs).[17] SFPs give supplementary food rations for children at risk for SAM, OTPs provide RUTF to treat children with SAM, and SCs are inpatient settings for SAM children with complications.[17] See Figure 1 for how Nigeria triages malnourished children in their CMAM system. All but the most severely malnourished children (i.e. those without edema, medical complications, or lack of appetite) are treated outpatient.[20-22] Outpatient management of malnutrition reduces cost and burden on health facilities and limits the child's exposure to infection in the inpatient setting.[15,20] Health workers engage in active case finding and follow-up if caregivers do not return for subsequent visits.[15] In addition to RUTF, CMAM facilities stock micronutrient powder, basic anti-infectives and vaccines to treat diseases that interfere with a child's nutrition.[15]

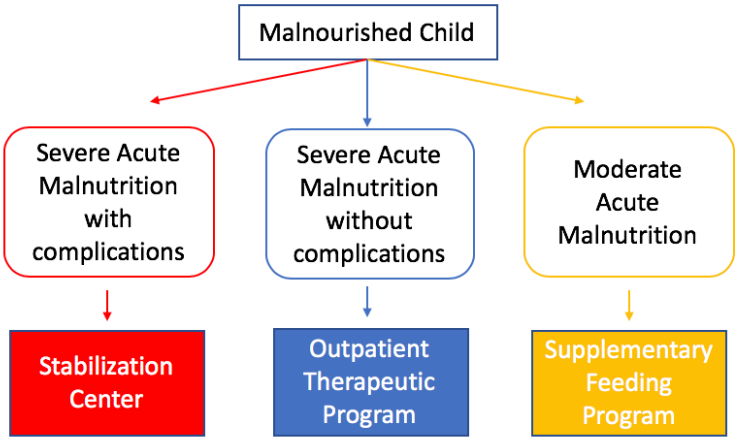

Figure 1: CMAM Triage of the Malnourished Child in Nigeria (adapted from Figure 1.1: Classification of Acute Malnutrition)[17]

An important role of CMAM operations is routine data collection, which is calculated and reported as standard indicators for comparison to national goals.[17] Efforts to standardize reporting came about in 2008, following an analysis that showed inconsistencies across the many contexts that CMAM was employed.[23] To address the inconsistencies, Save the Children UK and the Emergency Nutrition Network – in collaboration with other entities in the nutrition sphere – developed Standard Indicators and Categories for Better CMAM Reporting in 2015.[24] The indicators from this document reflect a consensus-based approach to community malnutrition and are now considered best practice in CMAM reporting.[24] Information is collected not only on patients, but health workers and facilities too. Outcome measures such as cures and discharges are collected alongside process indicators such as inventory and staff adherence to protocol. This allows for ongoing evaluation of CMAM programs.

Initially designed for emergency implementation, the CMAM model has proven effective and well-received as part of routine primary care in many countries around the world.[25] Indeed, CMAM implementation has shown to be most effective when integrated into existing health systems.[25] A 2013 Global Evaluation of CMAM concludes that the CMAM model maintains relevance to its intended purpose, and has caused more children with SAM to be identified and treated.[25]

There are, however, notable challenges in CMAM. Although global guidelines have outlined SAM management, standardization remains unclear about program planning,[25] monitoring and evaluation,[25-27] integration with existing services[27] and local resources,[25] community assessment and mobilization,[25,28] addressing gender gaps,[12,25,29] and treating moderate acute malnutrition (MAM).[25,30] For example, a child with MAM receives RUTF if they live in Chad, whereas the same child in Nepal is ineligible.[30] Other challenges include shortages of nutritionists[26,31] and supplies,[27,31] equitable CMAM coverage due to remote or inaccessible locations[6,12,19,25,26], poor estimation[25] of population and malnutrition incidence (especially in conflict areas),[6] and predominance of male nutritional staff[12] and caregivers in discussions and support groups.[25] Perhaps the most enduring challenges across CMAM contexts are funding stability,[26,27,32] program expense[25,31,32] (of which RUTF comprises up to 50%),[25] high default rates and relapse.[33] Despite challenges, countries that integrate and scale-up CMAM have improved education and community sensitization toward early recognition of malnutrition where health coverage is limited.[30,34] One such example is Nigeria.

CMAM in Nigeria

Nigeria has a unique structure for carrying out CMAM. Its government is composed of three main levels including federal, state, and Local Government Area (LGA), with Primary Health Centers (PHCs) spread throughout each LGA.[29] CMAM is funded and thoroughly integrated at each government level, with federal guidelines for many areas that lack global standardization such as management of MAM and integration with Infant and Young Child Feeding (IYCF) services.[34] Guidelines also delineate the roles of each government level in CMAM, with some shared responsibilities. The Federal Ministry of Health (MoH) coordinates the many stakeholders involved in CMAM, develops national policy, and liaises with related MoH operations[17] (such as IYCF and HIV/AIDS). The MoH shares responsibilities with states and LGAs to plan rollout, training & supplies; conduct supportive supervision; and manage data.[17] States and LGAs control distribution of CMAM materials and perform monitoring and evaluation.[17] PHCs are responsible for verifying and fulfilling referrals, treating outpatients and inpatients (or referral to closest inpatient facility), ruling out conditions that contribute to malnutrition, counselling, managing volunteers, and reporting activities to the LGA.[17] Activities at every level are supported by UNICEF and local non-governmental partners.[34]

Nigeria has made considerable progress in scaling up CMAM programming during the ten years[34] that it has been in place, despite challenges posed by the country's size and scale of necessary resources. Beginning in 2009, as an international NGO-led effort across ten LGAs, CMAM is now part of a minimum service package that all Nigerian health facilities must provide.[34] This, aided by robust[34] national ownership and strong political will and leadership[34] from the MoH, has resulted in sites delivering CMAM up fourfold and admissions for SAM up fivefold between 2013 and 2017.[30,34]

Through the large CMAM network, two types of monitoring data are being collected: Data Quality Assessments (DQAs) and supportive supervision. DQAs represent a relatively time-consuming and technical evaluation, performed periodically by state and federal government.[29] Trained personnel travel to health facilities and collect objective indices from health center records, comparing them to prior ones.[29] Analysis of DQAs are underway, with the data employed at several levels of government.[29] This contrasts with supportive supervision data, which focus on protocol adherence and service provision, such as the availability of anthropometry tools or provider adherence to discharge protocols. Unlike DQAs that analyze patients and outcome indicators, supportive supervision data primarily use facilities as the basic unit of analysis and produce process indicators. Supportive supervision data are collected nearly every time a health facility is visited by supervisory staff (ideally once every month). Hence, a lot more data are produced more regularly compared with DQAs. The data, however, are on a central server and underutilized at scale.[35] Such is the case with other health projects in Nigeria, where the process indicators may be put to use locally,[36] but at larger levels of governance they could be put to much greater employ. Currently, raw supportive supervision data are not conducive to visualization and decision-making in a larger scope. Without this, monitoring program quality and identification of under-performing facilities is significantly hampered.

Dashboards

Dashboards carry great promise in increasing data accessibility at larger levels.[37] They are used frequently in business and healthcare, and are designed to allow managers to rapidly interpret a few key indicators of highest validity and utility.[38] A useful dashboard relies on timely data, an

organized presentation, and usability by the end-user.[37] They can convey a lot of useful information using only simple analysis techniques, which facilitates quick and routine processing of new data with a low requirement for statistical literacy. Transcending the value of a single graph or written report, a dashboard aims to be just complex enough to convey a general picture of a situation without overwhelming the viewer with too much information. The result is a handful of key figures that maximize informativeness and readability, and minimize the time required to process new information.

A data visualization guidebook from the American Evaluation Association provides insights into dashboard design and evaluation.[37] In terms of design, the author emphasizes the importance of a single screen such that users can see all information of a given category at a glance.[39] Selecting inappropriate types of graphs or introducing "meaningless variety" thereof are common mistakes in dashboard design.[39] For example, if pie charts are added to "mix it up" where a series of bar graphs would suffice, this makes users work harder for comparison. When demonstrating quantitative data, the author states that bar graphs are superior to pie charts, especially for showing parts-to-whole or nominal comparison of items.[37] Pie charts have limited utility as humans are poor at comparing areas-by-color and angles (limitations of pie charts).[39] In terms of evaluating a dashboard, the author suggests using a multistep process. This begins with early usability testing to determine if users can evaluate what is going on in the data, flag areas needing attention, and understand the context and organization of the dashboard.[37] This gauges effectiveness from early on, intentionally ignoring aesthetics, which is not a major priority and can actually harm design (as in the case of "meaningless variety"). Once the dashboard is built and published, this is considered the "beta" version, and evaluation continues as the dashboard is

piloted for 6-12 months.[37] After the pilot phase, the dashboard is again evaluated for effectiveness, and measures are reviewed to assess how well they achieved their purpose. The refined dashboard is then considered "Dashboard 1.0".[37]

Though there are a variety of manuals on the topic of dashboards,[39-41] methods to evaluate a dashboard (such as the method described above) remain expert opinion only and lack rigorous testing – particularly for dashboard use in the development sector. The only study on dashboard evaluation that was found in the literature was a 2017 paper, in which Karami et al lay out a generalized set of criteria for evaluating, building, and selecting a dashboard for use in healthcare.[42] From their review of the literature, they determined 56 criteria for evaluating dashboards, then grouped the criteria by seven categories: user customization, knowledge discovery, security, information delivery, integration and system connectivity, visual design, and alerting. Using the Delphi method to generate consensus, 46 experts in information management, medical informatics, and software engineering (with radiologists included as end-users) confirmed and ranked the 56 criteria. Nearly all criteria within "knowledge discovery", which allows users to conduct root analysis and determine cause of events, ranked as high priority. "User customization" criteria, which empower the user to change dashboard outputs to suit their needs, ranked highly, with less priority given to the "discussion forum" criterion. "Security", covering data protection and access restriction, was ranked highly in all criteria except "version control" which tracks changes to the data source. Categories of "information delivery" (timeliness and organization of graphics), "visual design" (aesthetic), "alerting" and "system connectivity" were uniformly ranked as high priority. Respondents were divided on only a few of the 56 criteria, namely the single-screen scroll-free feature and access to source code

manipulation. Limitations to the study were that it did not produce a single dashboard evaluation tool, results were not stratified by respondent type, and findings may be unique to the target audience of radiologists. However, the findings from this study lend some guidance as which general features may enhance a dashboard's usefulness.

Dashboards in Action

The following are a selection of dashboard applications, three in African contexts and one in US Hospitals, that illustrate the benefits and lessons learned from using a dashboard for program monitoring.

