BID INITIATIVE
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JUNE 31, 2018

BID INITIATIVE
FINAL EVALUATION REPORT
IMMUNIZATION DATA QUALITY AND USE IN TANZANIA

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Abbreviations

DC	district council
DDUM	district data use mentor
DIVO	district immunization and vaccination officer
DPT	diphtheria-pertussis-tetanus
DPT3	diphtheria-pertussis-tetanus third dose
EIR	electronic immunization registry
EIS	electronic immunization system
eLMIS	electronic logistics management information system
HCW	health care worker
IVD	immunization and vaccine development
JSI	John Snow, Inc.
M&E	monitoring and evaluation
MOHCDGEC	Ministry of Health, Community Development, Gender, Elderly and Children
PORALG	President's Office, Regional Administration and Local Government
RIVO	regional immunization and vaccination officer
TC	town council
TIIS	Tanzania Immunization Information System
TImR	Tanzania Immunization Registry
VIMS	Vaccine Information Management System

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Acknowledgements

We thank the Ministry of Health, Community Development, Gender, Elderly and Children for their collaboration through the Immunization and Vaccine Development Program, particularly in reviewing the data collection tools and helping in securing ethical clearance. Our appreciation is extended to the National Institute of Medical Research for their review of and input on the study protocol and tools and for granting the ethical clearance to undertake this study through the National Health Research Ethics Committee.

We are extending our appreciation to the Arusha regional authority and the Tanga regional authority, specifically the regional medical officers and regional immunization and vaccine officers, for their support and coordination throughout the data collection exercises. We would like to show our gratitude to the district immunization and vaccine officers, in-charges and nurses in all districts of Arusha Region and Tanga Region for their endless support and coordination in making data collection possible in all facilities.

We would also like to show our gratitude to the entire BID Initiative team for the hard work they are doing to design and implement data quality and use interventions, around which our evaluation is centered. Many team members have contributed to the design of data collection tools and processes and dedicated their time to collecting quality data. To the BID team, your hard work and commitments made this study possible, and you are all highly appreciated.

We are also immensely grateful to Ngwengwe Bulula (Tanzania Ministry of Health), Stephano Mugeta (BID Initiative-Tanzania), Emily Carnahan (BID Initiative monitoring and evaluation (M&E) lead-Seattle), Robert Kindoli (BID Initiative M&E lead-Tanzania), Hassan Mtenga (BID Initiative country lead-Tanzania), Chipo Zulu (BID Initiative M&E lead-Zambia), Celina Kareiva (BID Initiative communications associate), Laurie Werner (BID Initiative global director), and Johannes van Dam (PATH director of HIV/TB and Health Systems Innovation and Delivery) for their review, comments, and feedback on this report.

Executive summary

BID Initiative background

The BID Initiative, led by the Ministry of Health, Community Development, Gender, Elderly and Children (MOHCDGEC) in Tanzania, in partnership with PATH, is funded by the Bill & Melinda Gates Foundation and is grounded in the belief that better data, plus better decisions, will lead to better health outcomes. It is designed to shine a light on the challenges surrounding data collection, quality, and use and has identified practical, country-owned, country-led solutions to improving immunization service delivery—and potentially applying them to other health areas, as well.

The BID Initiative worked with the governments of Tanzania and Zambia beginning in 2013 to develop data quality and use solutions, including information technology tools and change management activities to foster an environment conducive to data use for decision-making. In Tanzania, a standards-based electronic immunization registry (EIR) has been introduced to track children and their vaccination records at a health facility level. The initial rollout used a registry called the Tanzania Immunization Information System (TIIS), which was subsequently redesigned and replaced by the improved Tanzania Immunization Registry (TImR). At higher levels of the health system TImR is integrated with the Vaccine Information Management System (VIMS) to make up the Tanzania Electronic Immunization System (EIS). The EIS is integrated with data use interventions, including peer network platforms, data use job aids, mentorship, and targeted supportive supervision. Together, these interventions foster sustainable positive system changes in the way immunization services are planned, executed, supervised, and reported.

Purpose of the evaluation

This report summarizes the evaluation findings from Arusha Region and Tanga Region based on data that were collected between 2015 and 2018. In Arusha Region, data were collected at baseline (preintervention), midline (approximately 4 months post-intervention), and endline (12 months post-intervention). In Tanga Region, data were collected at baseline and midline only due to implementation timelines. The evaluation assesses the preintervention (baseline) status of immunization service delivery compared to the progress made after the introduction of data quality and data use interventions at midline and endline. The evaluation focused on the following key areas:

- Data quality in terms of immunization data reporting accuracy, completeness, and timeliness.
- Data use for management decisions among key users of immunization data, including health facility nurses, health facility in-charges, and district immunization and vaccination officers (DIVOs).
- Aspects critical to a culture of data use, including peer networks where immunization data are discussed or used, feedback between levels of the health system, and motivation to improve data quality and use.

Methodology

The evaluation is based on a pretest and posttest design in the first two implementation regions before and after the introduction of data quality and use interventions. The midline data are intended to show short-term changes as compared to the baseline, whereas the endline data are intended to show sustained, longer-term changes. Through this study design we can understand how data quality and use are changing over time.

At baseline, the key metrics of data quality were measured through review of immunization source documents and reports for the previous three months prior to the introduction of interventions; after the introduction of the EIR, data extracted from the EIR were used to continue to monitor aspects of data quality. The evaluation measured data use and perceptions of data quality through surveys of health care workers (HCWs) at baseline, midline, and endline. The BID team surveyed HCWs at both the facility and district levels who are in positions to directly use immunization data. At facility level this included the facility in-charge who is responsible for overseeing the performance of all departments (including immunization) and the head immunization nurse who is responsible for the immunization program's data collection and reporting, data use, and immunization service delivery. At district level this was the DIVO.

For comparability across points of data collection, this report presents data from the subset of facilities where data were collected at each time point (baseline and midline in Tanga; baseline, midline, and endline in Arusha). The results represent 64 facilities in Arusha Region, including 47 in-charge interviews and 56 nurse interviews, and 84 facilities in Tanga Region, including 61 in-charge interviews and 72 nurse interviews. Facility results are not intended to be representative of the entire region, or generalizable to other regions beyond Arusha and Tanga.

Summary of the major findings

The following are key findings realized after the implementation of the interventions in the Arusha and Tanga Regions:

- The large majority of nurses and in-charges in Arusha and Tanga regions report having average, high, or extremely high capacity in using the new system and using data generated from it. Results show a moderate increase in the system and data use capacity of nurses and in-charges between midline and endline in Arusha Region—likely due to system migration from the Tanzania Immunization Information System (TIIS) to TImR, which occurred at the same time as the endline data collection and required HCWs to reorient themselves to the new EIR. Nurses reported a slightly higher capacity than in-charges in both Arusha and Tanga, in part because they use data most frequently, on a daily basis.

- More than 80 percent of nurses reported having ever used data from the new system at midline in Tanga and endline in Arusha. Among in-charges, 62 percent at endline in Arusha and 69 percent at midline in Tanga reported having ever used data from the new system. Again, nurses were more likely to report using the data because it is part of their daily work in delivering and recording immunizations.

- All HCWs surveyed in Arusha Region, including both in-charges and nurses, reported "good" or "excellent" immunization data quality by endline. The same was true of HCWs in Tanga Region, according to midline data. This is an improvement from baseline findings, where the majority of nurses and in-charges thought the data quality was “good” or “fair.” Among those facilities actively using the EIR, the system ensures timeliness of reporting, completeness of reported data elements, and internal accuracy as the data are aggregated across different levels of reporting.

- As data quality improves, HCWs are more likely to use it for decision-making. There were substantial increases in the ability of in-charges and nurses to identify coverage and defaulter data in both Arusha and Tanga. Among nurses in Tanga, for instance, there was more than a two-fold increase in those who reported taking action on coverage and defaulter data. Improvements were not as pronounced for stock management data, however; this is likely due to challenges with VIMS and TImR integration.
- Even before interventions were introduced, there was already a high perceived emphasis on data quality and use in Tanzania among both in-charges and nurses. Midline and endline data therefore saw only small shifts in the emphasis on data quality and use among higher levels of the health system. Among nurses, for instance, 93 percent initially reported higher level emphasis on data use, as compared to 86 percent at endline. Despite this, there is still some room for improvement.

Key conclusions and recommendations

Prior to the implementation of interventions in the Arusha and Tanga Regions, there were observed data quality challenges, poor perceptions of data quality, and limited use of data for decision-making. The evaluation results show that after the implementation of data quality and use interventions, there have been improvements. The EIS allows HCWs to rely on the data to know who should receive immunization services, where these individuals are located, and what specific vaccinations they need. The interventions have raised awareness among HCWs and facilitated data use for service delivery improvements.

As the data quality and use interventions are scaled up in Tanzania and shared with other countries, the results of this evaluation can help inform future monitoring, evaluation, and implementation.

