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Assessment of data quality and reporting systems for underserved populations: the case of integrated community case management programs in Nigeria

Florence M Nyangara[1],*, Tajrina Hai[1], Kirsten Zalisk[1], Lynda Ozor[2], Joy Ufere[2], Chinwoke Isiguzo[3] and Ibrahim Ndaliman Abubakar[4]

[1]ICF International, International Health and Development Division; 530 Gaither Road, Suite 500, Rockville Maryland, 20850 USA, [2]World Health Organization Country Office; UN Building, 617/618 Diplomatic Drive, Central Business District, Abuja, FCT Nigeria, [3]Society for Family Health; No 8 Port Harcourt Crescent, Area 11, Garki, Abuja, Nigeria, and [4]Niger State, Ministry of Health; Minna, Nigeria

*Corresponding author. ICF International, International Health and Development Division; 530 Gaither Road, Suite 500, Rockville Maryland, 20850 USA. E-mail: florence.nyangara@icf.com

Abstract

Decision makers are searching for reliable data and best practices to support the implementation and scale-up of the integrated community case management (iCCM) programs in underserved areas to reduce under-five mortality in low-income countries. This study assesses data quality and reporting systems of the World Health Organization supported Rapid Access Expansion program implementing iCCM in Abia and Niger States, Nigeria. This cross-sectional study used data from 16 primary health facilities in both states. Data were collected through review of registers and monthly summary reports of 140 community-oriented resource persons (CORPs), assessments of the five dimensions of the data reporting systems and 46 key informant interviews with stakeholders. Data quality was assessed by availability, completeness and consistency. Each component of the reporting system was assessed on a 3-point scale (weak, satisfactory and strong). Results show that both the structure, functions and capabilities, as well as data collection and reporting tools dimensions of the reporting system were strong, scoring (2.80, 2.73) for Abia and (2.88, 2.75) for Niger, respectively. Data management processes and links with national reporting system components scored low 2 s, indicating fair strength. Data availability, completeness and consistency were found to be good, an indication of adequate training and supervision of CORPs and community health extension workers. Indicator definitions and reporting guidelines were the weakest dimension of the system due to lack of data reporting guidelines in both states. In conclusion, the results indicate satisfactory data reporting systems and good quality data during early implementation of iCCM programs in the two states. Hence, countries planning to adopt and implement iCCM programs should first develop structures, establish national standardized tools for collecting and reporting data, provide for adequate training and supervision of community health workers and develop reporting guidelines for all reporting levels to ensure data quality.

Keywords: Integrated community case management, child health, community health worker, pneumonia, diarrhea, malaria health information system, data reporting system, monitoring and evaluation, data quality, Nigeria

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Key Messages

- Good quality data to support the integrated community case management (iCCM) programs in underserved areas by community health workers is achievable, as demonstrated in Abia and Niger States, Nigeria.
- Centrally establishing and strengthening the data collection and reporting system for the iCCM program in terms of structure, capabilities and standardizing reporting tools at the beginning of the program helped contribute greatly to the improvement in quality of data in Abia and Niger, Nigeria.
- Conducting annual data quality assessments of the iCCM routine data should be emphasized and supported to help identify strengths, gaps and opportunities to strengthen the data management systems and improve data quality for better programming and policy decisions.

Introduction

In recent decades, there have been reductions in under-five morbidity and mortality in several sub-Saharan Africa countries (Black *et al*. 2010; Liu *et al*. 2015); however, variations across and within countries have widened and, in some cases, childhood deaths have increased among underserved populations in low-income countries (Black *et al*. 2010; United Nations Inter-agency Group for Child Mortality Estimation (UN-IGME) 2015; You *et al*. 2015). To address this disparity and accelerate progress in child survival, the integrated community case management (iCCM) strategy was initiated in 2004 by the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) as an equity-focused, high-impact, and cost-effective strategy targeting the leading causes of childhood deaths in underserved areas (Hamer *et al*. 2012; WHO and UNICEF 2004; Young *et al*. 2014). The goal of iCCM is to increase access to prompt and accurate treatment of three major childhood killer illnesses—diarrhea, malaria and pneumonia—and identify malnutrition among children under-five (Guenther *et al*. 2017; Marsh *et al*. 2012; Mubiru *et al*. 2015; Seidenberg *et al*. 2012; WHO and UNICEF 2004; Young *et al*. 2012; Young *et al*. 2014; Yourkavitch *et al*. 2016). Nigeria adopted the iCCM strategy in 2013 and started implementing it in Abia and Niger States with funds from the Canadian Government through the WHO Rapid Access Expansion (RAcE) Program.