In an example from Liberia, Guyon et al describe the role of a dashboard in making better use of IYCF data.[43] The Liberia Agricultural Upgrading Nutrition and Child Health (LAUNCH) project initially presented data in a quarterly written report but found the transition to an excel-based dashboard to increase information accessibility and comprehension by program managers.[43] Displaying information in a visual format that was easy to digest facilitated more engagement with the data, enhancing interaction and promoting insight.[43] Programmatic issues, such as lack of community group participation and insufficient food distribution points, were identified as a result of greater data interaction, and improvements were reflected in subsequent reports.[43] Managers were also able to link data to external factors, such as national health campaigns and seasonal changes, improving future planning and forecasting. Managers could copy figures for use in presentations and documents, further improving usability.[43] The utility of the dashboard proved superior to a summary quarterly report. With its aid, further analysis was facilitated, and managers were able to make better assessments and decisions for IYCF programming.[43]

Poy et al learned similar lessons from a vaccine coverage dashboard that covered six African countries, including Nigeria.[36] Using district-level health data from regional WHO offices that are updated monthly,[36] they produced a dashboard to monitor third-dose coverage of the diphtheria-tetanus-pertussis (DTP) vaccine.[36] With more accessible coverage data, the dashboard allowed program managers to rapidly identify high-risk and non-high-risk areas for immunization coverage, and track progress toward goals of 80% third-dose coverage.[36] This dashboard both reduced the time required to interpret new data and minimized inter-reader bias.[36] Authors discussed the dashboard's impact on increasing awareness of process monitoring, like cold chain and stock availability, which are not rigorously monitored in low- and middle-income countries.[36] "In ... Nigeria, process indicators are collected and analyzed locally, but the extent of systematic use in national decision-making processes can be further improved."[36] While tracking outcomes may be the most straightforward method of program evaluation, reliance on them "will indicate too late that there is a problem". A better grasp of process indicators allowed program managers to gain better insight into successes and shortcomings during the campaign and respond in a timelier manner before failures occur.[36] Further, in directing more attention to process monitoring at the local level, dashboard implementation highlighted areas for improvement in the data collection process.[36] The dashboard was limited when poor data quality and high staff turnover threatened the project's sustainability.[36] As this was a study of international scope, dashboards must be adopted at national levels along with rigorous staff training to ensure ownership and sustainability.

Etamesor et al also reported improvements in data quality after rollout of a standardized dashboard in Nigeria, with some challenges as well.[44] As part of a new routine immunization (RI) reporting system, the District Health Information System version 2 (DHIS2) developed a dashboard for RI monitoring.[44] Project managers reviewed health facility performance via the dashboard on a monthly basis, and study authors reported "an improvement in availability and timeliness of actionable health information to decision makers."[44] Despite these improvements, state and LGA buy-in was a challenge, and a recent country-wide initiative to delegate more power to states led to confusion in lines of authority.[44] The project timeline had to be frequently adjusted due to unforeseen needs for computer training, difficult-to-reach communities, and lacking incentives for timely reports.[44] Sustainability of the dashboard was a concern due to reliance on subnational government funding. Authors provided three policy recommendations to address these challenges and further the impact of the dashboard.[44] First, they advised consolidating primary healthcare under one state-level governance structure "to ensure that the principle of one management; one plan and one M&E for [primary healthcare] is maintained in all states of Nigeria".[44] Second, an accountability framework, which rewards or sanctions health facilities based on performance, could enhance data quality while reducing fraud and incompetence.[44] The final policy recommendation was to institutionalize the expectation that M&E officers must have computer skills, the lack thereof being a major hindrance to M&E operations.[44] With these adjustments, and further adoption and ownership of the dashboard, study authors suggest that the dashboard can improve immunization reporting and coverage.[44]

Research on dashboard creation and implementation in the United States provided further insights into the challenges and opportunities they present. Ratwani and Fong developed

dashboards to improve patient safety event reporting systems (PSRS) in U.S. hospitals.[45] Using PSRS data for event reporting and data visualization is recognized by the Institute of Medicine as having enormous potential to improve quality and reduce medical error, and many states now require it.[45] However, implementation was variable, and users cited challenges to existing visualization platforms, from inability to interact with and explore variables of interest, to the time burden to find and analyze data of interest, to a lack of regard for the end-user.[45] To make the data more accessible, study authors developed two dashboards for a 10-hospital system in the mid-Atlantic, one for hospital staff and the other for administrators.[45] The products were end-user focused and interactive, allowing the user to explore big-picture trends across the hospital system, or focus on certain variables within each hospital. This provided administrators and staff with informative, user-friendly patient safety data which reduced the burden of analysis and encouraged greater exploration and discovery. As a final benefit, the process of creating and implementing the dashboards drew increased awareness to patient safety.[45]

Limitations of Dashboards

In addition to the issues described above, Mason et al warned against decision-making from over-generalized data.[46] By their nature, dashboards make generalizations across diverse areas and populations, relying on thresholds to indicate where attention is needed.[46] But the necessity for action can vary among populations.[46] From 1,175 malnutrition surveys conducted over a decade in the Horn of Africa, they found that GAM had a significantly different impact on under five mortality rates in agriculturalist vs. pastoralist populations,[46] with the latter showing higher resilience to mortality at the same GAM level. This example highlights the need for what Smith calls “measure definition”,[37] which ensures that measures are calculated, interpreted, and acted

upon in a way that serves the intended purpose (in this case, drawing attention to groups in need of nutrition assistance). While attention to measure definition helps dashboards reflect what they are intended to, contextualizing thresholds as Mason et al suggest is a major challenge for dashboards, increasingly so as the scope of the data set increases.

Even an idyllic dashboard that perfectly captures and relays information to the user does not tell the user what to do with the information. Protocols must be built around dashboards to bridge the gap between learning from data and acting on it. Meijers et al accomplished this by coupling a dashboard – built as a feedback system for nutritional care providers in home care settings – with a decision tree.[47] The goal was to better align provider practices with evidence-based interventions.[47] Semi-structured interviews and multidisciplinary focus groups were conducted to glean specific needs for the dashboard-decision tree, and how to interpret its results.[47] Using a Likert scale and open questions, managers indicated that the dashboard was very useful for improving nutrition indicators, and they looked favorably upon coupling dashboards with decision trees to simplify analysis and standardize evidence-based intervention.[47]

Dashboards are also limited by the timeliness with which they are employed.[48] Dowding et al performed a literature review to determine the utility of dashboards in process monitoring and improving patient care.[48] Analysis of eleven papers (all focusing on high-income countries) found that dashboards are more likely to be useful when they are constantly in sight, and available at the point of decision making.[48] When users had to take the effort to pull it up, their use declines, and the dashboard is less likely to be of benefit.[48]

Chapter Three: Methods

Introduction

A special studies project was undertaken to help those engaged in CMAM operations rapidly identify needs and prioritize resources for poorly-performing Primary Health Centers (PHCs). A simple, automated dashboard was created that allowed UNICEF and the Nutrition Cluster to use data from supervisory visits to target limited technical supervision resources. The dashboard was created and hosted using Tableau without need for advanced statistical software in order to ensure ease of use. Extensive feedback was provided by key partners to ensure the project's relevance.

Ethical Considerations

As this project was not considered human subject research and Emory IRB approval was not required. The reason was that it used secondary data representing facilities and provider responses with no patient-level nor personal health information and the nature of the project is quality improvement. A form to this effect was obtained from Emory University and is available upon request.

Population and Sample

The population reflected in this study were health facilities providing CMAM services in the northeast Nigerian states of Borno and Yobe.[49] Facilities took the form of either fixed primary health centers or mobile outreach clinics.[34] This population was selected due to the public health emergency declaration by the Nigerian Government in 2016 following the high prevalence of acutely malnourished children in these states, and the large volume of data being received that

cannot be analyzed quickly for programmatic decision-making. The sample data included all health facility supportive supervision reports that were received between March 2018 up until initiation of this project – May 2019.

Procedures

Survey Instrument

The survey, developed by UNICEF Nutrition Sector, was administered on a tablet device. It collected information on facility characteristics, the nature and quality of services provided, record-keeping, items in stock, support, and staffing. It was designed so that variables had clear ranges, skip patterns, multiple choice options and drop-down menus so that further cleaning would not be required. Results were uploaded to a database managed by UNICEF. The survey used facilities as the basic unit of analysis, with several "exit interview" questions for caregivers of malnourished children to ensure they were given appropriate treatment and follow-up instructions. The dashboard project used only facility-level data, with no patient data reflected. The survey consisted of 157 variables, a majority of which were binary (yes/no) process indicators. See Appendix A for full details on all sections in the questionnaire, including which variables were used.

Data Collection

The survey was administered to a facility staff person during supervisory visits. Collection was not part of a routine reporting system, rather it occurred on an ad hoc basis nearly every time a health facility was visited by supervisory staff. This happened ideally once a month (with some variation due to logistical and contextual circumstances).[34] Thus, survey data often included

multiple entries for each health facility, representing the multiple surveys that were performed at these facilities across the reporting timeframe. Supervisors, based in each LGA, were skilled personnel from local non-government organizations with whom UNICEF contracted for better mobility in insecure locations.[34] These supervisors worked with local government nutrition focal persons to visit and collect facility data as part of CMAM operations.[34] Supervision by UNICEF nutrition experts able to provide technical guidance were more limited.[34]

Data collection was designed to produce an exhaustive representation of all facilities. However, several LGAs in northeast Borno and northern Yobe remained unstable, thus data was limited from these hard-to-reach areas.[49]

The dataset was provided for this project from UNICEF with the understanding that it would be used only for the purposes of the dashboard.

Data Cleaning

As previously stated in the *Survey Instrument* section, the data did not require cleaning, apart from filtering so that only the newest entry for each facility was represented in the dashboard. The variable "health facility" was a unique number assigned to each PHC. "Start" and "end" timestamped the date and time of the survey. These three variables were used for filtering. This process was performed using Tableau Prep to filter by the most recent (maximum) value of both "start" and "end". Quality control checks were manually performed on the data that resulted from this filter to ensure deduplication was successful. Entries that were missing data for "health

facility" were excluded as they could not be reliably identified in an automatable manner. No further data cleaning was performed.

Data Visualization – Single-Subject-Area Graphs

Survey variables were organized and summarized into key reference indicators, which provided a basis for 10 single-subject-area graphs that convey decisional information for project managers. To form the reference indicators, a framework was developed that was based on the article by Mambulu-Chikankheni et al, in which study authors laid out key areas for improving CMAM activities.[50] Authors cited needs for (a) supportive supervision and provider motivation, (b) adequate resources, (c) firm operational structures, and (d) thorough training. Fifty-five of the survey's 157 variables were chosen to be included in the dashboard based upon their fit within this framework, adequacy of data (some variables were not applicable in all survey contexts), and feedback from project recipients at the CDC and UNICEF.

The 10 single-subject-area graphics were created with a goal of simplicity. They facilitated assessment of specific needs by health facility and local government area. They included Site Visits, PHC Count per LGA, Morale by LGA, Medicine Stock by LGA, RUTF Stock by LGA, Equipment Availability by LGA, Height board Availability by LGA, WASH Needs by LGA, Knowledge Training by LGA, and Skills Training by LGA. See Table 1 for the 10 single-subject-area graphics organized within the Mambulu-Chikankheni framework, and the survey variables that were used in each graphic.