Recommendations for monitoring and evaluation:

- Ensure consistent use of the EIR among health facilities by tracking system usage and building follow-up mechanisms.
- Design new approaches for measuring HCWs’ capacity in using the EIR.
- Continue using data use scenarios[a] as a measure of data use and data-driven decision-making, but consider other complementary metrics.
- Plan to evaluate the consistency between parallel reporting systems (paper and electronic) when introducing an EIR.

Recommendations for implementation:

- Work with MOHCDGEC to develop guidelines to encourage data use and to support the transition from paper to electronic in order to eliminate parallel reporting systems. This process has already started with 33 facilities in Tanga Region beginning in March 2018.

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[a] Data use scenarios refer to three scenarios that HCWs were asked about in the baseline and midline surveys related to identification of low diphtheria-tetanus-pertussis (DPT) coverage, defaulters, and vaccine stock balance. These are scenarios where we would expect HCWs to use data to inform decision-making.

- As part of the sustainability strategy, work with the Ministry of Health, Community Development, Gender, Elderly and Children (MOHCDGEC) and the President's Office, Regional Administration and Local Government (PORALG) to develop a mechanism in which District Data Use Mentors (DDUMs)[b] can continue to support facilities to use the EIR.
- Plan for intensification of targeted supportive supervision during and after the initial stage of EIR rollout and develop a strategy for continued DIVO support.

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[b] DDUMs are government district staff who can both help with the deployment and provide the critical ongoing support and mentoring to facility staff as they use the interventions.

BID Initiative background

The context and challenges

Routine immunizations and new vaccine introductions have proven to be one of the most cost-effective ways to save lives and improve health around the world. Vaccines prevent an estimated 2.5 million deaths each year.[1] Over the last decade, increased attention to and investments in immunization have reduced mortality rates, particularly among children under five years of age.[1] However, global stakeholders and national governments acknowledge that achieving higher immunization rates requires reliable, accessible, and actionable data.

In Tanzania, immunization coverage has remained virtually unchanged since 2010, with 75 percent of children receiving all basic vaccinations. The 2015–2016 Tanzania Demographic and Health Survey and Malaria Indicator Survey further indicates that 89 percent of children between 12 and 23 months of age received their last dose of diphtheria-tetanus-pertussis (DPT3).[2] However, reaching the last mile and maintaining high vaccine coverage rates requires accurate, timely, and actionable data. The Tanzania Immunization and Vaccine Development (IVD) Program is constrained by limited and often unreliable and inaccurate data that may not reflect the actual realities on the ground.

The following are the priority data-related challenges Tanzania is striving to address:

- Inaccurate or uncertain denominators.
- Difficulty identifying children who do not start immunization.
- Defaulter tracing.
- Poor data visibility at the facility level.
- Complex data collection tools.
- Insufficient supply chains and logistics.
- Inadequate data management and use capacity.

The BID Initiative in Tanzania is led by the MOHCDGEC, in partnership with PATH. It is funded by the Gates Foundation. The BID Initiative is grounded in the belief that better data, plus better decisions, will lead to better health outcomes. It is designed to shed light on the challenges surrounding data collection, quality, and use. It has identified practical, country-owned, country-led solutions to improve immunization service delivery—and potentially other health areas, as well. The BID Initiative worked with the governments of Zambia and Tanzania to develop data quality and data use solutions, including information technology tools and change management activities, to foster an environment conducive to data use for decision-making.

In Tanzania, PATH and the MOHCDGEC have implemented these interventions in three regions—Arusha, Tanga, and Kilimanjaro. John Snow, Inc. (JSI) has supported implementation in a fourth region, Dodoma, and there are plans to continue to scale the interventions to 10 more regions by end of 2018 and subsequently nationwide based on availability of resources.

The solutions: data quality and data use interventions

In order to address immunization data quality and use challenges, the BID Initiative, together with the MOHCDGEC, developed a standards-based electronic immunization registry (EIR) system to track children and their vaccination records. The EIR uses barcodes as a unique identification for immunized children to ensure no child is missed because of receiving vaccines in different facilities. In the process, it simplifies how health care workers (HCWs) search for children who are due for vaccines. The EIR also improves data visibility across all levels of the health system to prevent stock outs, reduce wastage, and allow for proper planning of distribution of vaccines and services. The EIR is known as the Tanzania Immunization Registry (TImR) at a health facility level, and at higher levels of the health system TImR is integrated with the Vaccine Information Management System (VIMS) to make up the Tanzania Electronic Immunization System (EIS).[c]

The EIS is integrated with data use interventions in the form of messenger platforms, such as WhatsApp, which foster peer learning and networking among HCWs, encouraging them to share their experiences, challenges, and approaches to addressing different implementation issues. Data use job aids, mentorships, and targeted supportive supervision were also designed, tested, and implemented alongside EIR trainings. Together, these interventions foster sustainable positive system changes in the way immunization services are planned, executed, supervised, and reported.

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[c] The EIS provides end-to-end visibility into the vaccine supply chain, including stock and coverage data, from a facility to a national level.

Overview of the final evaluation report

This report contains an overview of the BID Initiative, a summary of the evaluation purpose and methodology, key findings on data quality and use changes in two regions, then ends with evaluation conclusions and recommendations. The Appendix includes additional details about the evaluation design, methodology, and limitations.

Purpose of the evaluation

This report presents findings from an evaluation of the contribution of the BID Initiative to changes in data quality and data use. The evaluation is based on data collected at baseline, midline, and endline of BID implementation in Arusha Region and data collected at baseline and midline of BID implementation in Tanga Region.

The evaluation focused on the following key areas:

- Immunization data reporting availability, completeness, and accuracy.
- Data use for management decisions among key users of immunization data, including health facility nurses, health facility in-charges, and district immunization and vaccination officers (DIVOs).
- Aspects critical to a culture of data use, including peer networks where immunization data are discussed or used, feedback between levels of the health system, and motivation to improve data quality and use.

Primary audience and users of the evaluation

The evaluation findings will be used by BID staff and representatives from the MOHCDGEC to inform lessons learned, better target future interventions, and adapt implementation as necessary for Arusha, Tanga, Kilimanjaro, Dodoma, and other regions of Tanzania as the country continues to scale up. The findings will also be used to inform an external evaluation of the BID Initiative that is being conducted by Mott MacDonald on behalf of the Gates Foundation. The findings will be shared with the Arusha and Tanga Regional health staff, districts, and facilities where the data were collected. The findings will be used by relevant stakeholders to understand how the data quality and use interventions address issues in immunization service delivery and to provide evidence to inform the MOHCDGEC's decisions on replication and scale up of the interventions.

Methodology

The evaluation is based on a pretest and posttest design to compare the state of data quality and use in the first implementation regions before and after the introduction of interventions. Through this study design, we can understand the contribution of the interventions to observed changes in data use and data quality.

At baseline, the key metrics of data quality were measured through review of immunization source documents and reports for the previous three months prior to the introduction of interventions. The key metrics included the availability, completeness, and accuracy of the data. After the introduction of TImR, data extracted from TImR were used to continue to monitor aspects of data quality.

The evaluation measured data use and perceptions of data quality through surveys of HCWs at baseline, midline, and endline. The BID team surveyed HCWs at both the facility and district levels who directly use immunization data. One facility in-charge and one nurse involved in immunization service delivery were surveyed at each facility, and the DIVO was surveyed for each district.

Data quality and use interventions were implemented in Tanzania in a phased approach, starting in the Arusha Region in 2015 followed by Tanga in 2017 and later Kilimanjaro and Dodoma. Interventions were first introduced at a district level before they were rolled out within each facility in that district. Since implementation occurred in phases, data were also collected in a phased or "rolling" approach. This maximized the use of limited resources by collecting baseline data during the first "touches"[d] in a district/facility, prior to introduction of interventions. Approximately four months after the rollout of interventions, midline data were collected to assess short-term changes in data quality and use at facility and district levels. Approximately 12 months after the rollout of interventions, endline data were collected to assess sustained, longer-term changes.

In Arusha Region, baseline data were collected in all facilities providing immunization services and midline and endline data were collected in a representative sample of facilities across all districts. In Tanga Region, baseline and midline data were collected in a representative sample of facilities across all districts. There were not 12 months remaining in the project timeline after the rollout of interventions in Tanga Region, so it was not possible to collect endline data as originally planned. Additional details on the sampling strategy and timeline for data collection are included in the Appendix.

For comparability across points of data collection, this report presents data from the subset of facilities where data were collected at each time point (baseline and midline in Tanga; baseline, midline, and endline in Arusha). The results represent 64 facilities in Arusha Region, including 47 in-charge interviews and 56 nurse interviews, and 84 facilities in Tanga Region, including 61 in-charge interviews and 72 nurse interviews. Facility results are not intended to be representative of the entire region, or generalizable to other regions beyond Arusha and Tanga.