Decision makers in various countries are searching for reliable data and evidence of best practices to guide the adaptation, implementation and scale-up of the iCCM strategy. As in many successful programs, the approach of establishing and strengthening the data reporting system, as well as generating and using good quality of routine data for decision making is critical and considered a key priority for program improvement (Avan *et al*. 2016; WHO 2007). This strategy becomes even more important as iCCM programs expand rapidly in several countries that have inadequate systems in place to generate credible evidence to support their programmatic and policy decisions for underserved populations (AbouZahr and Boerma 2005; Guenther *et al*. 2014; Mitsunaga *et al*. 2013; Mphatswe *et al*. 2012; WHO 2013). Very few published studies on data quality assessments (DQA) of the iCCM routine data exist to help identify best practices, gaps and opportunities to establish strong data management systems and improve data quality for evidence-based decisions (Stevens *et al*. 2016; Mitsunaga *et al*. 2013; 2015).

According to WHO's 2016 data quality review report, health data produced in low-resource settings are rarely routinely available for every population and quality problems limit their use for policy directions (Stevens *et al*. 2016). This is especially true for data from underserved and marginalized areas where a majority of

illnesses and preventable deaths occur. Furthermore, iCCM programs rely on data collected during sick child assessment and treatment by trained community health workers (CHWs) that report routinely through suboptimal monitoring and evaluation (M&E) systems at all levels of program decision points (Ledikwe *et al*. 2014; Yourkavitch *et al*. 2016). Global partners are supporting countries in strengthening their M&E systems to help generate good quality data for iCCM, especially at the point of service delivery. This support will help address data quality problems at the source and establish data credibility for program and policy decisions (Guenther *et al*. 2014; WHO 2007). Consequently, there is an urgent need to establish systematic efforts to conduct ongoing assessments of data quality and their M&E systems to demonstrate and ensure that the iCCM data are of good quality and to identify areas to improve data collection and reporting of reliable information in underserved areas.

In 2013, Global Affairs Canada funded WHO through the RAcE program to implement the iCCM strategy in five countries, including Nigeria, to help reduce morbidity and mortality among children under five. In Nigeria, the iCCM program targets children under 5 years of age in hard-to-reach areas. Hard-to-reach areas are defined as areas outside the 5 km radius of a functioning ward health center that has road accessibility, 24-h service and adequate availability of human resources and medical supplies. As part of RAcE program, WHO commissioned ICF to provide independent M&E support to program grantees and to conduct annual DQAs. In Nigeria, two non-governmental organizations (NGOs) in two states were funded as forerunner implementing sites, the Society for Family Health (SFH) in Abia State and the Malaria Consortium in Niger State. The two NGOs worked in collaboration with the Federal Ministry of Health (FMOH), the State-level Ministries of Health (SMOHs) and the State Primary Healthcare Development Agency in both states to adapt and implement the iCCM program. The iCCM program in Nigeria is implemented through trained community volunteers, known as Community Resource Persons (CORPs), who are supervised by government's lowest-cadre the Community Health Extension Workers (CHEWs) based at primary healthcare facilities in their wards. By 2015, the program was introduced and rolled out in phases in 15 local government areas (LGAs) in Abia State: Arochukwu, Bende, Ikwano, IsialaNgwa South, IsialaNgwa North, Isuikwato, Umunneochi, ObiomaNgwa, Ohafia, OsisiomaNgwa, Ugwunagbo, Ukwa East, Ukwa West, Umuahia North and Umuahia South. The program was introduced in six LGAs in Niger State: Edati, Lapai, Mariga, Paikoro, Rafi and Rijau (Nyangara and Adesoye, 2015; Hai and Ibrahim, 2015).

This paper assesses the M&E systems and the iCCM data quality defined by availability, completeness and consistency in both implementing states, Abia and Niger, Nigeria.
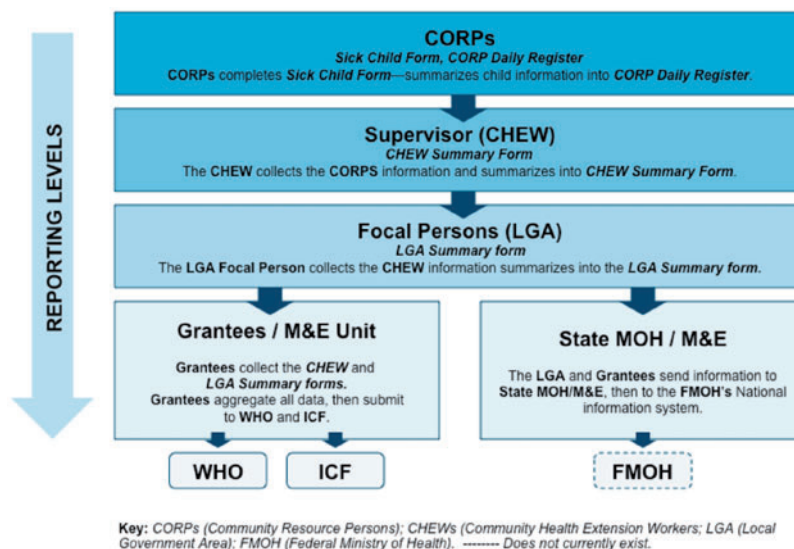
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Figure 1. Overall iCCM data flow in Nigeria.