Table 1: Major areas of CMAM need according to the Mambulu-Chikankheni framework (organized by color), single-subject-area graphs that were created for the dashboard, and the survey variables that were used within each graph

MC Framework	Graph	Variables
Support Supervision & Provider Motivation	Site Visits	GPS longitude, GPS latitude, today
	PHCs per LGA	Health facility, LGA
	Morale by LGA	Job motivation, team job motivation, job satisfaction, team job satisfaction, job competency
Adequate Resources	Stock - Medicines	Amoxicillin, Coartem, Albendazole, Vitamin A
	Stock - RUTF	RUTF
	Stock - Equipment	MUAC tape, Job Aid, Scale, Thermometer
	Stock - Heightboard	Heightboard
Firm Operational Structures	WASH	Water, Latrine, Soap, Handwashing
Thorough Training	Training - Knowledge	Marasmus causes, kwashiorkor causes, malnutrition causes OTP admission criteria, RUTF explained, malnutrition explained, key nutrition messages given, OTP discharge criteria, other OTP discharge criteria SC referral criteria, SC referral explained, medical complications requiring SC referral
	Training - Skills	Height check, WFH recorded Weight check, child undressed, correct standing, scale calibrated, weight reading Oedema check, oedema explained, oedema correctly checked, oedema correctly checked feet, oedema grade MUAC explained, MUAC measured, left arm measured, correct measurement, MUAC reading Children registered, physical exam performed

MC = Mambulu-Chikankheni, PHC = Primary Health Center, LGA = Local Government Area, RUTF = Ready-to-Use-Therapeutic-Food, WASH = Water And Sanitation Hygiene, MUAC = Middle-Upper-Arm-Circumference, OTP = Outpatient Therapeutic Program, SC = Stabilization Center, WFH = Weight-For-Height

The **Site Visits graph** showed the locations of CMAM facilities on a map, with recency of last supportive supervision survey indicated by color. This graph was designed to give nutrition managers perspective on the geographic spread of health facilities and the recency of their last site visit. The goal was to provide a geospatial perspective on which facilities may require supervisory visits. For this purpose, the graphic plotted PHCs on a map of northeast Nigeria

using the variables “GPS latitude”, “GPS longitude”, and “today” (day of survey). The most recent month of data collection for each facility was used. The range of visit dates for this data set was March 2018 – May 2019, indicated by color. More recent visits were shown in green (Oct 2018-May 2019), more distant visits were in red (Mar 2018-Sept 2018).

PHCs per LGA was a table that showed CMAM facility count within each LGA. This gave the user an idea of the number of facilities within each LGA.

Morale by LGA showed a morale score for each facility, reflecting reports of the facility focal person that was interviewed. The goal of this graph was to give nutrition managers a way to identify where morale is low so that appropriate intervention could be made to mitigate harm to CMAM programming. Facility morale was portrayed using a scoring system that was based on reports of “job motivation”, “team job motivation”, “job satisfaction”, “team job satisfaction”, and “job competency”, each on a scale of one (high) to three (low). The five categories were added to determine workplace morale score for each facility, with five being best possible and 15 worst possible. See Table 2 for details of the scoring system. A graph was generated with a color-coded legend that indicated morale score by facility. Data represented the most recent visit for each facility.

Table 2: Morale score tabulation

Variables	*Score*
Job Motivation	1 (best) to 3 (worst)
Team Job Motivation	1 (best) to 3 (worst)
Job Satisfaction	1 (best) to 3 (worst)
Team Job Satisfaction	1 (best) to 3 (worst)
Job Competency	1 (best) to 3 (worst)
Total	**5 (best) to 15 (worst)**

The four **Stock graphs** were generated to provide a quick view of which facilities reported stockouts or lacking equipment within the context of the rest of the facilities in each LGA. These graphs directly depicted variables of medicines, RUTF, other anthropometric equipment, and height boards, each with a color-coded legend that corresponded to supply status. The four graphs were then stacked into a single graph where each row represented a group of supplies. Data represented the most recent site visit for each facility. Medicine status reflected the variables “amoxicillin”, “coartem”, “deworming”, and “vitamin A”. These were categorized as “med sufficient” if all four had sufficient one-month supply, “stockout multiple” if more than one item was insufficient, or “no [medicine item] only” if only a single item was insufficient with all others sufficient. For example, the phrase “no deworming only” would mean that the facility had amoxicillin, coartem, and vitamin A but not deworming. RUTF status showed whether the facility had sufficient PlumpyNut® product, where “sufficient” was defined within the survey as a one-month supply for health facilities or two-week supply for outreach facilities. These were correspondingly marked as “RUTF sufficient” or “RUTF stockout”. Equipment status reflected the variables “MUAC tape”, “Job Aid”, “weigh scale”, and “thermometer”. These were categorized as “eqp sufficient” if all four were available, “stockout multi” if more than one item was reported unavailable, or “no [equipment item] only” if only a single item was unavailable and all others were sufficient. Height board status was marked “available”, “no height board”, or “unknown” if the survey response was “not applicable”. Height boards were

graphed separately from anthropometric equipment due to the high number of "not applicable" responses.

A **WASH graph** showed the status of various WASH-related items. The goal of this screen was to identify facilities in need of WASH-related support. To do this, a graph was generated that directly reflected the variables "handwashing facilities", "latrine", "soap", and "water". PHCs were categorized as "WASH sufficient" if all four were available, "WASH insufficient" if more than one was unavailable, or "no [WASH item] only" if only a single item was unavailable and all others were sufficient. Data represented the most recent site visit for each facility.

The two **Training graphs** were generated to identify which CMAM facilities have training needs and allow comparison of those needs across LGAs. To this end, these two graphs depict CMAM provider knowledge and malnutrition assessment skills, color-coded to specific competencies. The two graphs were then stacked into a single graph with the top row representing CMAM knowledge and the bottom row malnutrition assessment skills. Due to the high number of variables that went into the final Training graph, variables were grouped and displayed by competency.

The three knowledge competencies included "Malnutrition Causes", "OTP Admission/Discharge", and "SC Referral". (1) "Malnutrition Causes" assessed whether health providers were able to accurately identify causes and signs of malnutrition (variables: "malnutrition causes", "signs marasmus", "signs kwashiorkor"). (2) "OTP Admission/Discharge" assessed whether health providers could accurately identify criteria for

OTP Admission/Discharge (variables: “OTP admission criteria”, “RUTF explained”, “malnutrition explained”, “key nutrition messages given”, “OTP discharge criteria”, “other OTP discharge criteria”). (3) “SC Referral” assessed whether health providers could accurately identify criteria for referring a patient for inpatient care (variables: “SC referral criteria”, “SC referral explained”, “medical complications requiring SC referral”). PHCs in this row were identified as “knowledge sufficient” if all three competencies were demonstrated, “multiple knowledge training needs” if more than one competency was inadequate, or “poor [knowledge competency] only” if only a single competency was unmet with all others being sufficient.

The five skills competencies included “Height Check”, “Weight Check”, “Oedema Check”, “MUAC Check”, and “Exam”. Each of the following competencies assessed whether health providers used appropriate anthropometric technique and physical exam skills to evaluate for growth and malnutrition. (1) “Height Check” used the variables “height check” and “weight-for-height recorded”. (2) “Weight Check” used the variables “weight check”, “child undressed”, “correct standing”, “scale calibrated” and “weight reading”. (3) “Oedema Check” used the variables “oedema check”, “oedema explained”, “oedema correctly checked”, “oedema correctly checked feet”, and “oedema grade”. (4) “MUAC Check” used the variables “MUAC explained”, “MUAC measured”, “left arm measured”, “correct measurement”, and “MUAC reading”. (5) “Exam” used the variables: “children registered” and “physical exam performed”. PHCs in this row were identified as “skills sufficient” if all five competencies were demonstrated, “multiple skills insufficient” if more than one competency was missed, or “Poor [skill competency] only” if only a single skill competency was unmet with all others being sufficient. See Table 3 for details.

Table 3: Training Graphs, Competencies, and Variables that went into them

Graph	Competency	Variables
Knowledge	Malnutrition Causes	Provider was able to correctly describe marasmus and kwashiorkor, and explain the primary causes of malnutrition
	OTP Admission/ Discharge	Provider was able to correctly identify outpatient therapeutic program admission and discharge criteria, explain RUTF feeding, explain malnutrition, and provide key nutrition messages per CMAM guidelines to caretakers
	SC Referral	Provider was able to correctly identify stabilization center referral criteria and medical complications that necessitate this referral. Provider also explained to the caretaker why their child needs to be referred, to where and what treatment will be provided
Skills	Height Check	Provider measures height and weight-for-height z-score is recorded correctly
	Weight check	Provider measures weight, child is undressed, mother holds child on scale, scale is calibrated, and weight is read correctly
	Oedema Check	Provider conducts oedema check, explains oedema to the caretaker, presses thumbs on both feet and counts to 3 seconds, checks for deepening spot, and then grades oedema correctly
	MUAC check	Provider measures MUAC, explains to caretaker what is done, uses child's left arm with clothes removed, MUAC tape is wrapped around middle of upper arm with appropriate tightness, and MUAC is read correctly
	Exam	Children are registered in any form of registration book and provider physically examines the entire body of the child from head to toe per standard CMAM protocol

OTP = Outpatient Therapeutic Program, SC = Stabilization Center, MUAC = Middle-Upper-Arm-Circumference, RUTF = Ready-to-Use-Therapeutic-Food, CMAM = Community Management of Acute Malnutrition

Data Visualization – Summary Graphs

Upon finishing the 10 single-subject graphs, two summary graphs were created to provide a broader perspective. These took into account variables from all aforementioned graphs to display a composite Health Facility Score for individual PHCs. The score was calculated by assigning 0-2 points for each health facility in the areas of training; last supervisory visit; morale score;

WASH; and availability of RUTF, medicines, height boards and other equipment. “Undesirable Outcomes” was added to include outcome measures as a small part of facility performance assessment. This used the variables “stagnating weight” and “absentee/defaulters”, reflecting whether the health facility had children with stagnating weight or weight loss, and if there are children who were absent or defaulted from the program. Scores were tabulated for each PHC totaling 0 (worst) to 18 (best). Those that scored in the top fifth and bottom tenth percentiles were displayed in separate graphs. They were color-coded by state (Borno or Yobe). See Table 4 for the composite scoring system.

Table 4: Scoring system spanning all competency areas, used to broadly evaluate health facility performance and rapidly identify poorly performing facilities.

	Points		
	0	**1**	**2**
Training Knowledge	Multiple Training Needs	One Training Need	Knowledge Sufficient
Training Skills	Multiple Training Needs	One Training Need	Skills Sufficient
Last Supervisory Visit	2+ months	1 month	(n/a)
Morale Score	8-15	7	5, 6
WASH	Missing Multiple Items	Missing One Item	WASH Sufficient
Stockout RUTF	Missing RUTF	n/a	RUTF sufficient
Stockout Med	Missing Multiple Items	Missing One Item	Med Sufficient
Stockout Heightboard	No HB or unknown	Available	(n/a)
Stockout Other Eqp	Missing Multiple Items	Missing One Item	Eqp Sufficient
Undesirable Outcomes	Stagnating & Absentee/default	Stagnating or Absentee/default	No stagnating nor Absentee/default

WASH = Water And Sanitation Hygiene, RUTF = Ready-to-Use-Therapeutic-Food

So that all steps in the dashboard process could be reproducible for ongoing application, data preparation and variable consolidation was performed in Tableau Prep (version 2018.2) and graphics were generated in Tableau Desktop (version 2019.2). This software was suggested as it is already in use by CDC and UNICEF staff involved in emergency nutrition response. Using the files from these applications, users could plug raw data into Tableau Prep, which prepares, cleans, and deduplicates it for visualization in Tableau Desktop. Simple instructions were created to facilitate this process and provided to UNICEF stakeholders.

Extensive guidance was provided from CDC partners with the Emergency Response and Recovery Branch during development of the dashboard's first draft. As these partners were already working with UNICEF Nigeria, they had contact with in-country staff as well as expertise on the situation and insight into what was needed for the dashboard to be useful. Proposals for the dashboard were submitted to them routinely and early drafts were shared periodically via Tableau Online. Their feedback helped to shape every aspect of the dashboard's first draft.