At the district level, DIVOs were surveyed in all districts in Arusha and Tanga Regions, with the exception of Arusha City Council because it was the first pilot district and there was not an opportunity to collect unbiased baseline data. In Arusha Region DIVOs (n=6) were surveyed at baseline, midline, and endline; and in Tanga (n=11) at baseline and midline only.

Refer to the Appendix for additional details about the methodology, sample size, and limitations.

Overview of the areas discussed: the BID theory of change

The BID Initiative is working to achieve four primary outcomes. The first two are focused on improving data quality and use in the BID demonstration countries (Tanzania and Zambia), and the remaining two are centered on accelerating the diffusion of knowledge, ideas, lessons learned, and innovations that arise out of the BID Initiative activities.

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[d] Touches are visits to provide on-the-job training to health workers, strengthen the data use culture, and ensure the smooth implementation of the full package of interventions.

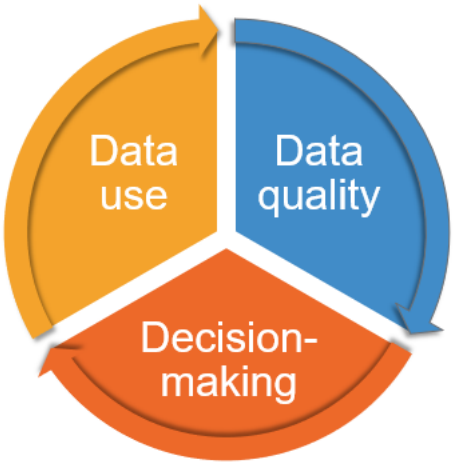

Figure 1. Cycle of data use, data quality, and decision-making.

The BID Initiative theory of change is based on the overall hypothesis that better information will lead to better decisions, which will lead to better health outcomes. Better information focuses on more accurate, complete, and timely data about vaccine delivery, including who should receive immunization services, where they are located, and what specific vaccinations they need. Better information also focuses on improved supply chain data, including more accurate, complete, and timely data on vaccine availability at all levels of the health system. Access to better information on vaccine stock and immunization delivery will facilitate better decisions and lead to stronger immunization programs. These data insights will help health workers provide the necessary immunization services to the right children at the right time, order new vaccine stocks when needed, and ensure that all necessary vaccines are readily available and safe to use. Improved decisions will also ultimately increase efficiencies in the health system, build a culture of data use, reduce vaccine wastage, increase the number of children receiving on-time immunizations, and increase the number of children completing their vaccination schedules.

A key part of BID's theory of change is the cyclic nature of data quality affecting data use and decision-making, and vice versa (Figure 1). As people use data more, they will care more about the quality of that data and will even work to influence their quality. As the quality improves and their confidence in the data increases, they will be more likely to use the data to make decisions.

Implementation context

This evaluation includes health facility and district level findings from Arusha and Tanga, the first two regions of implementation. There are 287 health facilities across seven districts in Arusha and 327 health facilities across 11 districts in Tanga that provide immunization services and are implementing the data quality and use interventions. Both regions have the same immunization system structure that is consistent throughout the country, with a regional immunization and vaccination officer (RIVO) and DIVOs who manage the immunization program and vaccine supply chain. Tanga is larger (with more facilities and districts), but both regions have a mix of urban and rural districts with some large districts that require long travel distances between the district health office and the furthest facilities. One notable difference in immunization practice is that in Arusha most children are registered in the immunization system at six weeks, whereas in Tanga, most children are registered at birth (for their BCG and OPV0 doses).

Implementation began in six facilities in Arusha City Council and Meru District, the pilot districts of Arusha Region, in April 2015 and interventions were rolled out to all facilities in Arusha Region by April 2017. A subset of low-volume facilities with limited connectivity were designated as ‘paper facilities’ that would submit revised paper reports to the district. However, given the challenges in transporting paper from facility to district levels for scanning and printing the monthly plans, as well as the costs associated with this process, all districts in the Arusha Region decided to transition their paper facilities to electronic data entry in July 2017. Facilities with limited connectivity enter data into a tablet and sync their data once per week by taking the tablet to a nearby place with an available internet connection.

The initial rollout in Arusha Region was using an EIR called the Tanzania Immunization Information System (TIIS), which was subsequently redesigned due to performance issues and userability. TIIS was replaced after analysis of the system proved it couldn’t scale nationally, due to difficulties syncing and frequent system crashes, making it difficult for health facilities to manage busy clinic days. The user interface for TImR is similar to TIIS in many ways, but there are some new features that impact workflows which required reorientation. Beginning in November 2017, districts in Arusha Region switched from TIIS to TImR, which coincided with endline data collection. The system change raised challenges for ownership, which is reflected in the endline results and is further discussed in relation to the evaluation findings.

Although TImR was an improved system, it had some challenges related to the accuracy of the standard reports generated within the system, making it difficult for HCWs to track their performance. System developers iterated on the TImR reports, but they were not finalized until after midline data collection in Tanga and endline data collection in Arusha. In contrast, TIIS reports were stable and functioning accurately at the time of midline data collection in Arusha, thus explaining some of the observed differences in midline and endline results. Another notable factor affecting the evaluation results was a change in the certification requirements for HCWs at the end of 2017 that resulted in many HCWs losing their positions. This impacted rollout in Tanga and system usage in both regions as many trained system users were abdicated from their posts.

The BID team refined implementation approaches and the package of interventions based on experience, feedback, and lessons learned from rollout in Arusha. Implementation began in Tanga Region in July 2017 and later in Kilimanjaro in November 2017, with a streamlined approach that included more involvement from district data use mentors (DDUMs) and the new version of the EIR, TImR. Lessons learned from implementation in the first three regions were shared with JSI to inform their implementation of the data quality and use solutions in Dodoma Region.

In parallel to the introduction of the new EIR at a health facility level, the MOHCDGEC, alongside other partners including JSI and CHAI, developed a Vaccine Information Management System (VIMS) using an electronic logistics management information system (eLMIS) code base. VIMS is an electronic system that collates (1) service delivery data, (2) vaccine stock management data, and (3) cold chain equipment inventory data at the district level. The stock management feature is similar to TImR, which has a web application. VIMS is being rolled out from the national down to the district level, and TImR interfaces with VIMS at the district level. DIVOs use VIMS to distribute vaccines to facilities. TImR is then used at the facility level to track what is received and consumed and the aggregated number of children vaccinated daily is integrated with VIMS every 24 hours. In Arusha and Tanga, VIMS and TImR held separate trainings and in Tanga in particular, these trainings came in quick succession. VIMS training was held in Tanga in May 2017, followed by TImR training in July 2017, so health workers had to learn two new systems at once. In the Kilimanjaro Region training that followed, TImR and VIMS trainings were more closely aligned.

Evaluation findings

Data quality challenges

Prior to the introduction of the new data quality and use interventions, both Arusha and Tanga faced similar challenges in accessing high quality data. The evaluation measured aspects of data quality at baseline using the routine immunization data captured on paper-based IVD source documents (tally sheets, stock ledgers, and monthly IVD reports). These baseline findings are important to understand the data quality challenges the new interventions were put in place to address.

The key measures of data quality measured at baseline included the availability, completeness, and accuracy of the data. The baseline data quality results presented here are based on the full sample of baseline data available, including 231 facilities in Arusha Region and 99 facilities in Tanga Region.[e] See the Appendix for more details on the evaluation methodology and sample selection.

Data availability

A major obstacle to improving immunization coverage and optimizing service delivery is that decision-makers at all levels of the health system are not effectively using data to inform decisions in planning, performance management, and the delivery of services. Health workers, for instance, often have poor visibility into vaccine supplies and difficulty identifying children who default on immunization schedules. To improve services, they must have accessible, actionable data in order to provide more targeted care.

Under the previous, paper-based system, the completed IVD paper tools were the primary form of record-keeping for facilities. At baseline, BID staff assessed to what extent source documents (including IVD monthly reports, stock ledgers, and tally sheets) were available at the facility level.

The **IVD monthly report** is the main source of immunization data used to report from the facility to the district level, and among subsequent higher levels of the health system. **Tally sheets** are used to record all children who have been provided with vaccines. **Stock ledgers** record the vaccines received and used at the facility level, as well as any vaccine wastage. Previous months of data captured on these tools need to be readily available at facilities to inform planning of service delivery.