Methods

Study design

The DQAs used a cross-sectional study design with a combination of qualitative and quantitative methods of data collection. Data collection for the DQAs was conducted in October and November 2015 in both States using adapted versions of the ICF-developed DQA tools, which were modeled after the MEASURE Evaluation Data Quality Audit Tools (Hardee, 2008; Yourkavitch et al. 2016). The DQA included three data collection approaches: (1) verifying CORP registers and CHEW monthly summary reports for the most recently completed program quarter (May through July 2015) for data availability, completeness and consistency; (2) conducting an M&E system assessment using a 3-point scale to understand its five components: (a) structure, functionality and capabilities; (b) indicator definitions and reporting guidelines; (c) data collection reporting forms or tools; (d) data management processes; and (e) linkage with the national reporting systems; and (3) observing the M&E system and conducting key informant interviews to collect supplemental qualitative data. The ICF DQA tools were adapted to the indicators being assessed, the State and LGA, the number of CORPs per facility, and the respondents in the iCCM data collection and reporting system. Before ICF started the DQA, it secured ethical approval from the ICF Institutional Review Board and the local National Health Research Ethics Committee of Nigeria. Verbal consent was obtained for all participants before reviewing their reports and conducting interviews with them. As a first step, the researchers mapped the iCCM data flow in Nigeria from the source to the end-user, illustrated in Figure 1.

Facility sampling

The study used a multi-stage sampling procedure to select eligible facilities and CORPs in each State. The sampling frame for the first stage comprised LGAs that had implemented iCCM for at least a year by the time of this study began in the two states (9 of 15 in Abia; 3 of 6 in Niger). A convenient sample of four of the nine eligible LGAs in Abia (Arochukwu, Bende, Isialangwa South, and Ohafia) and three of six eligible LGAs in Niger (Lapai, Paikoro, and Rijau) were chosen because they were actively implementing the

iCCM program in May to July 2015, and reports for these months were available, which was an indication of activities. A random sample of two health facilities in each selected LGA was chosen in Abia. A random sample of eight health facilities in each selected LGA was chosen in Niger. The total study sample included 16 health facilities. The daily registers and monthly summary reports of all 154 CORPs reporting to these 16 facilities were targeted for review, but because some CORPs were no longer active (10 in Abia) and (4 in Niger), only 140 CORPs were included in the study (Table 1).

Data sources

The main sources of data were daily registers and monthly summary reports of all 140 CORPs at the 16 sampled facilities that were reviewed for the May to July 2015 period. Data were also obtained through key informant interviews with representatives and observations of the iCCM reporting system. In each facility, one CORP was selected randomly from among those who came to the health facility the day of the assessment for interviews; 16 CORPs from the two states ($N = 16$) were interviewed.

The research team also interviewed other key stakeholders who were involved in iCCM data collection and were knowledgeable about the reporting system. The respondents included one CHEW for each sampled facility ($N = 16$); the focal person for each of the seven LGAs ($N = 7$), the program managers for RAcE and the lead M&E officers at the grantee level ($N = 4$); the state-level iCCM focal person and the SMOH M&E officer in Abia ($N = 2$); and the SMOH M&E officer in Niger ($N = 1$). A total of 46 key informant interviews were conducted.

Data collection and assessment

Trained DQA researchers, including one ICF staff and a local consultant for each state, visited and collected data from the selected facilities in the program areas. The DQA tools and interview guides were adapted before implementation, pilot tested and refined further for each state. The pilot tests of the DQA data collection instruments occurred in hard-to-reach areas, similar to those in the study sample, but which were not included in the study. The iCCM M&E system assessments were performed at four levels (facility, LGA,

Table 1. Facilities sampled and number of CORPs by selected local government areas in Abia and Niger