Data Analysis

The analysis employed in the ten graphs was kept at a basic level in order to simplify interpretation. In Health Facility Performance, percentiles were chosen as a means to identify a small number of top- and bottom- performing health facilities. Stock, WASH, Training and Morale each used 100% bar graphs to represent PHC needs, and the proportion thereof in each LGA. Other graphics (Site Visits, Primary Health Center Count) used basic counts only with no further analysis employed.

Dashboard Feedback

When the first draft of the dashboard reached an appropriate level of functionality and clarity, it was shared and discussed in meetings with two UNICEF nutrition officers who work as data specialists in Nigeria. During these meetings, dashboard goals and aims were shared, then officers were walked through each screen. Officers were asked to provide general insights and suggestions as the dashboard screens were explained, then they were asked specific questions from *Data Dashboard as Evaluation and Research Communication Tool*'s Usability Testing section.[37] The goals of these feedback sessions were to add context for the dashboard's findings, as well as to determine if the dashboard effectively communicates relevant information to stakeholders (as recommended by Smith).[37] Observations from the nutrition officers, as well as their feedback on improving the dashboard, were recorded in phone conversations and included over the next two chapters. Chapter 4: Deliverable presents the dashboard's first version before stakeholder feedback was incorporated. This feedback will be incorporated in future versions of the dashboard that extend beyond the timeframe in which this thesis was written.

Chapter Four: Deliverable

The following figures show the first complete version of the dashboard and its initial results, where Figure 1 contains a flowchart of the entire dashboard, and subsequent figures show the individual dashboard screens. The goal was to create a dashboard of supportive supervision data that helps project managers identify poorly performing health facilities.

A total of 2,782 entries for facility-level data were used in the dashboard project. Many of these entries were duplicates, as some facilities were visited multiple times within the reporting timeframe. A median of five entries (IQR 2-9) were reported per PHC.

Figure 1: Flowchart for entire dashboard. The first screen the user sees is titled "Overview & Methods" (far left). Users scroll through the screens using a navigation bar at the top of each screen, where the darker blue box indicates which screen is currently in view. A total of seven screens were included in the dashboard including (in order left to right) "Overview & Methods", "Health Facility Performance", "Site Visits & Facilities per Local Government Area", "Stock", "WASH", "Training" and "Morale". Each screen is explained in more detail below.

The first screen, titled “Overview & Methods”, provided a brief discussion on the aims of the supportive supervision data and the aims of the dashboard, as well as the methods used to develop the composite Health Facility Performance score (Table 4 from Methods chapter). This screen oriented the user to the intent and scope of the dashboard, in addition to setting up the user to understand the second screen, Health Facility Performance, pictured below in Figure 2.

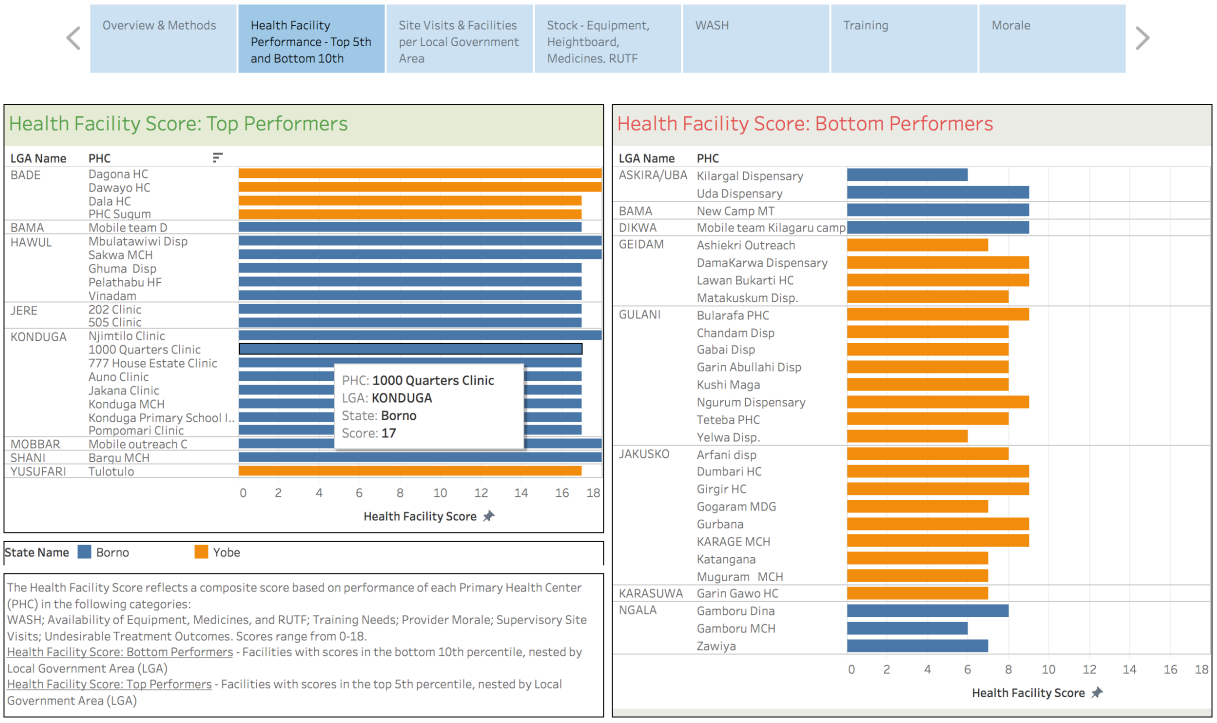

Figure 2: Health Facility Performance Screen – Top 5th and Bottom 10th Percentiles. This second screen represented a summative, core takeaway figure for nutrition managers working with the dashboard. It aimed to flag overall top- and bottom-performing health facilities so that program managers could prioritize where support is needed most, and look to top-performers to glean lessons on what they are doing right. The X-axis represents a composite score of 0-18 that was developed to reflect overall facility performance (see Methods for composite score derivation). Two graphs were generated where the Y-axis identified the State, Local Government

Area (LGA) and Primary Health Center (PHC) name of each facility that was flagged. Facilities in the top 5th percentile are depicted in the graph on the left whereas facilities in the bottom 10th percentile are depicted in the graph on the right. A total of 345 unique facilities, with data representing the most recent site visit, were assessed across 26 LGAs. The key (center left) color-coded each PHC by state, and a caption (bottom left) described how the composite score was derived. A white box appeared when users scrolled over the data, which indicated PHC, LGA, state and composite score for each bar of data. Blue boxes at the top of each screen are the navigation bar, with the darker blue indicating which screen is currently in view.

Both states had a roughly equal total number of facilities flagged as top or bottom (49.0% in Borno and 51.0% in Yobe), however 72.0% of flagged Borno facilities were high-performing, whereas only 19.2% of flagged Yobe facilities were high-performing. The median score of all facilities in Borno was 14 (IQR 12-16) whereas that in Yobe was 13 (IQR 11-14). Over half (57.1%) of all bottom-performing facilities were contained within two Yobe LGAs: Gulani (8) and Jakusko (8). A similar proportion (56.5%) of all top-performers were in two Borno LGAs: Konduga (8) and Hawul (5). The 28 bottom-performers were distributed amongst eight LGAs. The 23 top-performers were also distributed amongst eight LGAs. The only LGA that was represented in both graphs was Bama.

The Health Facility Performance Screen clearly flagged 28 of the worst-performing health facilities in northeast Nigeria. Though active conflict is worse in Borno, Yobe facilities had both a lower median facility score, and more low-performing facilities (especially in Jakusko, Gulani and Geidam). This is likely attributable to chronic poverty in Yobe (particularly severe in

northern LGAs like Jakusko and Geidam),[51] influx of IDPs to the relatively stable environment in Yobe,[51] and Borno receiving more international support as a focus of the humanitarian crisis.[52,53] Gulani and Geidam are significant return areas, where those who once fled violence are now returning in unpredictable patterns.[51] This, in addition to IDPs from Borno and elsewhere, makes structured service delivery difficult.[51] The Borno LGAs of Ngala and Dikwa, which border Marte (an area without CMAM coverage due to security concerns) reported a total of four under-performing facilities, perhaps reflecting challenges and strains placed by those fleeing Marte. Other PHCs of concern were reported in Akira/Uba (south Borno), Bama (east Borno), and Karasuwa (northwest Yobe). The reports of underperforming facilities that are far from conflict areas may reflect strains placed on health systems that are seeing a high influx of IDPs.[11]

The screen also identified the 23 best-performing facilities, mostly within Borno. Konduga had the most top-performers, perhaps because it is just south of the Borno capital Maiduguri, and is well resourced. Hawul in the south of Borno also had many top-performing facilities, despite neighboring Askira/Uba reporting multiple poor-performers. This contrast is also seen in Bade (Yobe) where top-performing facilities are reported in close proximity to a problem area like Jakusko. This reflects heterogeneity in facility performance, even within smaller areas. Heterogeneity can also be seen within a single LGA, as in the case of Bama where both a top- and bottom-performer was reported. Other top-performing PHCs were reported in Yusufari (northern Yobe), Mobbar (northern Borno), and Shani (southern Borno), which may be benefitting from the stability of neighboring LGAs or countries. It is difficult to know if these results are meaningful or represent a stable trend without more data over time, however the

screen provided a readout of where needs are currently greatest. When this is combined with the map in screen three (Figure 3), those needs can be better contextualized.

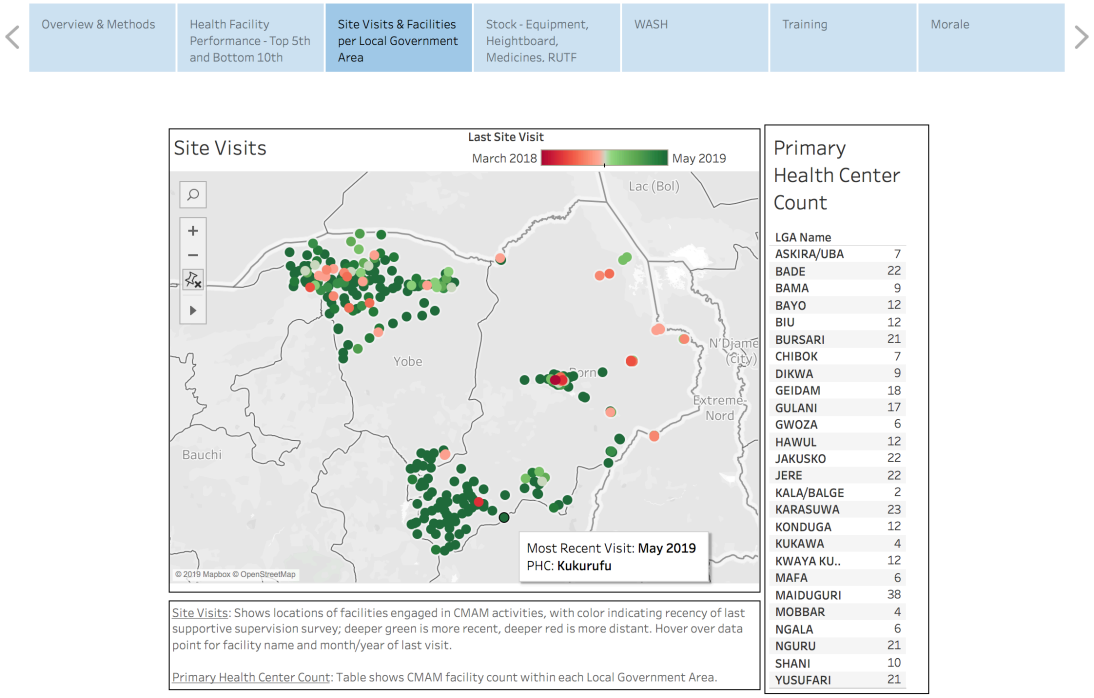

Figure 3: Site Visits & Facilities per Local Government Area Screen. This third screen was designed to give nutrition managers perspective on the geographic spread of health facilities, recency of their last visit, and an idea of the number of facilities within each LGA. A map pinpoints the locations of 350 surveyed facilities, including some that were not open at the time of visit. A color spectrum (top right) indicates the range of site visit dates, which for this dataset was March 2018 – May 2019. Visits in Oct 2018-May 2019 were green, whereas Mar 2018-Sept 2018 were red. Primary Health Center Count (right) showed facility counts grouped by LGA. A caption (below) oriented users to how to read the map and table. A white box appeared when users scrolled over each mapped data point, which told the user the PHC name, month, and year of the most recent visit. Blue boxes at the top of each screen are the navigation bar, with the darker blue indicating which screen is currently in view.