According to the baseline assessment, the availability of completed IVD source documents for the three months prior to the implementation of the new data quality and use interventions varied by district (Figures 2-3). Availability of source documents was generally higher in Tanga Region as compared to Arusha Region. In Arusha Region, 71 percent of facility IVD monthly reports were available over the three months of data collection compared to 81 percent in Tanga Region. Tally sheets were generally the least available source document, with an average of 52 percent of all tally sheets available in Arusha and 66 percent available in Tanga. In Arusha district council (DC), all facilities were missing the tally sheets, and nearly all facilities were

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[e] Note that while the sample includes facilities from each district, the sample was not designed to be representative of each district; the results should not be generalized to all facilities in a given district or region. The sample presented in this section differs from the following sections; it includes all baseline data, whereas the following sections maintain a comparable sample over time by only including facilities with all time points of data (baseline, midline, endline).

missing stock ledgers. This was, in part, because the majority of facilities were using health management information system (MTUHA book 7 tally sheet) tally sheets in place of the IVD tally sheets.

Without these reports and source documents on hand, facilities do not have access to their data over the most recent months and therefore do not have a clear understanding of their performance. With the introduction of the EIR, HCWs enter data electronically for each child as they are seen, and those data are automatically aggregated within the system. Thus, as long as each child is entered into the EIR, there will no longer be cases of missing source documents as the individual-level data and aggregated reports are readily available within the EIR at all levels of the health system.

Figure 2. Arusha Region baseline availability of completed IVD source documents at health facilities (over 3 months).

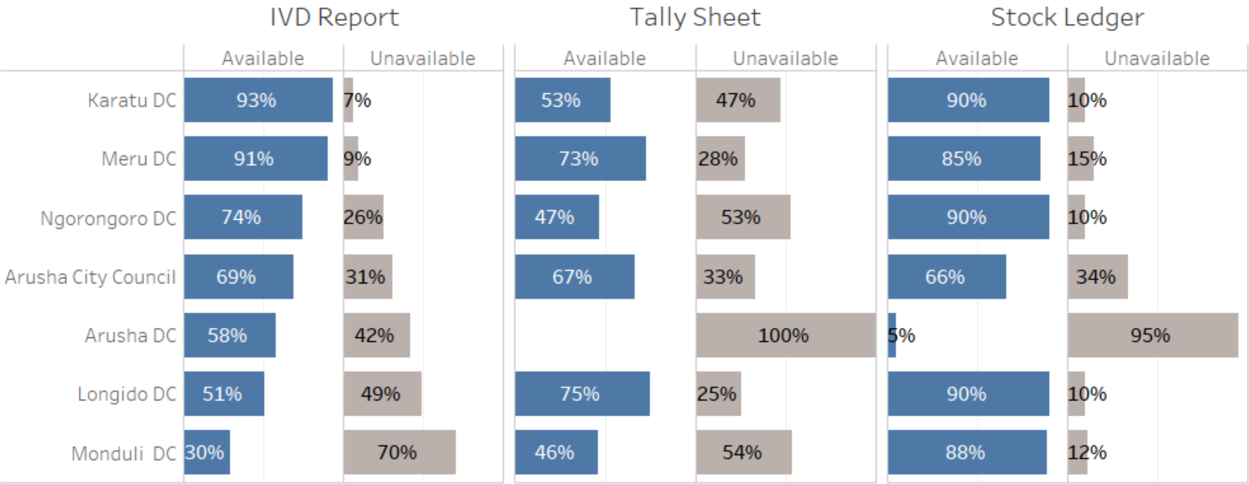
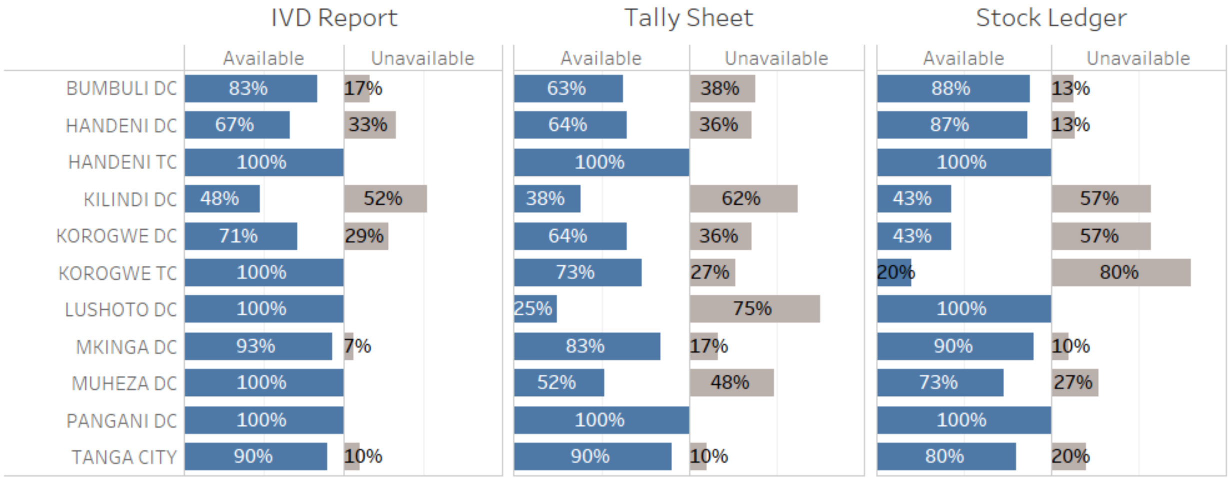


Figure 3. Tanga Region baseline availability of completed IVD source documents at health facilities (over 3 months).



Completeness of data elements

The IVD monthly report is the main source of vaccine information for the district level and above. An incomplete IVD monthly report—where not all fields are filled in—can compromise the quality of the data and limit its use for decision-making across various levels of the health system. During baseline, BID staff assessed the completeness of the data elements in IVD monthly reports by comparing the number of complete data fields against the required fields in each IVD monthly report that was available at the facility for the baseline period (three months pre-intervention).

The completeness of data elements in the IVD monthly reports differed by district (Figures 4-5). The lowest average completeness levels were observed in Monduli DC (Arusha) and Kilindi DC (Tanga) at 74 and 75 percent complete, respectively. Most districts had a relatively high percent completeness even before data quality and use interventions were introduced. For instance, five districts in Arusha had an average completeness score of more than 90 percent in their sampled facilities.

Figure 4. Completeness of data elements in IVD monthly reports at baseline (average across 3 months pre-intervention) in Arusha Region.