Name of LGA	Health facility	Expected number of CORPS	Number of CORPs
Abia State			
Arochukwu	Ukwuakwu	7	7
	Ndioji	14	14
Ohafia	Agboji	9	6
	Amaogudu	11	8
Isialangwa South	Umuajuju	11	9
	Umuawu	8	8
Bende	Igbere	4	3
	Ngwu	13	12
Total	8 (Facilities)	77	67
Niger State			
Lapai	Muye PHC	10	8
	Gulu MCH	7	7
Paikoro	Tunga Mallam BHC	10	10
	Adunu BHC	6	6
Rijau	Rijau PHC	12	12
	Ushe PHC	10	9
	Dugge PHC/MCH	10	10
	Dukku BHC	12	11
Total	8 (Facilities)	77	73
Grand Total	16	154	140

Note: BHC: birthing health center; MCH: maternal health care; PHC: primary health care.

grantee and SMOH). The systems assessment data were generated by reviewing iCCM M&E documents and guidelines and observing the system. These reviews were complemented by key informant interviews with individuals who were knowledgeable about the iCCM data reporting system at each level. The key informants were CHEWS, LGA focal persons, grantee project staff and iCCM state officers. The M&E system assessment used a 3-point scale score: 1, '*Not at All*'; 2, '*Partially Agree*'; 3, '*Completely Agree*.' The assessment posed questions across the five M&E system dimensions: (1) structure, functions, and capabilities; (2) indicator definitions and reporting guidelines; (3) data collection reporting and tools; (4) data management processes; and (5) links with the national reporting system. The results were calculated for an overall average score for the entire iCCM M&E system for each state.

To assess data availability, completeness and consistency, the team conducted data verification by reviewing and tracing iCCM data from the CORPs to the CHEWs. Data in CORP registers were aggregated and compared with the data in CHEW monthly summary forms at the facility. The interviewers reviewed and extracted the verified counts of cases of sick children treated, as recorded in CORP registers and the corresponding values reported in the CHEW monthly summary forms. The three routine monitoring indicators selected for verification in this study were pneumonia, malaria and diarrhea treatments.

Data analysis

The M&E system assessment data were analyzed in microsoft excel using the 3-point scale score for each of the five dimensions. Then the average score was calculated for the whole M&E system. The scores were complemented with information from observations of the system and key informant interviews to show stakeholder perspectives about the iCCM data collection and reporting system and the quality of data. Information collected in the key informant

interviews was subjected to thematic content analysis. The main themes and sub-themes, such as quality of data, data use, data tools, issues, and opportunities for system improvement, were compared across respondents as much as possible. The interviews were also used to describe the strategies used to strengthen the M&E system for iCCM across the five dimensions as it was being established and implemented in both states.

The data were summarized for each of the selected indicators by reporting level. Verification of data availability was assessed by noting the presence or absence of the CORP registers and CHEW summary reports over a 3-month period (May to July, 2015). Completeness was assessed by reviewing each record in the CORP register and CHEW summary reports for information entered in the sick child, assessment, classification and treatment sections. Verification ratios were calculated to assess the extent of CORP register entries for pneumonia, malaria and diarrhea treatments that also had the appropriate diagnostic and classification fields completed, in alignment with the recorded treatment. We also calculated consistency ratios to describe the data reporting consistency between CORP registers and CHEW summary forms and within CHEW summary forms.

Results

The DQA team computed the M&E systems assessments using a 3-point scale. Overall, the strength of the iCCM M&E systems in both Abia and Niger can be categorized as satisfactory, with an average score of low 2 s on a 3-point scale (2.18 and 2.32, respectively) (Figure 2).

The scores for each dimension of the M&E systems also show a similar pattern between the two states. Results show that the structure, functions and capabilities component of the iCCM M&E system for both states was the strongest dimension, with scores of 2.80 and 2.88 for Abia and Niger, respectively. The data collection and reporting forms and tools dimension of the iCCM M&E system were strong, with the second highest component scores of 2.73 and 2.75 for Abia and Niger, respectively. These two components were also strongest at the facility level, with scores of 2.92 and 3.0 in Abia and Niger, respectively. The data management processes and links with national reporting system dimensions scored slightly >2, indicating fair strength. Although, indicator definitions were evident, the lack of data reporting guidelines and documentation of this component was a major issue, resulting in the lowest scores of the iCCM M&E reporting systems assessment across all levels for both states, with an average score of 1.13 (Table 2). The system assessment was not conducted for the LGA level because in both states, data were not aggregated consistently at this level before being submitted to the next level.