In Borno, the map showed that the number and recency of site visits within a 10-mile radius of the state capital Maiduguri were generally very good, with a small number of exceptions. Fifty-four of 61 facilities in this area were green indicating they were visited within the previous seven months, though the remaining seven were more distant: Bash Hausari, Gunda CHC, Shuwari 2, Cattle Ranch, Sabon Gari Outreach, Kulomari, and Lawan Maijir. Borno's southern region had 68 facilities, only one of which (Kida) was over seven months since the previous visit. Forty-one remaining facilities were spread throughout Borno's Eastern and Northern regions, 15 of which had not been visited in the previous seven months. Facilities in these regions were more spread out, and visit dates were more remote. Notably, regions south, north, and east of Maiduguri did not have facility reports, leaving out many LGAs from analysis.

In Yobe, facility reporting was divided into two major clusters: the northern half of the state, and the southern tip. The northern cluster contained 147 facilities, with higher concentration in the northwest. Fourteen facilities in the northern cluster were over seven months since the last visit. These 14 were distributed evenly with little apparent association to urban centers. The southern cluster of 19 facilities was much smaller in terms of geographic spread, with two facilities flagged over seven months old: Dokshi and Zango Dispensary. The data reflected no facility reports in Yobe's center and eastern regions, including near the capital Damaturu.

According to the Primary Health Center Count, the number of facilities within each LGA varied greatly between two (Kala/Balge) and 38 (Maiduguri) per LGA. The median was 12 facilities per LGA (IQR 7-21).

Of note, there were many facilities in Borno and Yobe that were not mapped. This is because the supportive supervision survey that produced data for the dashboard was only being used by facilities that are supported by UNICEF. This represented a major limitation of the dashboard at this stage. Additionally, there was no data available for six of the above facilities (1.7%) as they were closed at the time of data collection. These facilities fell into the five LGAs of Ngala, Kukawa, Gulani (two), Biu and Dikwa. Half of them (Ngala, Dikwa and Kukawa) bordered LGAs in active conflict, and many such facilities were damaged or destroyed.[54] Closed facilities represented a small subset of the data, and while closure may indicate they were visited outside normal operating hours, it is also possible these facilities have suspended CMAM activities and the local malnourished children are without treatment.

In conclusion, the Site Visits and Facilities per Local Government Area screen succeeded in portraying which facilities have not reported data recently and may be due for a supervisory visit. However, the data were significantly limited as they only portrayed facilities supported by UNICEF. There are many more PHCs throughout Borno and Yobe that did not report data and could not be mapped. It is important, given the exhaustive nature of CMAM facility surveys, that all operating facilities throughout each state be represented in the dashboard. The Primary Health Center Count additionally provided users with insight into where PHCs are distributed among LGAs. Shortages and supportive needs identified by the dashboard should be contextualized due to the wide distribution of facilities across different LGAs.

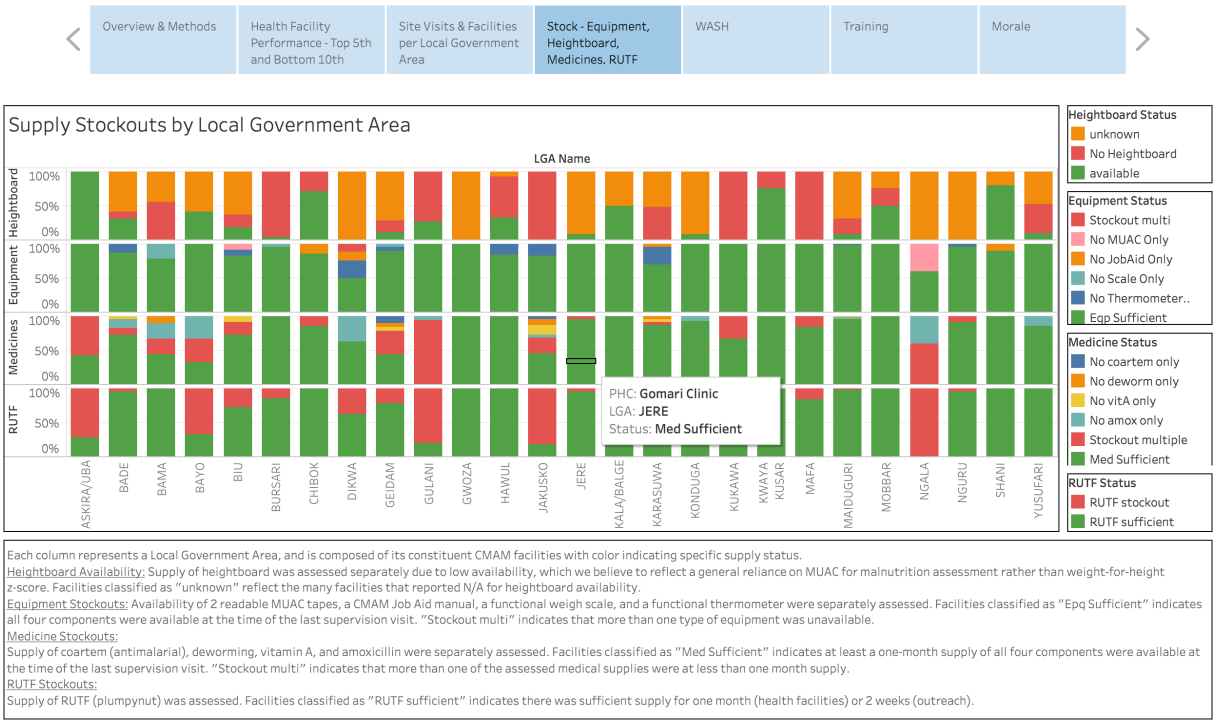

Figure 4: Stock Screen showing supply status of Height Boards, Equipment, Medicines and RUTF across 345 total health facilities in 26 LGAs. The goal of this screen was to provide a quick view of which facilities reported stockouts, especially stockouts of multiple items, within the context of the rest of the facilities in its LGA. Each bar represented an LGA made up of equal highlightable color-coded segments, representing PHCs. Each row shows a different supply category with a color-coded legend (right) that corresponds to supply status. A caption (below) oriented the user on how to read the data and described what specific items were assessed in each row. A white box appeared when users scrolled over the data which indicated PHC name, LGA and stock status for each data point. Blue boxes at the top of each screen are the navigation bar, with the darker blue indicating which screen is currently in view.

The height board data revealed large gaps in availability and routine use of this tool. Most PHCs reported height board status as unknown (48.4%) or unavailable (33.0%). Notable exceptions to

this trend were four LGAs in south Borno that reported over 50% height board availability: Askira/Uba, Chibok, Kwaya Kusar and Shani. Askira/Uba was the only LGA with height board availability in all of its PHCs. The other three LGAs of Chibok, Kwaya Kusar, and Shani had height boards in all facilities but two. PHCs in Mafa, Kukawa and Jakusko all reported no height boards. All PHCs in three east Borno LGAs (Dikwa, Gwoza, Ngala) and one in northwest Yobe (Nguru) reported “not applicable”.

In contrast to height boards, other equipment required for nutritional assessment were available in most (90.4%) facilities. The equipment data identified only one PHC, Mobile Team Fulatari in Dikwa, with multiple-item stockout. Thirty-two facilities (9.3%) reported a single-item equipment stockout. The most common missing item was thermometers (6.4%), followed by scale, job aid, and MUAC tape (all 1.2%). Importantly, statistics on single-item stockouts included facilities where the item is part of a multi-item stockout. Twelve of 26 LGAs reported no equipment stockouts in all PHCs. The highest percentage of facility stockouts was found in Dikwa (50%) followed by Ngala (40%).

The medicine data were generally positive, with a few important exceptions. Forty-nine facilities (14.2%) had multiple-item stockouts, over half of which were attributed to three LGAs: Gulani (14), Geidam (six) and Jakusko (five). The highest percentage of multi-item stockouts was found in Gulani, (93.3%) followed by Ngala (60.0%) and Askira/Uba (57.1%). Neither Gulani nor Ngala reported a single facility with full medicine stock. The remaining medicine stockouts were distributed among 16 LGAs, and seven LGAs reported no medicine stockouts. The most

common stockout item was amoxicillin (18.6% of all facilities), followed by coartem (13.0%), deworming (7.5%) and vitamin A (7.2%).

The RUTF data showed parallel areas of concern. Seventy facilities (20.3%) had insufficient RUTF, over half (52.9%) of which were attributed to three LGAs: Jakusko (18), Gulani (12), and Bayo (seven). Five LGAs reported over 50% of facilities with insufficient RUTF: Askira/Uba, Bayo, Gulani, Jakusko and Ngala. Fifteen LGAs had at least one facility with insufficient RUTF, with the remaining 11 LGAs reported no RUTF stockouts. Ngala showed all five facilities at stockout.

The Stock screen provided users a quick assessment of availability of ten critical CMAM items across 345 PHCs in northeast Nigeria. It flagged 11 LGAs in various need of supplies, with particularly urgent needs in Ngala, Jakusko, Gulani, and Askira/Uba. These areas were spread widely in the two-state region, however they have been flagged in the composite score above as having critical needs in many separate areas of assessment. Of note, LGAs receive RUTF and medicine supplies from separate sources.[34] Stockouts of both may indicate local mismanagement of supplies, or broader logistical challenges of supplying these sites. Site-specific investigations could add important clarity.