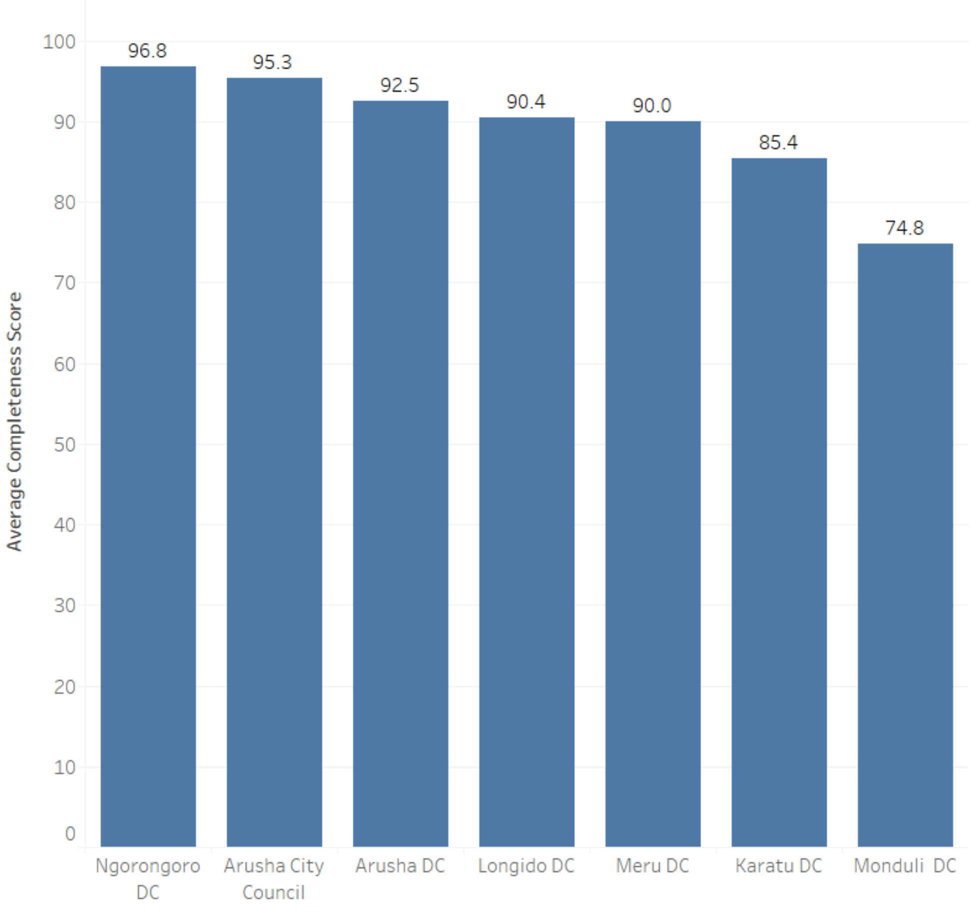
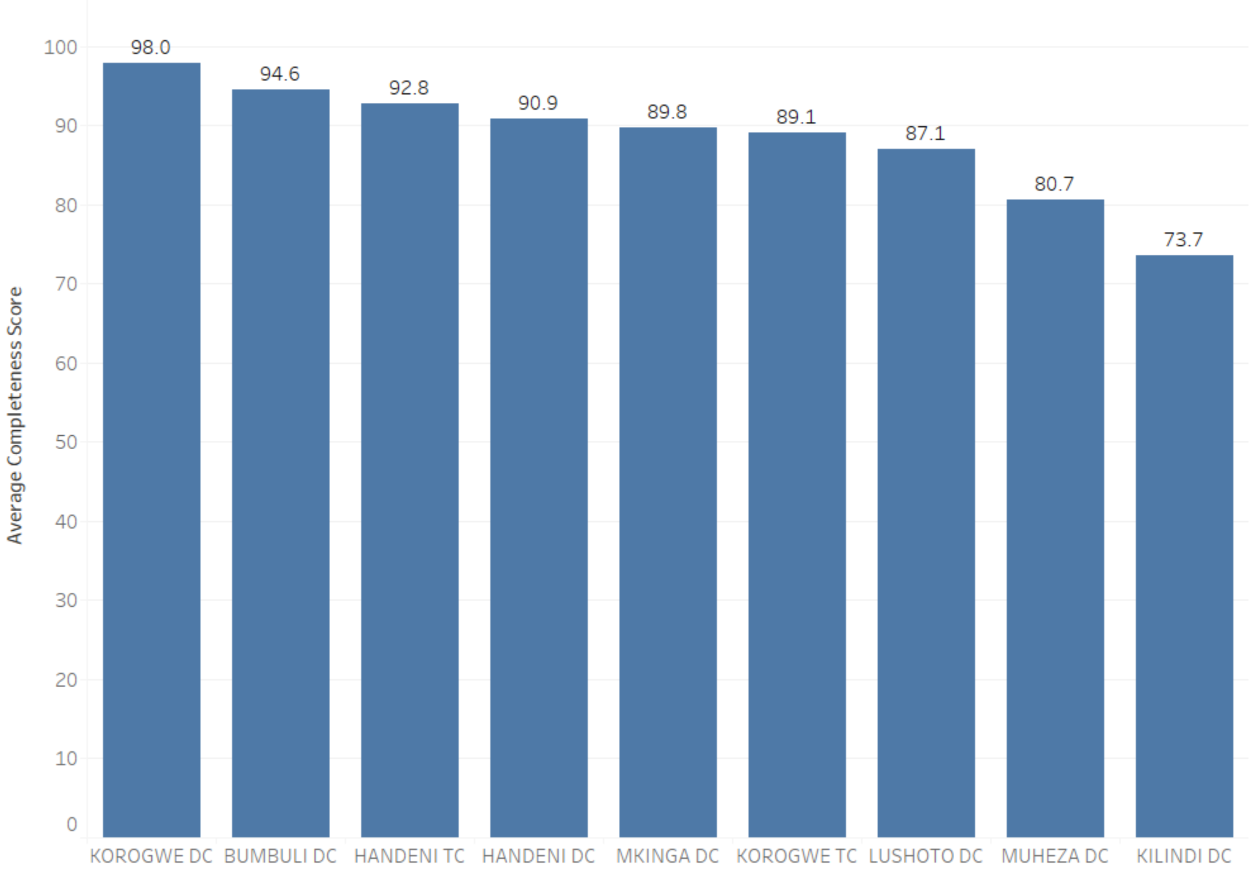


Figure 5. Completeness of data elements in IVD monthly reports at baseline (average across 3 months pre-intervention) in Tanga Region.



With the introduction of the EIR, there are built-in data quality and consistency checks that do not allow HCWs to skip fields or enter data that are not valid based on the system's predetermined rules. For example, in TImR, required fields include the child's unique ID, caregiver's name, date of birth, date of vaccination for each dose delivered, and available stock batch numbers. The system verification ensures the completion of all individual fields in the EIR before HCWs submit the report. Thus, the essential data needed for tracking performance and planning service delivery are filled.

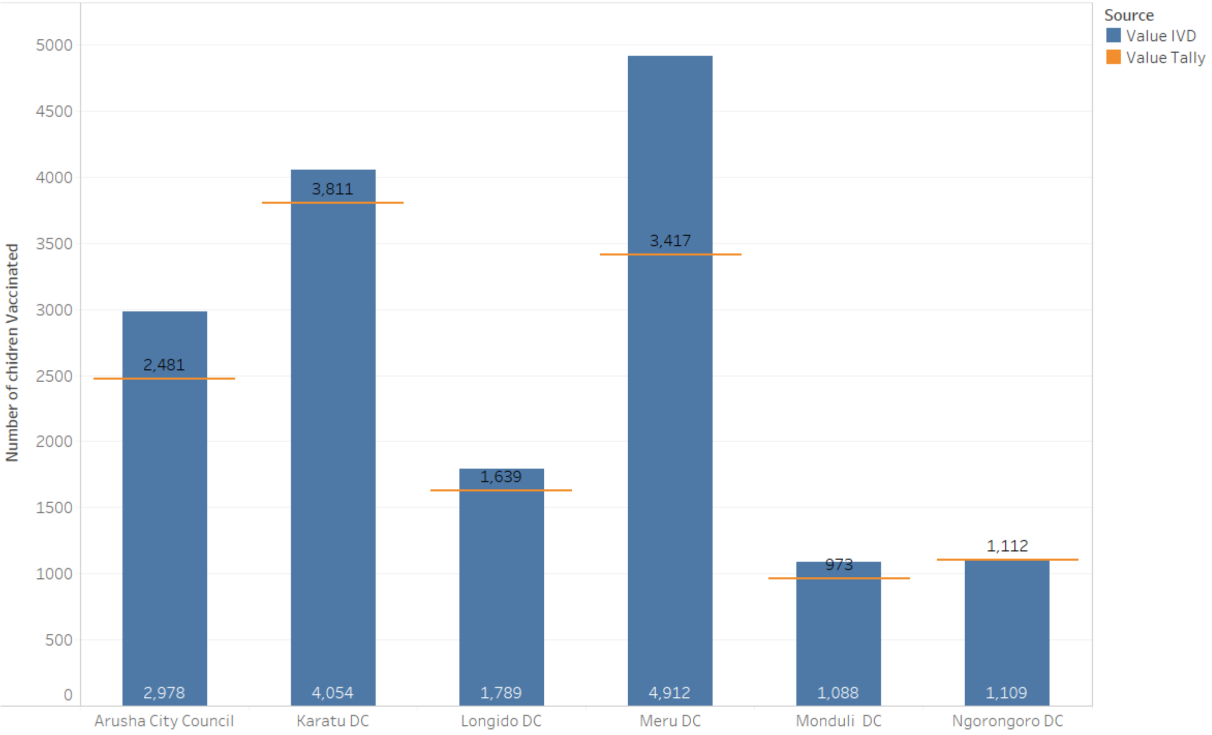
Data accuracy

Poor accuracy was a commonly cited challenge for HCWs that the new data quality and use interventions aimed to address. In the paper-based system, HCWs were expected to fill out tally sheets and child registers for each child vaccinated and to update stock ledgers with changes in vaccine stock. These source documents were used to aggregate the data and complete the IVD monthly report at the end of the month. Poor record keeping on the source documents and manual calculations of a facility's performance without clear instructions, and sometimes with limited skills to fill the reports, compromised the quality of the reports submitted by facilities.

At baseline, the evaluation measured the accuracy between source documents to determine whether the numbers in the tally sheet and the numbers in the stock ledger were consistent with the aggregate numbers in the IVD report.

For each facility that had a tally sheet and IVD report available for the same month,[f] we compared the total number of DPT tallies (doses 1, 2, and 3) with the total number of reported children vaccinated with DPT1, DPT2, or DPT3 in the IVD report. Over the three months of baseline data, the majority of districts with available data in Arusha (Figure 6) and Tanga (Figure 7) reported more children vaccinated with DPT in the IVD report as compared to the tally sheets. This discrepancy implies that facilities are not filling out the tally sheets for each vaccine administered, which means they may not be keeping accurate records and that the reported immunization coverage rates may not reflect reality. In some cases, the HCW may count the number of vials used during the month (instead of the tally sheet) to estimate the number of children immunized; this usually results in a higher number of vaccinated children in the IVD report compared to the numbers verified in the tally sheet as depending on reconstitutions and syringe withdraw practices, a vial of 20 doses is unlikely to vaccinate 20 children. Although there were discrepancies, the available data for some districts (Ngorongoro DC, Bumbuli DC, Handeni DC, Kilindi DC, Mkinga DC, and Muheza DC) were highly accurate with less than a 5 percent discrepancy between the reported values in the tally sheet and IVD report.