Availability and completeness

In Abia, 67 CORPs were responsible for reporting to the sampled facilities, with a total of 201 registers expected for the 3-month period. In Niger, 73 CORPs were responsible for reporting to the sampled facilities, with a total of 219 CORP registers expected for the 3-month period. The availability of both CORP registers and CHEW summary forms was high in both states. In Abia, 98% of CORP registers (196 of 201) and 100% of CHEW summary forms (24 of 24) were available. In Niger, 91% of registers (190 of 219) and 96% of CHEW summary forms (23 of 24) were available. Completeness of the data fields for the indicators traced in the DQA among available CORP registers and CHEW summary forms was 100% in both states.
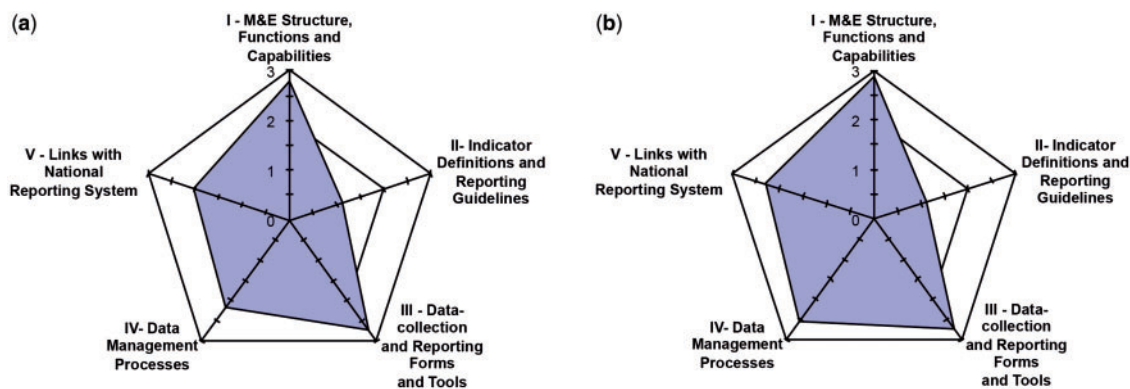
Figure 2. Summary of iCCM M&E systems assessment by functional components of data management system to ensure data quality for Abia and Niger States, Nigeria.

Table 2. Summary of iCCM M&E systems assessment by state, reporting level, and functional components of data management system needed to ensure data quality[a]

iCCM reporting level	M&E system dimensions					Average (per level)
	I: M&E structure, functions and capabilities	II: Indicator definitions and reporting guidelines	III: Data-collection and reporting forms and tools	IV: Data management processes	V: Links with national reporting system	
Abia State						
State MOH	2.00	1.00	1.00	1.00	1.33	1.27
SFH(Grantee)	2.67	2.33	3.00	2.08	2.33	2.48
Facility average	2.92	1.00	2.92	2.34	2.08	2.25
Overall average	2.80	1.13	2.73	2.18	2.03	2.18
Niger State						
State MOH	2.00	1.00	1.00	1.22	2.33	1.51
Malaria consortium	2.83	2.33	2.50	2.50	2.00	2.43
Facility average	3.00	1.00	3.00	2.74	2.33	2.41
Overall average	2.88	1.13	2.75	2.56	2.30	2.32

[a]2.5–3.0 (Yes, Agree Completely); 1.5–2.5 (Agree, Partly); < 1.5 (No, Not at All).
Note: SFH: Society for Family Health; MOH: Ministry of Health.

CORP register verification ratios

According to the verified treatment counts in the CORP registers, CORPs in Abia State treated more cases of pneumonia than CORPs in Niger State, but the opposite was true for malaria and diarrhea cases (Figure 3).

Table 3 shows the summary statistics for the verification ratios, which assess the extent to which CORP register entries for diarrhea, malaria or pneumonia treatments also had the appropriate diagnostic and classification fields completed, in alignment with the recorded treatment. The findings show that the quality of treatment data appropriately recorded by CORPs ranged from satisfactory (69%) to good quality (90%) across the three treatments that were assessed. In both states, register entries in which CORPs recorded giving treatment for diarrhea, malaria, or pneumonia were not always filled out appropriately. In Abia, on average 82% (verification ratio (VR) = 0.82) of entries that indicated pneumonia treatment included the appropriate symptoms, assessment information and child's age; 90% (VR = 0.90) of entries that indicated malaria treatment included the appropriate symptom, assessment information, and child's age; and 81% (VR = 0.81) of entries that indicated diarrhea treatment included the appropriate symptom and noted that both oral rehydration solution (ORS) and zinc were given. In Niger,

on average the percentages for appropriate recording of pneumonia, malaria, and diarrhea treatments were 88% (VR = 0.88), 79% (VR = 0.79) and 69% (VR = 0.69), respectively.

The details of verification ratios for individual CORPs are shown in Figure 4[(a)—Abia State and (b)—Niger State)]. The patterns for both states show that CORPs recorded treatments in their registers without also recording the appropriate corresponding symptom and assessment information, hence the deviation from '1' (meaning complete alignment). More Niger CORPs had incorrect recording (deviations from '1') for malaria and diarrhea treatments, compared with Abia CORPs.