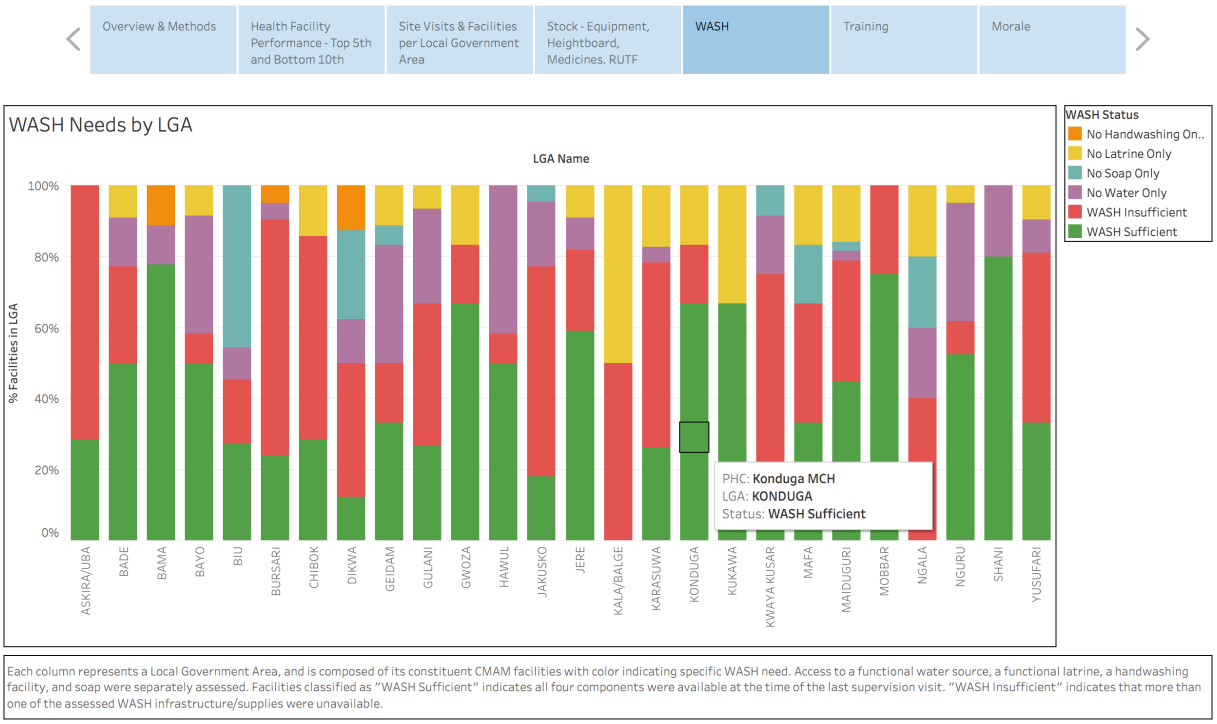

Figure 5: WASH Needs showing availability of hygiene items across 345 total health facilities in 26 LGAs. The goal of the WASH screen was to identify facilities in need of WASH-related support. Each bar represented an LGA made up of equal highlightable color-coded segments, representing PHCs. A legend (right) color-coded the WASH status of each PHC, and a caption (below) explained how to read the graph. A white box appeared when users scrolled over the data which indicated PHC name, LGA and WASH status for each data point. Blue boxes at the top of each screen are the navigation bar, with the darker blue indicating which screen is currently in view.

The WASH screen revealed a great degree of variability in facility hygiene supplies. One third (33.6%) of all facilities were "WASH insufficient" (meaning more than one item is missing), with at least one such facility in a majority (88.5%) of LGAs. Most LGAs (61.5%) reported fewer than half of its facilities were "WASH Sufficient". The LGAs with the smallest proportion

of “WASH Sufficient” facilities were in Ngala and Kala/Balge (both zero), followed by Kwaya Kusar (9.1%), Dikwa (12.5%), Jakusko (18.2%), and Bursari (20.0%). The most common missing WASH item was water (45.8% of all facilities), followed by latrine (36.8%), soap (17.7%), and handwashing (10.7%).

The WASH Screen clearly identified over two hundred facilities in need of WASH-related support, with every LGA reporting a shortage of some kind. The screen drew particular attention to the east Borno LGAs of Ngala, Kala/Balge and Dikwa, all three of which are close to Marte and the heart of ongoing conflict. Jakusko in western Yobe has been frequently flagged as an area in need in the Performance and Stock screens. Conversely Kwaya Kusar and Bursari have not raised attention yet, indicating that these areas may be in need of WASH support only. Lastly, the screen draws attention to the general lack of water and latrines in many facilities, perhaps reflecting the challenge of supplying these things relative to soap, a tangible item. The “handwashing” variable was not a commonly missing item, so physical handwashing stations seem to be available even if running water is not.

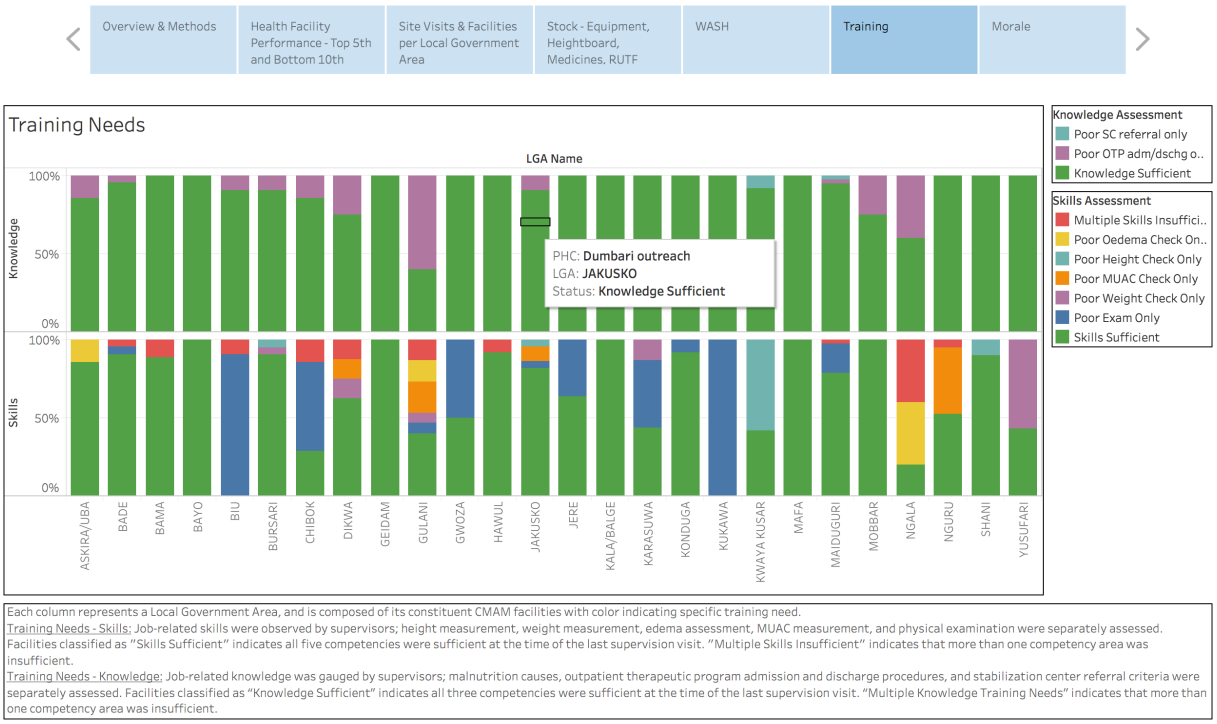

Figure 6: Training Screen showing status of CMAM Provider Knowledge and Skills Assessments across 345 total health facilities in 26 LGAs. The goal of this screen was to allow nutrition managers to quickly identify facilities in need of training. Each bar represented an LGA made up of equal highlightable color-coded segments, representing PHCs. A legend (right) color-coded the training status of each PHC, and a caption (below) explained how to read the graph. A white box appeared when users scrolled over the data which indicated PHC name, LGA and training status for each data point. Blue boxes at the top of each screen are the navigation bar, with the darker blue indicating which screen is currently in view.

The knowledge data revealed that most facilities had sufficient training. Only 7.0% of facilities reported a single-item training need, and zero facilities had multiple needs. Most of these were poor OTP admission/discharge knowledge (6.4%). Two facilities reported poor SC referral knowledge. These training needs were identified in twelve different LGAs. Gulani contained the

highest proportion of facilities with unmet need (60%) followed by Ngala (40%). Gulani also had the highest total number of facilities (9) in need of skills training.

In contrast, there were a lot more gaps reported in skills assessments. Nearly one third of facilities (31.6%) had some form of skills training need, 3.5% of which reported multiple skills training needs. Needs were spread across 21 LGAs. The most common skills training need was physical exam (15.9%), followed by weight check (7.2%), MUAC (6.7%), height check (3.5%), and oedema check (2.9%). The LGAs with the highest percentage of facilities in need of training were Biu (100%), Kukawa (100%), Ngala (80%), and Chibok (71.4%). The LGAs with the highest total number of facilities in need of training were Karasuwa with 13 facilities, followed by Yusufari with 12, and Biu with 11.

The Training screen flagged over a hundred facilities in need of improvement, indicating that there was a greater need for skills-based vs. knowledge-based training. This screen drew particular attention to the LGAs of Gulani and nearby Biu, Ngala and Karasuwa; all except Biu have been flagged in previous screens for their supportive needs. More analysis is needed to assess if these training needs correspond to poor performance indicators.

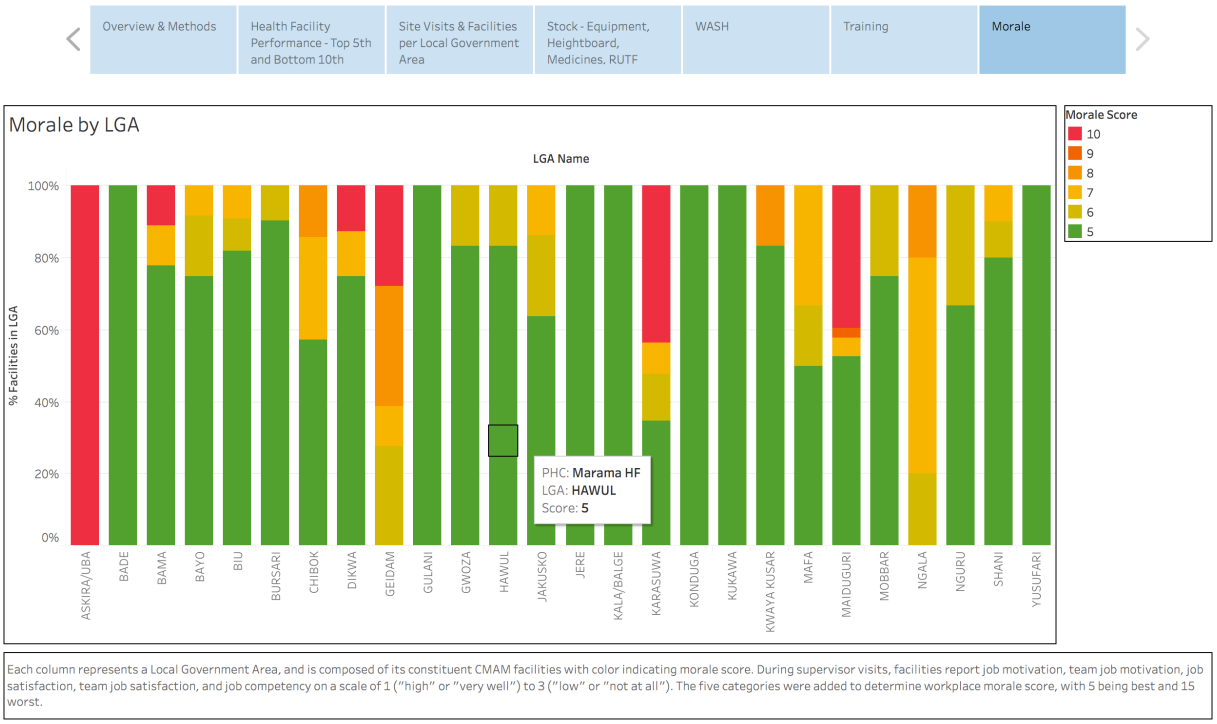

Figure 7: Morale Screen showing status of CMAM Provider Morale across 345 total health facilities in 26 LGAs. The goal of the Morale screen was to give nutrition managers a way to identify where morale is low so that appropriate intervention can be made to mitigate harm to CMAM programming. Each bar represented an LGA made up of equal highlightable color-coded segments, representing PHCs. Colors indicate morale score where green indicates higher morale and red indicates lower morale. A legend (top right) color-coded the morale score for each PHC, and a caption (below) explained how to read the graph. A white box appeared when users scrolled over the data which indicated PHC name, LGA and morale score for each data point. Blue boxes at the top of each screen are the navigation bar, with the darker blue indicating which screen is currently in view.