Figure 6. Arusha Region comparison of children vaccinated for DPT series in IVD monthly report versus tally sheet over 3 months at baseline.



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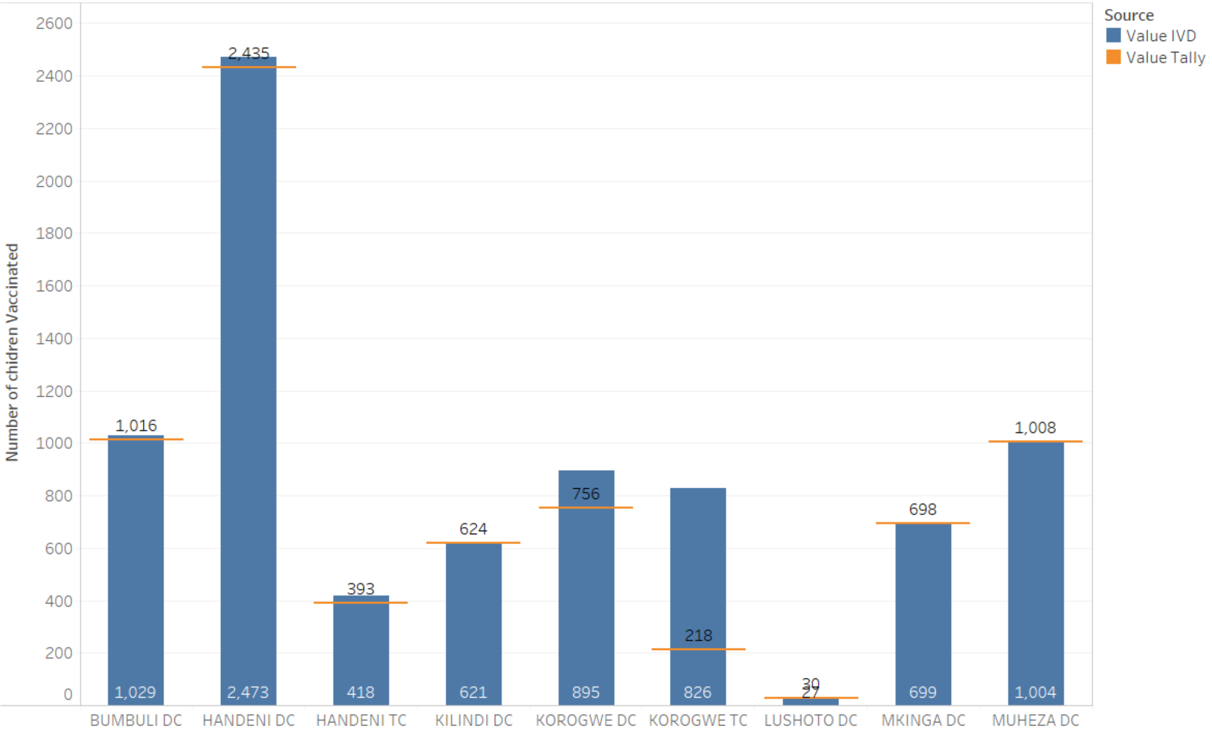
[f] Includes data from 104 facilities in Arusha Region and 46 facilities in Tanga Region.

Figure 7. Tanga Region comparison of children vaccinated for DPT series in IVD monthly report versus tally sheet over 3 months at baseline.



Similarly, we compared the stock ledgers to the IVD monthly reports to look at the number of doses of DPT reportedly received by each facility. The results show that over the three month baseline period, the majority of districts with available data in Arusha (Figure 8) and Tanga (Figure 9) reported more DPT doses received in the IVD report as compared to the stock ledger. Many of the differences were much larger than those observed between the IVD report and tally sheets. In some districts, the available source documents showed DPT doses received were more than 50 percent lower in the stock ledgers as compared to the IVD reports (Meru DC, Ngorongoro DC, Karatu DC, Monduli DC, Arusha DC, Korogwe DC, and Mkinga DC). In a few cases, the reported doses of DPT received in the stock ledger were much higher than in the IVD report (Kilindi DC and Lushoto DC).

Although stock ledgers were more readily available at facilities compared to tally sheets (Figures 2-3), they tended to have poorer accuracy compared to the IVD reports. The poor accuracy seen in Figures 8-9 implies that facilities were not consistently updating the stock ledgers when vaccines were received and, therefore, may not have had a reliable way of tracking their stock balance which is a data quality challenge.

With the EIR in place, HCWs no longer have to fill out paper-based source documents and aggregate them into a report at the end of the month. Instead, they enter data electronically for each child as they are seen, and those data are automatically aggregated within the system. The EIR also automatically recalculates stock balances whenever vaccines are issued or received. There are therefore no inconsistencies between the number of doses received or delivered, the stock on hand, and the aggregate number of children recorded at a facility or district level within the EIR. The EIR has improved the quality and availability of data by automating the process of collecting and aggregating data.

Figure 8. Arusha Region comparison of the number of reported DPT vaccine doses received versus the facility stock ledgers over 3 months at baseline.

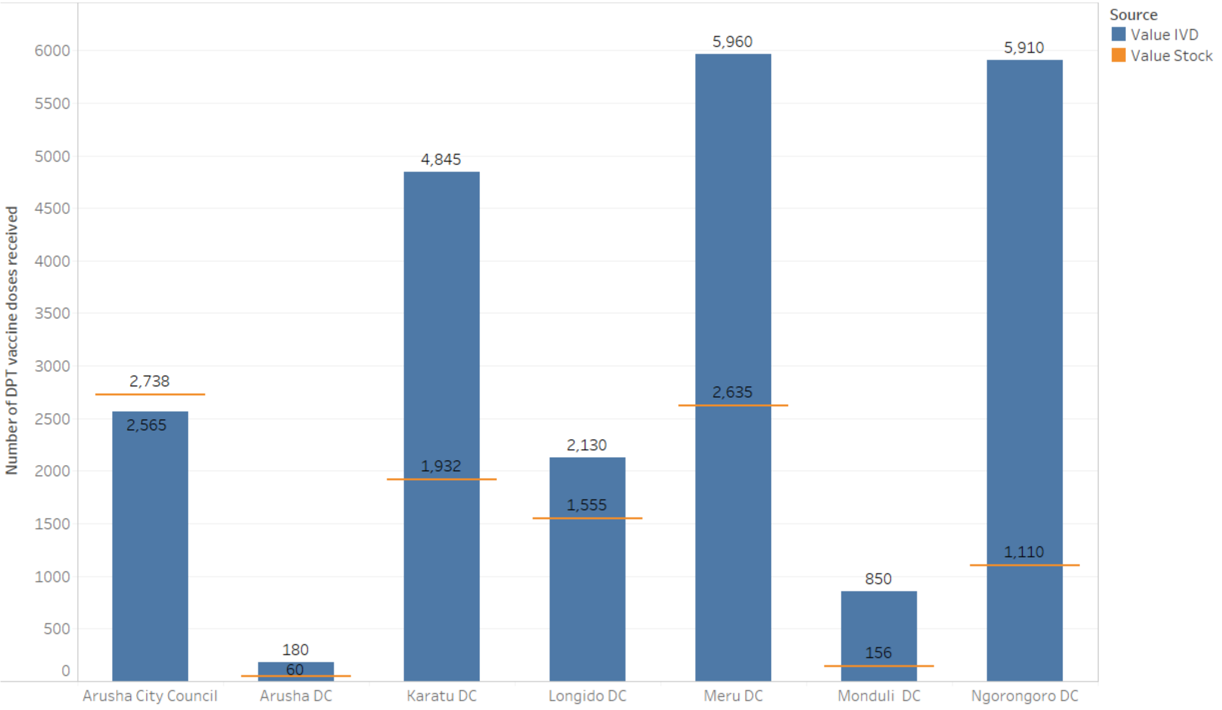
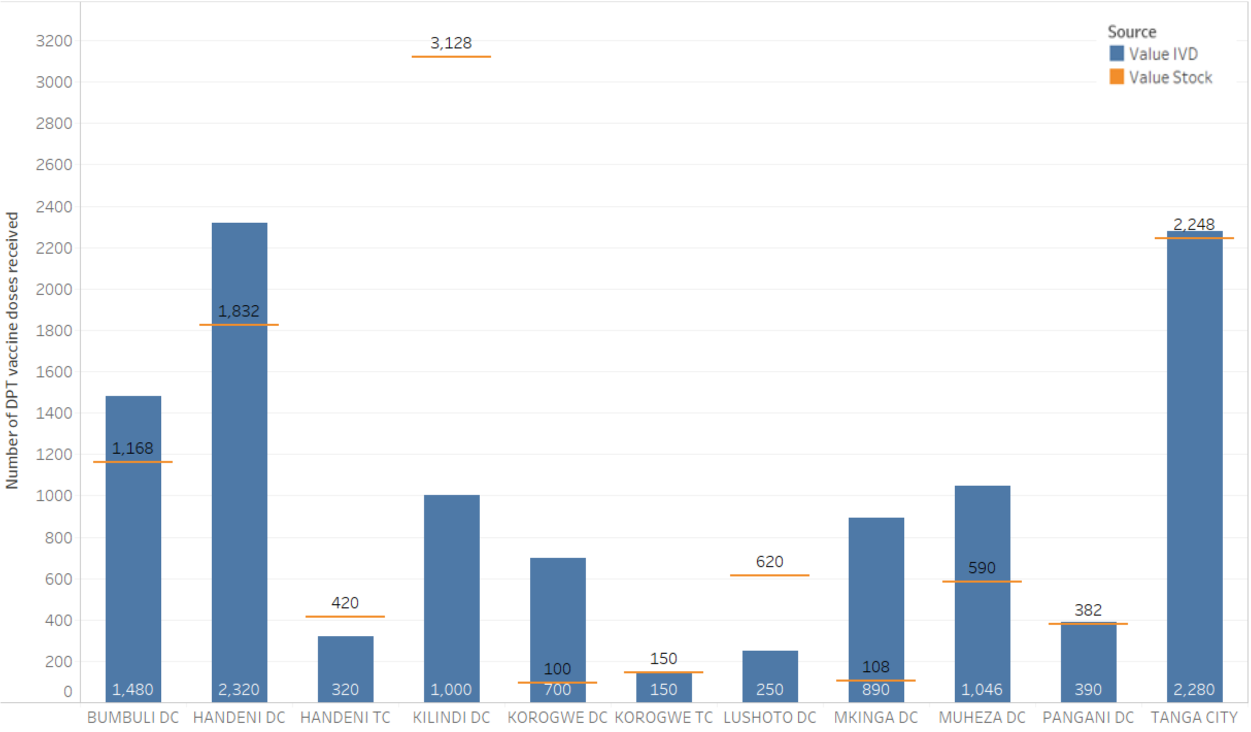