Consistency ratios

Table 4 shows consistency ratios comparing the verified number of cases in CORP registers to the value that the CHEW recorded for that CORP in the CHEW monthly summary forms. Consistency ratios equal to 1 indicate that the verified counts in the CORP register match the sum of values that the CHEW recorded for that CORP in the CHEW monthly summary forms for the 3 months assessed. A ratio >1 indicates that the verified count in the register is greater than the sum of values for that CORP in the CHEW monthly summary forms.
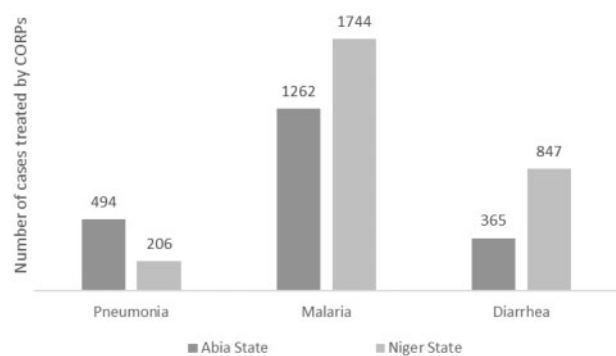
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Figure 3. Number of verified cases treated recorded in CORP registers May to July 2015.

Table 3. Verification ratio summary by state

Disease	Mean	Standard deviation	Minimum	Maximum	N
Abia State					
Pneumonia	0.82	0.30	0.05	1.00	67
Malaria	0.90	0.13	0.50	1.00	67
Diarrhea	0.81	0.27	0.20	1.00	67
Niger State					
Pneumonia	0.88	0.22	0.25	1.00	73
Malaria	0.79	0.25	0.05	1.00	73
Diarrhea	0.69	0.41	0.00	1.00	70

Conversely, a ratio <1 indicates that the verified counts in the register is less than the sum of values for that CORP in the CHEW monthly summary forms. Findings show greater consistency among the CORPs in Abia, compared with Niger. Not only are the means closer to 1, but the standard deviations are lower and the ranges of values are smaller in Abia (Table 4). Note that several CORPs are omitted from the consistency ratio calculations in Niger State; a ratio could not be calculated because the value in the CHEW summary forms, the ratio denominator, was 0, even though the verified counts from the CORP register was >0 for the 3 months assessed. This was much less common in Abia, where it happened in only two cases for one indicator—diarrhea treatment. In the CHEW summary forms reviewed, consistency ratios comparing the totals for the entire form (written at the bottom of the forms) to the sum of the entries for individual CORPs showed greater consistency among the CHEWs in Niger, compared with Abia, among available forms (Table 4).

It is important to note that it was not in the scope of the DQAs to assess whether CORPs correctly assessed, classified, and treated the sick children they saw. The DQA team worked only with the information that CORPs recorded in their registers. In both states, reporting consistency was assessed only at the CORP and CHEW levels. The assessment did not include the LGA or SMOH levels.

Discussion

The RAcE project is the pioneer iCCM program in Nigeria with limited implementation in two states, Abia and Niger. The findings of this study has programming implications for implementing and improving iCCM M&E systems and its data quality for better decisions to improve access health services in underserved areas in Nigeria and other countries. The RAcE program galvanized initial efforts to develop the national iCCM guidelines, training manuals and reporting tools. Although building and maintaining systems to monitor iCCM

implementation is a complex process, the results in Nigeria show progress towards establishing a strong, functional data collection and reporting system at the lowest levels of the reporting system. Considering the amount of data required to be collected from CORPs, who are volunteers with limited formal education, the overall iCCM reporting systems were found to be 'satisfactory' and the data quality was 'good' in the two states. On a 3-point scale, the reporting system was very strong on the structure, functions, and capabilities and in data collection and reporting forms and tools, as well as at the facility (lowest) level. This finding suggests that functional M&E structures and personnel responsibilities for collecting and reporting data at all levels have been well defined and established for the iCCM program in both states. The results also suggest that standardized national data collection and reporting forms and tools have been developed and are being used routinely to collect and report the iCCM program data. Indeed, many key informants said that the iCCM system strengthening efforts have focused on supporting capacity building efforts and establishing structures for iCCM data collection and management at the community, health facility and LGA levels within each state. Ensuring good quality data at the source is critical to the overall data quality at other higher levels of the reporting system. As a result of focusing at the service delivery points (lower levels), the CORPs and CHEWs in Abia and Niger states have been adequately trained, understand their roles, and are sensitized and motivated to save the lives of children in their communities.