Though most facilities (70.4%) reported high morale, many facilities scored less optimally, and there were important differences between states. Most LGAs (73.1%) contained one or more facilities with imperfect scores. The lowest morale score observed was 10, reported in 11.3% of facilities. These were in six LGAs, with Maiduguri containing the bulk (38.5%) of them. Considering the rest of the data, 0.3% (one facility) scored nine, 2.6% scored eight, 6.0% scored seven, 13.1% scored six. The median morale score of all facilities was five (IQR 5-6), with the same values found for Borno-only and Yobe-only facilities The LGAs with the highest proportion of low morale were Askira/Uba (10 in all facilities), Geidam and Ngala where no facilities scored better than six. Other LGAs with low morale were Karasuwa (48.5% scored 10) and Maiduguri (39.5% scored 10).

The Morale screen identified nearly 40 facilities with a score of 10 in critical need of morale improvement, with 63 more in various stages of demoralization. Maiduguri in Borno contained a large proportion of very poor scores, though both states reported the same median morale score of five. In some instances, poor morale scores paralleled other areas of need, as in the case of Ngala, Karasuwa, and Askira/Uba. Conversely Maiduguri and Geidam have not been flagged as much, indicating that many factors may be contributing to low morale beyond what is reported in the dashboard. Regardless it will be important for program managers to engage with CMAM staff where personal and team motivation, satisfaction, and competency scores are lowest.

Feedback from UNICEF

As discussed in the *Dashboard Feedback* section of Chapter 3, the first draft of the dashboard was shared with UNICEF nutrition officers who work as data specialists in Nigeria. They

provided their feedback via phone conversations. Results from the feedback sessions are discussed here, as well as the changes that they proposed for the future version of the dashboard.

The dashboard's first draft received generally positive feedback with some suggestions for improvement. The nutrition officers indicated that the dashboard helps easily identify areas that require attention. They also confirmed that it was easy to make sense of how the dashboard was organized. They indicated that the first screen titled Overview and Methods, while serving as a good foundation for data interpretation, needed some clarification. Specifically they said that the Health Facility score chart was vague on "undesirable outcomes", and this category needed adjustment so that the reader could better interpret the Health Facility Performance screen. They also pointed out that the reporting timeframe that was used (March 2018-May 2019) was not made clear, and its breadth made interpretation of the data difficult. They suggested indicating the reporting timeframe in this first screen and restricting it to the most recent quarter to help orient the reader and increase relevancy of the dashboard. Additionally, they said the Primary Health Center Count table in screen 3 only shows facilities that were visited and reported supervision data to UNICEF; there are many more facilities in each LGA, and they suggested editing this to report facilities visited as a percent of total number of facilities. They said the Stock screen compressed too much information into one screen; splitting between two screens (Equipment and Consumables) was proposed. Lastly, they said the training indicators were not self-evident, as indicators were each composed of more than one survey variable. They suggested including more detail on how these indicators were tabulated, which would help to interpret those data.

Chapter 5: Discussion & Implications

The goal of this thesis was to create a dashboard of supportive supervision data that helps project managers identify poorly performing health facilities engaged in malnutrition management of humanitarian emergency-affected communities in northeast Nigeria. This project revealed insights into the public health situation in northeast Nigeria as it pertains to CMAM service provision. Feedback from UNICEF officers added further context on the public health situation and CMAM. These insights are organized within the Mambulu-Chikankheni framework in the next section. The project also provided important lessons about the dashboard as a tool for ongoing CMAM process monitoring, and feedback from UNICEF officers described how the dashboard can be improved for process monitoring.

The Public Health Situation

Supportive Supervision & Morale

In terms of the public health situation, the Site Visits graphic indicated that there are large areas in central Yobe and north/south of Maiduguri in Borno that were not represented in the supervision data. This is largely because the supervision survey tool is currently used only by government health facilities that are supported by UNICEF. Nearly all facilities (98.5% or 350/355) in the data used for the dashboard indicated that UNICEF was their primary supporting organization. However, international non-governmental organizations (INGOs) support many more CMAM facilities.[49] Action Against Hunger (AAH), an INGO that has been operating in Nigeria since 2010,[55] supported over 80 facilities in central Yobe as of April 2018.[49] Over 30 facilities north and south of Maiduguri in Borno are supported by International Medical Corps (IMC), INTERSOS, and AAH.[49] These facilities are not currently represented in the dashboard

as they do not report supervision data routinely to UNICEF. Government facilities supported by UNICEF are generally clustered in strategic areas that received a large amount of IDPs.[11] This represented an important limitation to uniform supervision of all CMAM activities. To address this, we are working with UNICEF to get a full list of facilities to see which ones have never been visited. To improve the dashboard's utility, and more broadly ensure that CMAM facility processes are uniformly monitored and supported, it will be necessary to encourage buy-in from all agencies working in the nutrition sector. Without a uniform monitoring system, many health facilities may not receive necessary nutritional support. This could contribute to disproportionately high levels of acute malnutrition reported in Borno and Yobe in the national survey.[10]

Further reducing uniformity of supportive supervision were the 39 total facilities that had not been visited in over seven months. These facilities represented a significant departure from the CMAM goal of conducting supervisory visits every month. The cluster of these facilities in northern Yobe have likely not been visited due to fewer organizations working in Yobe as well as poorer communities in Yobe's north, as discussed in chapter four. Limited facility visits in Borno may be more attributable to ongoing violence and difficult access, as many flagged facilities were in the northeast. Regardless it is difficult to make generalizations from the dashboard based on facility reports that have not been updated in over seven months (some up to 14 months). Additionally, there were six facilities that were closed at the time of their most recent supervisory visit, discussed in the Site Visits section of chapter four. As half of them bordered LGAs in active conflict, these facilities may have been closed due to security concerns.[49] We recommend facilities that are closed at the time of supervisory visits to be

followed up promptly (within a month) by LGA nutrition focal persons so that the nature of the closure can be determined (temporary or permanent). This will ensure that such facilities are represented in the data and children continue to receive necessary CMAM services.

The Morale data showed a high number of "perfect" morale scores, indicating that this metric lacked discriminatory value. Given the structure of the supervision survey, it is difficult to assess facility morale more thoroughly. Validity of the morale score may improve by expanding the morale section to include more specific questions, or a free-response section to describe why respondents reported high motivation, satisfaction and job competence. Poor morale scores were clustered in certain areas, specifically Askira/Uba and Maiduguri. When discussing these results with in-country UNICEF staff, they pointed out that issues seemed to be in areas where some facilities are supported by partners and some are supported by government/UNICEF. This was the case in Askira/Uba and near the Borno capital Maiduguri. They indicated that facilities supported by INGO partners had more resources to provide incentives, more regular refresher trainings, and are perhaps better supplied. Having separate leadership with larger resource pools may have contributed to morale issues among government/UNICEF supported facilities. We recommend LGA-based nutrition staff follow up with facilities that were flagged with a poor morale score to determine what factors are at play (e.g. training needs, lack of incentives, or high staff turnover).

Adequate Resources & Firm Operational Structures

The dashboard revealed large gaps in availability of height boards, which are necessary for reporting weight-for-height Z (WHZ) scores, across many LGAs. CMAM protocols in Nigeria

stated that both middle-upper arm circumference (MUAC) and WHZ should be used, but if resources are inadequate or "admissions are high, it is recommended to just use MUAC and oedema for admission and discharge."[17] UNICEF nutrition officers stated that CMAM facilities in Nigeria are not routinely using height boards to assess WHZ, preferring instead to rely on MUAC as the indicator for acute malnutrition. Preferential use of MUAC-based assessment is because MUAC requires fewer and cheaper tools, does not involve calculation, and can be performed more quickly. Though WHO guidelines state either MUAC or WHZ can be used,[56] newer research indicates that MUAC-based and WHZ-based malnutrition assessments identify different children.[18] In Nigeria, only 59.9% of children with GAM and 49.0% of children with SAM (by MUAC or WHZ) are correctly identified by MUAC-only assessment.[18] This may complicate program planning and evaluation. We therefore recommend efforts to supply and standardize height board use in routine CMAM operations to ensure uniformity of the malnutrition data that is reported in Nigeria.

As mentioned in the previous chapter, LGAs flagged in the Stock screen for missing multiple types of consumables were a major concern for supply resourcing and management. RUTF and medicine supplies come from separate sources, where UNICEF and INGOs supply RUTF, and medicines come from the Nigerian Government and the WHO.[34] The Nigerian Government does not allocate any funding for RUTF due to expense (RUTF comprises up to 50% of CMAM programming cost)[25], and because RUTF is not yet on the Nigeria Essential Medicines List (EML).[34,57] Askira/Uba, Bayo, Gulani, Jakusko and Ngala all contained a significant amount of crossover in facilities reporting stockouts of RUTF and medicines. Ngala borders Marte, an LGA that is still inaccessible.[49] While seven aid organizations were active in Ngala LGA as of April

2018, aid workers reported significant security concerns outside of the main city (also named Ngala).[58] On the road between Maiduguri and Ngala (how aid is delivered), a convoy containing food was attacked and robbed in 2018.[58] Additionally, IDPs from conflict areas have flocked to urban centers such as Ngala town, doubling its population and adding pressure to CMAM operations that are already underfunded.[11,58] Bayo and Askira/Uba in Borno are more distant from the capital Maiduguri, from where supplies are managed and distributed.[34] Longer transports increase security risks as aid travels through rural parts of the state that are less policed. Inadequate funding has led less than half of households in Bayo and Askira/Uba to be reached for food aid, according to a report from August 2019.[11] Gulani and Jakusko in Yobe have both been flagged as containing many of the lowest-performing PHCs (chapter four, Figure 2) indicating that these locations are facing other difficulties beyond the supply realm. Challenges to distribution of RUTF and medicines are many, however security and inadequate funding are known contributors.[11] It has been proposed that placing RUTF on the National EML of Nigeria would help prioritize procurement of RUTF, and alleviate some of the issues with RUTF distribution and supply chain.[57] This could be accomplished by standardizing RUTF as part of every health facility formulary, which may also decrease the cost as demand rises and more manufacturers start producing it.[57] As of 2018, Nigeria was in the final steps of adding RUTF to the national list.[57] However, including RUTF in the EML is likely to only help facilities where non-EML supplies (such as RUTF) are missing while EML supplies are adequate. Facilities with both RUTF and essential medicine stockouts should receive follow up by LGA-based nutrition staff to evaluate where supply chain issues lie. Requisition and supply pathways for consumables vary by the area being served,[34] and further analysis by such individuals with more local contextual understanding may add important clarity to stockout issues.

The WASH data indicated that CMAM operations have difficulty providing basic sanitation and hygiene at sites of delivery. The apparent lack of running water in nearly half (45.8%) of all facilities, with over half (60.6%) of facilities reporting some kind of WASH-related need was surprising. Northeast Nigeria has a savanna climate with a dry season that lasts most of the year[59] and a wet season that brings flooding and water-borne illness.[11] Flooding, severe winds and sandstorms have damaged much of the WASH infrastructure at many CMAM sites.[4] Delivery of water and hygiene supplies is complicated by security and funding concerns, in addition to sporadic influx and efflux of IDPs.[4] This represents a challenge of resourcing in addition to operational structures. We recommend sharing the dashboard findings with the WASH cluster to learn more about these shortages, and what is being done to address them.