Figure 9. Tanga Region comparison of the number of reported DPT vaccine doses received versus the facility stock ledgers over.



EIR use and capacity

The new interventions, particularly the EIR, are designed to improve data quality. One of the key challenges identified by EPI managers in Tanzania before the EIR was introduced was the lack of unique identification of children receiving vaccination. Because of this, it was difficult for HCWs across all levels of the country's health system to identify duplicates, confirm their target population, or track children receiving vaccines at different facilities. The EIR links individual registration details (including the child's name, the mother's name, and his or her date of birth) with a barcode number that is unique to every child. With these barcodes, HCWs cannot register the same child twice and can use the numbers to track children receiving vaccines at multiple facilities. The EIR also has built-in validation checks that avoid duplicate entries or invalid data. Finally, the EIR automates reporting so HCWs are no longer required to do manual calculations or record entry that could potentially compromise the quality of the data.

A key assumption of the BID Initiative is that all levels of the health system will commit to using the new tools and practices and will encourage others to use them. The introduction of the EIR, therefore, can only be an effective solution to address data quality and use if it is used consistently by HCWs across all levels. As of May 2018, TImR is active in about 1,273 health facilities that provide immunization services, of which 287 are in Arusha Region, 327 in Tanga, 312 in Kilimanjaro, and 347 in Dodoma.

HCW capacity to use the EIR is an important determinant of system usage. Once the EIR was in place and fully functional, the midline and endline surveys asked nurses to self-report their ability to use the new system since they are the day-to-day users entering data. The nurses and in-charges were both asked to report their capacity to use data generated by the system.

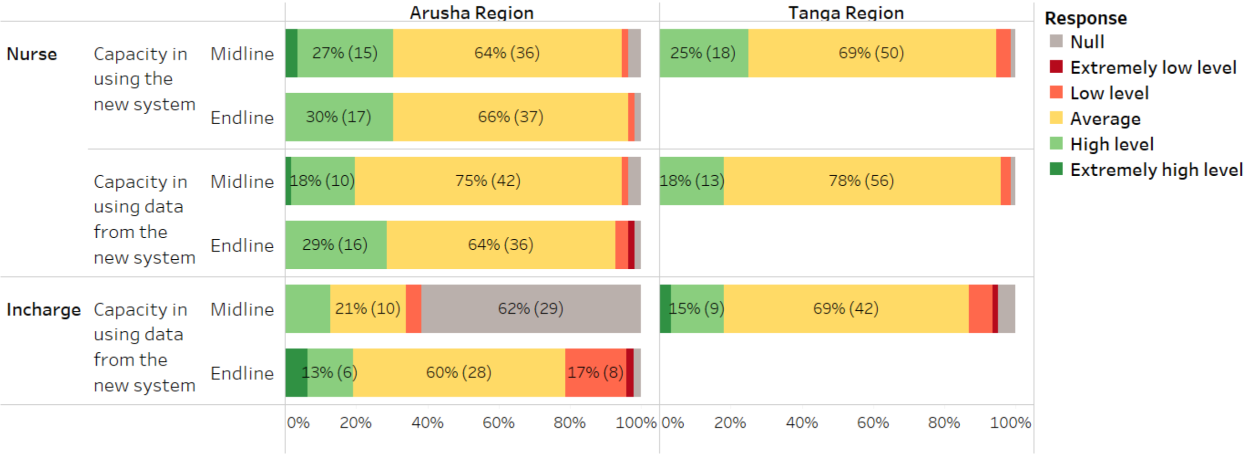
Midline data indicated that the majority of nurses and in-charges rated themselves as having "average" capacity (Figure 10). Results were similar at midline between Arusha and Tanga—with the exception of the Arusha Region in-charge responses where there was an issue with the survey question and many respondents left it blank. Nurses, who are responsible for entering the data, and who use it most directly on a day-to-day basis, reported slightly higher capacity in using data from the new system compared to in-charges. For example, in Arusha, 29 percent of nurses reported "high" or "extremely high" data use capacity at endline, as compared to 19 percent of in-charges. In-charges may or may not be active users of the EIR depending on several factors including self-interest and level of engagement during trainings and reporting processes.

There were no large improvements in nurse capacity between midline and endline data collection in Arusha Region (and it is difficult to interpret the in-charge changes due to the high number of 'null' responses at midline). This may be due to facility migration from TIIS to TImR. When TImR was introduced in late 2016, TIIS had already been rolled out to all health facilities in Arusha Region, and thus data needed to be migrated over to the new system. The process started at the beginning of December 2017 and corresponded with endline data collection. Endline results may therefore reflect the fact that health workers were still orienting themselves to TImR at the time of data collection. Endline results may also reflect that many HCWs who had previously been trained on the electronic system(s) were forced to abdicate their posts due to new policies on HCW certification.

The DIVO self-reported capacity results show a similar pattern that there were some declines in capacity at endline in Arusha (Figure 11) as DIVOs were orienting themselves to a new system. In general, DIVOs reported higher capacity than facility-level HCWs. It is the DIVO's role to use the system themselves and also to provide support to facility HCWs on using the system and trouble-shooting when necessary.

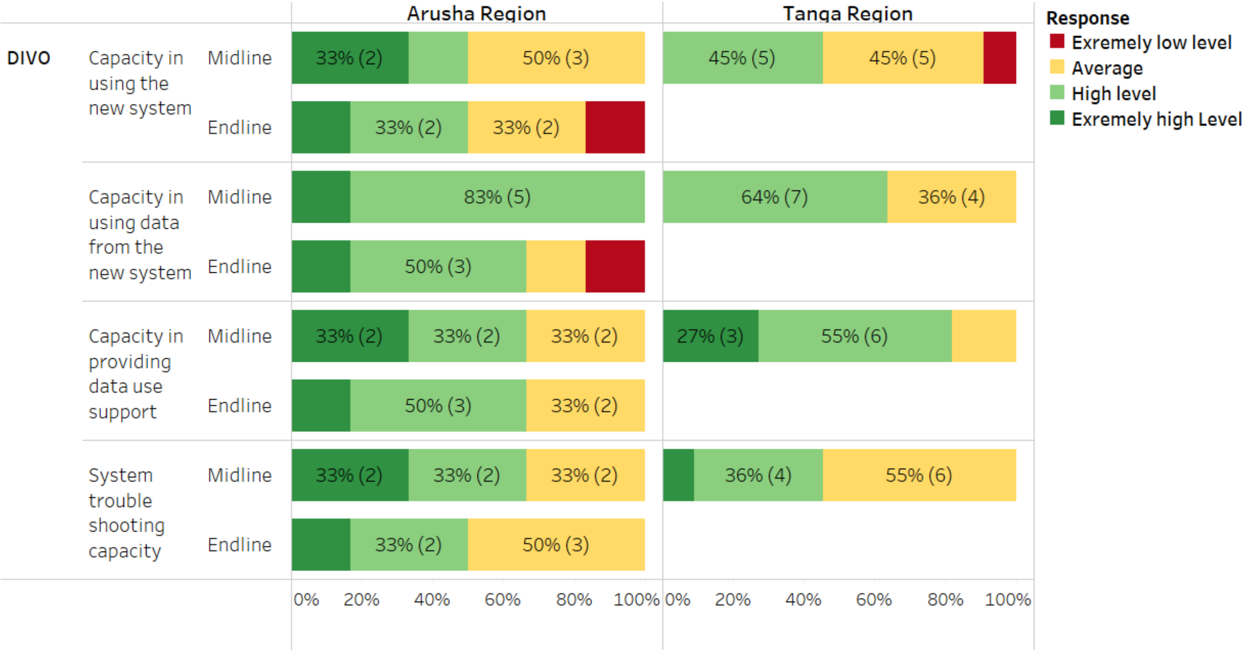
DIVOs in Arusha and Tanga reported slightly higher capacity in providing data use support (to facilities) as compared to their own capacity in using the new system or using data from the new system. Given their important role in providing ongoing support to facilities, there should be continued emphasis on building DIVO’s capacity to use the new system.