The overall system average score was only satisfactory because it was affected mainly by the deficiency of written procedures, guidelines and instructions for documenting, recording, aggregating, reporting and addressing data quality reporting issues, such as lateness, incompleteness, inaccuracy and missing reports at all levels in both states. This component was the least developed across all levels of the system. We recommend that as part of the initial phase of establishing a national iCCM data reporting system, it is important to develop simple and clear guidelines and standard operating procedures for each level of the M&E and reporting system (community, facility and national levels). This approach will help harmonize data collection and improve data quality for better decisions. Efforts should include developing procedures for completing and accurately documenting in registers and monthly reporting forms to improve data accuracy, and for systematically addressing reporting issues at all levels such as late submission of reports, missing values, incorrect aggregation, and implausible values. In the case of Nigeria, we learned during this study, that efforts were underway by the iCCM National Technical Working Group chaired by the FMOH to develop standard operating procedures (SOPs) that will be attached to the data collection and reporting forms and tools to be disseminated to the CORPs and CHEWs who are implementing the iCCM program.

The iCCM system linkage to the national data reporting system component also scored satisfactory. Nigeria is learning from the experiences in other countries like Malawi and Uganda that have initiated the capture of data on community treatments in their national information management systems. It is feasible for Nigeria to integrate the iCCM data system to the state and national levels to help decision makers understand the child health situation in underserved areas and consider resource allocations accordingly (Guenther *et al*. 2014; Ledikwe *et al*. 2014).

The assessment showed that the data management processes dimension was also satisfactory. An earlier DQA study in Malawi showed that the data management processes was the weakest dimension of the iCCM M&E system (Yourkavitch *et al*. 2016). In both countries, there was a lack of documented guidance and standard operating procedures for those collecting and reporting iCCM data.
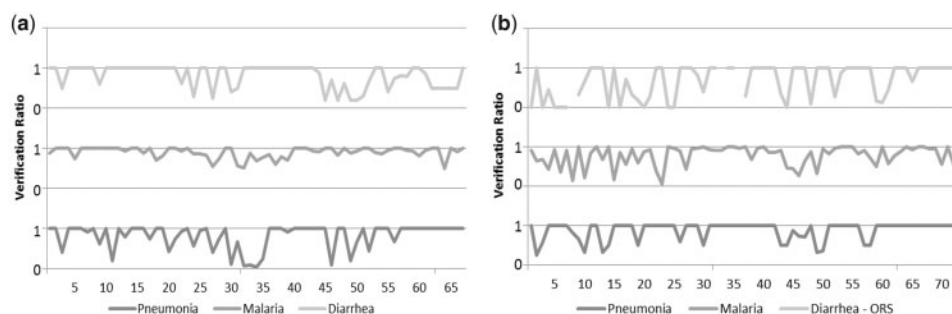
Figure 4. Individual CORP register verification ratios by state.

Table 4. Consistency ratio summary

Treatment	CORP registers vs CHEW form record					CHEW form records vs CHEW form total				
	Mean	SD	Min	Max	N	Mean	SD	Min	Max	N
Abia State										
Amoxicillin (fast breathing)	1.03	0.33	0.25	2.33	67	0.91	0.13	0.74	1.04	8
ACT1 (malaria)	1.05	0.33	0.06	2.00	67	0.87	0.16	0.68	1.03	8
ACT2 (malaria)	0.98	0.29	0.33	2.00	67	0.91	0.16	0.69	1.09	8
ORS and zinc (diarrhea)	0.93	0.65	0.00	4.00	65	1.13	0.78	0.45	3.00	8
Niger State										
Amoxicillin (fast breathing)	0.82	0.57	0.00	3.00	61	1.00	0.00	1.00	1.00	8
ACT1 (malaria)	0.86	0.82	0.00	6.00	72	1.02	0.04	1.00	1.13	8
ACT2 (malaria)	0.88	0.76	0.00	3.67	73	1.00	0.00	1.00	1.00	8
ORS (diarrhea)	0.81	0.71	0.00	4.17	71	1.02	0.06	1.00	1.18	8
Zinc (diarrhea)	0.70	0.62	0.03	3.50	65	1.00	0.00	1.00	1.00	8

However, it is worth noting that the RAcE program implementing agencies in Nigeria have learned from the successes and failures of existing iCCM programs in other countries such as Ethiopia, Malawi and Uganda, and as a result, they are putting more effort into establishing a comprehensive M&E system and national standardized tools from the start.

Data verification in both states showed high data availability and completeness of targeted register and form data fields. These findings suggest that the CORPs, CHEWs and M&E staff are thorough and that most of the required iCCM data are available and complete for programming decision-making.