Thorough Training

A potentially positive finding from the supervision data was the apparent lack of identified training gaps in provider knowledge. Though many facilities in Gulani showed a lack of OTP admission and discharge understanding, a vast majority of PHCs had sufficient provider knowledge in all assessed categories. This finding could arise from overreporting, and it is unclear from how the data were reported whether prompts were given or CMAM manuals were used during provider knowledge assessment. However, UNICEF nutrition officers pointed out that UNICEF had recently ramped up training for CMAM providers, which could have contributed to the positive findings from the knowledge training data as well.

Unlike knowledge training, skills training revealed a variety of gaps across many LGAs, the largest of which was physical examination. In Biu and Kukawa for example (both LGAs that have not raised concern in other areas), a majority of facilities reported poor exam skills, indicating that child registration and head-to-toe physical exams were either inadequate, or were not done. Based on this skill gap, we recommend refresher training be done with a focus on the physical examination module in UNICEF-supported facilities. This could be incorporated into ongoing efforts by UNICEF to improve CMAM training across all facilities that they support (mentioned above). Whether this gap also affects facilities that are supported by other INGOs remains unclear, though improving dashboard buy-in from all partners in the Nutrition Sector will lead to better awareness of CMAM training gaps in all facilities.

Other skills gaps were generally heterogeneous, and LGAs with many skills gaps did not align well with other needs across other dashboard screens. For example, many PHCs that reported height board as “unavailable” or “not applicable” still indicated that the provider’s height check skill was sufficient. This suggests that skills are perhaps being over-reported. We recommend efforts to validate the training data to ensure quality, which is not currently being done. This could take the form of following up with a subset of facilities to conduct basic verification. We further suggest comparing the dashboard results to outcomes data from routine Data Quality Assessment (RDQA) to determine if there was a meaningful link between adequate levels of training and program outcomes, such as facility cure rates. This analysis can strengthen the survey’s criterion validity, or the degree that survey variables predict outcomes. Based on these analyses, the Nutrition Sector can improve supervision monitoring and make informed decisions on locations and types of training that are most beneficial to CMAM programming goals.

The Dashboard as a Tool

As a result of low utilization of process measures, little is known in the programmatic reports and broader literature about the quality of nutrition services in northeast Nigeria. This dashboard is a unique tool and an important step toward better process measuring that is likely to be more user-friendly than data outputs that existed prior.[43,45] It conveys information from the survey variables that were assessed; facilitates comparison between facilities, LGAs and states; and highlights areas of highest need. This aligns well with the project's main goal. In line with the findings discussed in Chapter 2, this dashboard has the potential to be far more useful and encourage more data interaction than data outputs or written reports.[36,43-45] To our knowledge, this CMAM supervision dashboard is the first of its kind for Nigeria, and is an important step forward in improving process measuring.

An important feature of the dashboard that initially required attention was the need for unique facility identifiers. In order to be a useful tool, the dashboard relies on the assumption that each facility is singly and uniquely represented. However, the original supervision survey asked respondents to enter the facility name as free text, which made it difficult to differentiate PHCs with slight variations in spelling or title. Based on our early feedback, the survey was changed to include a unique number for each health facility to address this need.

The dashboard in its current form needs improvement in three main areas: supervision data quality and validity, ongoing evaluation and refinement, and buy-in from other INGOs in the Nutrition Sector. Solutions for each of these areas of need are proposed.

Data quality could be improved by having LGA nutrition focal persons follow up with a subset of facilities to conduct basic verification. Such follow up visits should take place relatively quickly (i.e. within a week of the previous visit) so that changes in staff, seasons, or other external factors do not impact survey results. Verification can also be performed by comparing supervision data with other CMAM data, such as that from the RDQA mentioned in chapter two.[29] Variables that match between the two surveys (such as RUTF availability, water or latrine availability) could be compared to assess data accuracy. Validation of survey indicators could be done by triangulating supervision findings with objective indices from health records and outcome performance metrics from the RDQA. With this analysis, one could look at facilities with RUTF stockout to check for high program admissions, or if MUAC-upon-discharge matches protocol in facilities that reported adequate MUAC training. Such efforts would ensure the dashboard provides an accurate portrayal of CMAM programming.

Evaluation and refinement are necessary to ensure that the dashboard is relevant and useful to its intended purpose.[37] Before widespread use, indicators that were developed for the dashboard should be compared with standard CMAM quality indicators that are used globally, such as defaulter rates and recovery rates.[24] The facility composite scoring system was tabulated based on the availability of variables from the supervision survey. As a result, domains that were used to tabulate composite scores were weighted unequally with more emphasis on Adequate Resources variables. This represented an important limitation to composite scoring, as facilities with many supply stockouts will score much lower than those with poor WASH or Training performance. Morale scoring is limited by how the survey was conducted; only one facility focal

person was interviewed, and morale score therefore reflects only one person's input from the most recent facility visit. Positive composite and morale scores should align well with low defaulter and high recovery rates and if not, be reconsidered. Validation could be done with a principal component analysis, or a similarly validated method used for scale development. Upon implementation of the dashboard, evaluation should take place periodically (Smith et al suggest after 6-12 months) by the organization that hosts it (in this case, UNICEF Nigeria).[37] During the evaluation, stakeholders that have worked with the dashboard are asked if they can evaluate what they are seeing in the various screens, if they can spot areas needing attention, if enough context is provided and whether the organization of the dashboard is understandable.[37] Each indicator in each screen should be reevaluated, and indicators should be removed or added based on user feedback. This will elucidate shortcomings that only manifest after rollout and ensure ongoing use and relevance of the dashboard.

As indicated from the survey data and UNICEF nutrition officers, the supportive supervision survey is only being administered in facilities where UNICEF is the primary supportive aid organization. Hundreds of other CMAM facilities are not represented in the dashboard, nor are they being monitored in a systematic way. For the dashboard to be a useful tool, it must represent all partners in the Nutrition Sector. Efforts to disseminate the dashboard will be made to encourage partners to buy into the supervision survey and dashboard monitoring system. Options for sharing the dashboard online (such as humanitarianresponse.info or hosting on a UNICEF website) will be explored.

Implications

CMAM Programs

- The supervision survey and dashboard tools only reflect facilities where UNICEF is the primary supportive aid organization. Dissemination of the dashboard may help encourage buy-in from other Nutrition Sector partner organizations.
- Children are being triaged and managed within CMAM services using MUAC cutoffs alone, rather than in combination with WHZ scores. MUAC measurement alone may miss a significant number of children in need of nutritional support.
- Shortages of CMAM supplies frequently span multiple supply sources, indicating that such facilities are facing broader challenges such as security and funding.
- Training appears generally adequate in terms of knowledge, but less so in terms of skills. We recommend UNICEF incorporates a physical exam refresher into ongoing efforts to improve CMAM training across all supported facilities. Additionally, validation of both dashboard training indicators and of reported training data would ensure information accuracy and determine if adequate levels of training correlate to CMAM programming goals.

Use of the Dashboard in Supportive Supervision

- This dashboard is a unique tool and an important step toward CMAM process measuring, which is not currently being done in a systematic method. The dashboard is likely to be more user-friendly than data outputs that existed prior. It conveys information from the survey variables that were assessed; allows simple comparison between facilities, LGAs and states; and highlights areas of highest need. Upon making the edits for clarity that

were recommended by UNICEF nutrition officers, which will take place beyond the scope of this thesis, the dashboard will be ready for dissemination to the Nutrition Sector.

- Unique health facility identifiers were essential to the dashboard being a useful tool.
- Assessing survey data quality and validity, performing continual evaluation and refinement of the dashboard, and securing buy-in from all partner organizations in the Nutrition Sector are necessary to maximize the utility of the dashboard as a CMAM monitoring tool.

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Appendix A: Survey Layout with All Variables Included

Sections	Variables*
Survey info - Automated	**Start date/time, end date/time**, day of survey, device ID, subscriber ID
Survey info - Manually Input	**GPS coordinates**, supervisor name and phone, interviewee name and phone, number of visits in this month, organization, **state**, **LGA**, ward, **health facility**, **CMAM site name**, CMAM level (OTP, ITP/SC), is facility open today
Supervision observation	Focal person present
Facility Hygiene	**Water source, latrine, handwashing, soap**, surrounding hygiene, consultation area clean,
Adequate Staff	Staff present, staff number, staff trained, number of staff trained, number not trained
Nutrition knowledge	Name **3 signs marasumus**, **3 signs kwashiorkor**, **3 malnutrition causes**
Equipment	**2 MUAC tapes, CMAM job aid manual, weigh scale,** spare scale battery, **height board with header/footer piece, thermometer**
OTP cards	Treatment cards available, registration/ration cards available, referral slips, weekly/monthly tally sheets, registration book
Health & Nutrition checkup	**Children are registered, physical exam performed**
MUAC	**MUAC measured, explained, correct technique, left arm used, read correctly**
Oedema check	**Oedema checked, explained, correctly checked, correctly checked feet, graded**
Weight check	**Weight measured, child undressed, while standing, scale calibrated, read correctly**
Height check	**Height measured**
OTP admission criteria	**Weight-for-height Z-score read correctly from table**, nutrition data recorded using assessment card, treatment decision, appetite test, admission criteria ellicited, **correct admission criteria**, appetite correctly assessed, **malnutrition explained**, OTP treatment card used, registration number provided, card is completed front and back, OTP ration card completed, RUTF given, **RUTF explained**, amoxicillin given, amoxicillin explained, coartem given, coartem explained, vitamin A given, albendazole given, albendazole explained, **key nutrition messages given**, OTP supplies available
SC referral	**When to refer, referral explained, medical complications explained**
Followup	What did HW do to follow up
OTP Discharge	**When to discharge as cured, other possible discharges**, RUTF transition, vitamin A transition, measles vaccine referral, nutrition counselling, SFP/CNM referral
Nutrition Counselling	Understands colostrum, feeding child at 6-11 months, 12-23 months, over 24 months, and during OTP treatment
Staff Management	**Last supervisor visit, personal motivation, team motivation, job satisfaction**, **work competence, CMAM competence**, CMAM perception, suggestions on CMAM improvement
Supplies	Store keeper present with keys, storage organized
Routine drugs	**RUTF, amoxicillin, coartem, albendazole, vitamin A**, expired drugs, last requisition sent, requested drugs delivered, when delivered, received all requested
OTP cards	Correctly filed, proper recording, correct admission, correct discharge, children not discharged, **stagnating/losing weight, absent/defaulters**, record monthly reports, cards verified, RUTF verified, community involvement
Community involvement	Community involvement, suggestions for improvement
Caretaker exit interview	Knowledge on followup day, RUTF given, RUTF use, breastfeeding first, wash RUTF, tear sachet, ready to use, take with water, no other food necessary, necessary away empties
*bolded variables were included in Dashboard	

OTP = Outpatient Therapeutic Program, MUAC = Middle-Upper-Arm-Circumference, SC = Stabilization Center, LGA = Local Government Area, CMAM = Community Management of Acute Malnutrition, ITP = Inpatient Therapeutic Program, RUTF = Ready-to-Use-Therapeutic-Food, HW = Health Worker, CNM = Community Nutrition Mobilizer