The assessment also showed that the recording consistency of treatments and the appropriate diagnosis and classification fields at the individual CORP level was high. The minor differences were attributed to failure to check the appropriate clarification columns on the form, such as for high breathing rates, when a treatment was given. There were a few cases in which children who were vomiting were given ORS, which is not part of the treatment protocol. Indeed, during data collection, the CORPs were asked why they provided ORS to children who were vomiting, and they responded that they believed it could prevent the child from getting dehydrated from a loss of fluids, similar to diarrhea. The range of verification ratios indicates that there is room for improvement, particularly for some individual CORPs. Recording in registers could be improved by encouraging CORPs to fill out the appropriate background, diagnosis and classification fields for each patient they treat during training, supervision, review meetings or even through more informal peer support.

Consistency ratios showed that while on average reporting consistency was good, there was a wide range among the individual CORPs and CHEWs assessed. There were discrepancies between the aggregated numbers reported by CHEW summary forms and those reported by CORP monthly registers, particularly in Niger. This may have been a result of the CHEW failing to check CORP registers and correct errors. These discrepancies suggest that the CHEWs may not be reviewing data for accuracy before copying the CORP register numbers into their summary forms for submission. In addition, CORPs use carbon copy paper to create duplicate copies of their registers, some of which were misaligned with the primary form on which the CORP entered the data and this may have contributed to some copying mistakes and computation errors. Also, a different pattern was observed in Niger, where inconsistencies between data reported in the CORP registers and the CHEW monthly summary reports was seen. In Abia, there was consistency between the data reported in the two levels. The results imply that the CHEWs in Abia were better at taking the data from the CORP registers and summarizing it in their summary forms, and that errors in Niger may have resulted from data errors already with the CORP registers. The key informant interviews revealed that this could be a reflection of the limited capacity among CORPs to accurately record data and check for errors before submitting their reports, which could be affected by the low literacy levels of CORPs in Niger. Similar to verification ratios, the consistency ratios results also showed that individual CORPs and CHEWs could benefit from further training and supervision on how to complete their registers and forms. In addition, simple reminders to work carefully and check their work to avoid and correct errors could be helpful. In some instances, if possible, it could be helpful to recruit CORPs who have more familiarity working with numbers and completing forms.

Study limitations

This data quality assessment reached only 16 health facilities in seven LGAs, and it is not intended to be statistically representative of all LGAs in the two states. It is important to note that the findings that are presented and discussed in this paper are a snapshot of what is happening in RAcE project areas, highlighting general data quality issues, challenges and opportunities for improvement in iCCM program data in this context.

Conclusion

The evidence generated from this study will help in understanding data quality and how it could be assessed and improved to provide reliable evidence to support iCCM program implementation and scale-up in Nigeria and other countries. The overall quality of the iCCM data from the two states in Nigeria was good, but there is room for improvement. This study has shown that well-trained CHWs with limited formal education can routinely collect and provide good quality data during community-level service delivery that will help understand the disease burden and address life-threatening illnesses in underserved areas. The central establishment of M&E structures, capabilities and standardized reporting tools have contributed greatly to the improvement in quality of data in Nigeria. However, challenges that were identified in this study included a lack of written reporting guidelines and mathematical errors made by CORPs and CHEWS during recording, collating, and aggregating data. These challenges can be addressed by developing and implementing written standard operating procedures for reporting at each level of the iCCM reporting system. This, coupled with careful selection and recruitment of CORPs that know how to read and write, annual refresher trainings and improved supervision of CORPs and CHEWS would contribute to improving the quality of data captured in the registers and reporting forms. It also would address reporting issues systematically, as demonstrated in other settings (Wogi *et al.* 2014). More resources should also be made available to conduct annual DQAs beyond the RAcE project for continued data quality improvement.

The grantees, SMOH, FMOH and the iCCM National Technical Working Group should make concerted efforts to establish and link the iCCM data system to the national health information system to help facilitate decision making for underserved populations in Nigeria. They should also help institute an iCCM reporting structure that links to the state-level reporting systems and clarifies lines of authorities and responsibilities for data quality, including iCCM data ownership and system maintenance (Avan 2016). Learning from other countries such as Malawi and Uganda, Nigeria's national iCCM National Technical Working Group could also plan and strengthen the iCCM system to capture and report data on iCCM services and facility-level data into the national health information system and help monitor its national coverage (Guenther *et al.* 2014). Based on the results of this study, other countries that are planning to establish M&E systems for iCCM programs should ensure that they have developed a well-integrated and community institutionalized system within the national health information system to help harmonize and avoid parallel systems by various actors. Initial efforts should also focus on developing national standardized tools for collecting and reporting data, provide for adequate training and supervision of community health workers and others involved in the iCCM reporting system and develop SOPs for all levels.

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Ethics

The ethical approvals for this study were obtained from the ICF Institutional Review Board and the National Health Research Ethics Committee of Nigeria.

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