Figure 10. Self-reported facility health worker capacity in system and data use.



Note: There was an issue with the Arusha Region in-charge questionnaire at midline, causing many respondents to leave the response blank (‘null’). For this reason, we caution the interpretation of the in-charge Arusha midline results.

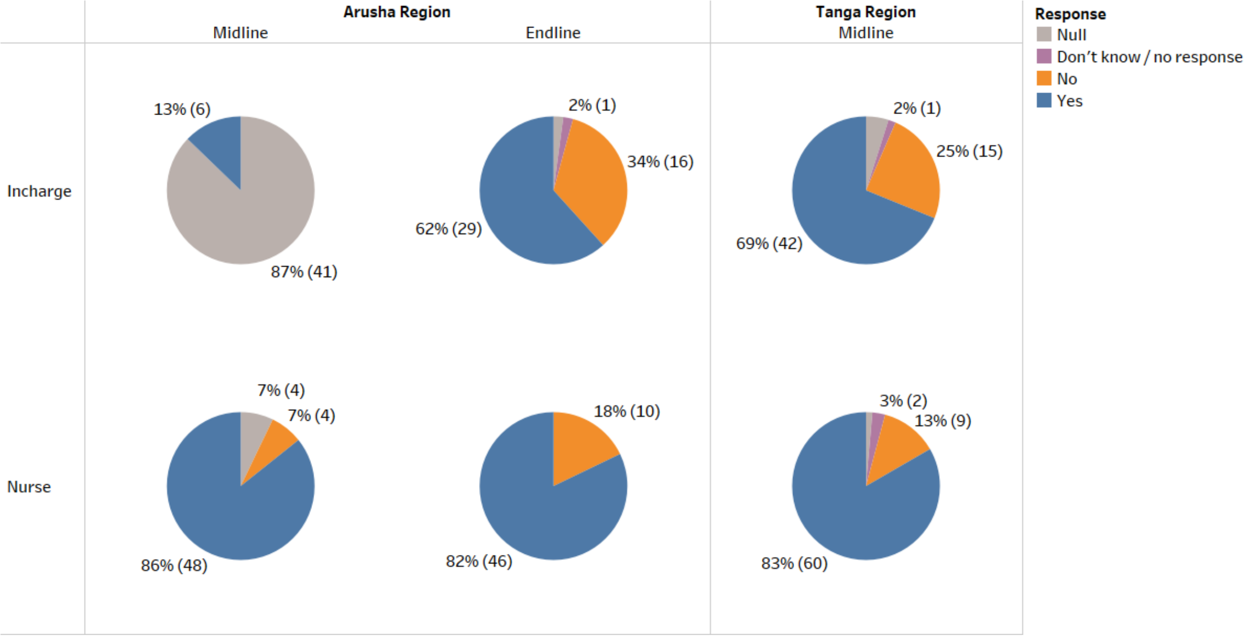
Figure 11. Self-reported DIVO capacity in data use and system trouble shooting.



During midline and endline, the BID team also assessed EIR usage by asking HCWs whether they had ever used data generated from the new system. At endline, the majority of in-charges (62 percent) and vast majority of nurses (82 percent) in sampled immunization clinics in Arusha reported using data from the system (Figure 12). There was a slight decrease from midline to endline among nurses; as above, this may be due to system migration from TIIS to TImR and the fact that health workers were still familiarizing themselves with the new EIR. (The large number of ‘null’ responses among in-charges at midline in Arusha was due to an issue with the survey question that caused many respondents to leave the response blank.) The percentage of in-charges and nurses in Tanga who had used data from the new system at midline were similar to the results in Arusha at endline. Generally, nurses were more likely than in-charges to have used data coming from the new system.

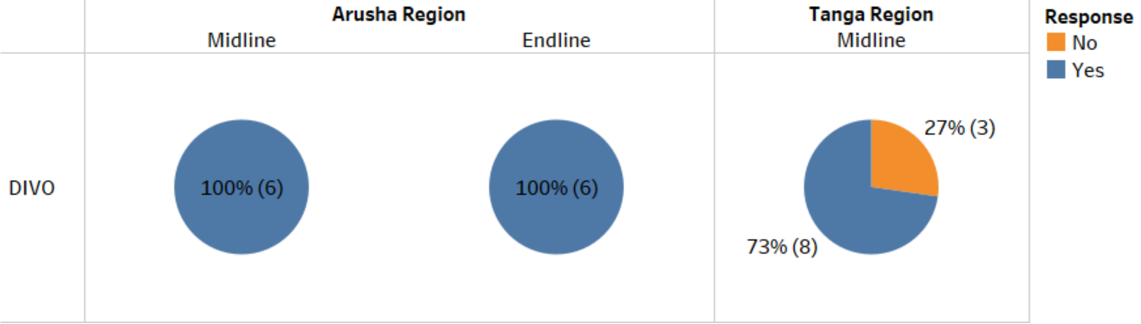
At the district level, all DIVOs (n=6) in Arusha Region reported using data from the new system at midline and endline (Figure 13). In Tanga, at midline when the new system had been in place for approximately four months, 73 percent of DIVOs reported using data from the new system.

Figure 12. In-charges and immunization nurses who have ever used data from the new system.



Note: There was an issue with the Arusha Region in-charge question at midline, causing many respondents to leave the response blank ('null'). For this reason, we caution the interpretation of the in-charge Arusha midline results.

Figure 13. DIVOs who have ever used data from the new system.



Perceptions of data quality

Just as important as measures of data availability, timeliness, completeness, and accuracy is the perception of data quality among data users. The evaluation assessed how HCWs perceive the quality of the immunization data they are using since this is likely to impact how and if they use the data in their daily decision-making process. HCWs were asked to rate key dimensions of data quality (accuracy, completeness, and timeliness) on a four-point scale: excellent, good, fair, or poor.[g] Figures 14 and 15 show the ‘excellent’ and ‘good’ responses at each survey time point.

Figure 14. Perceptions of data quality in Arusha Region.

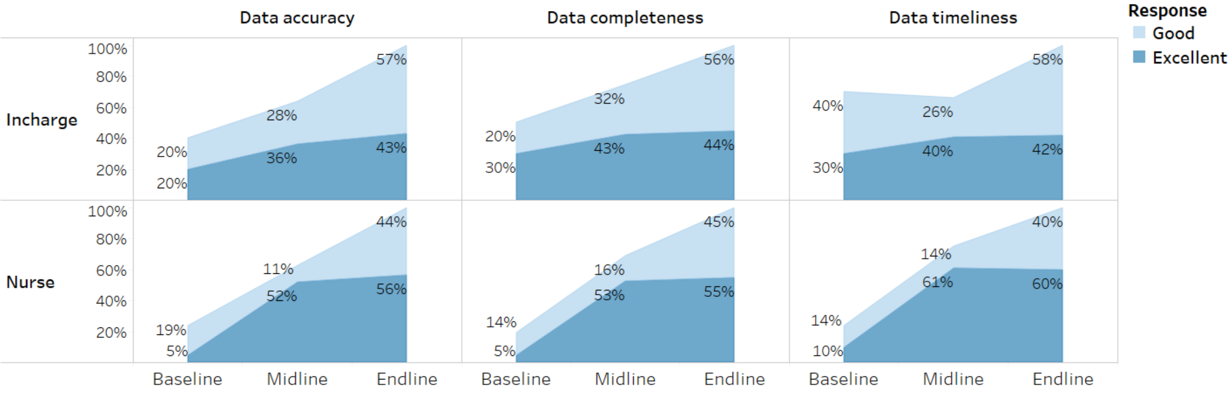
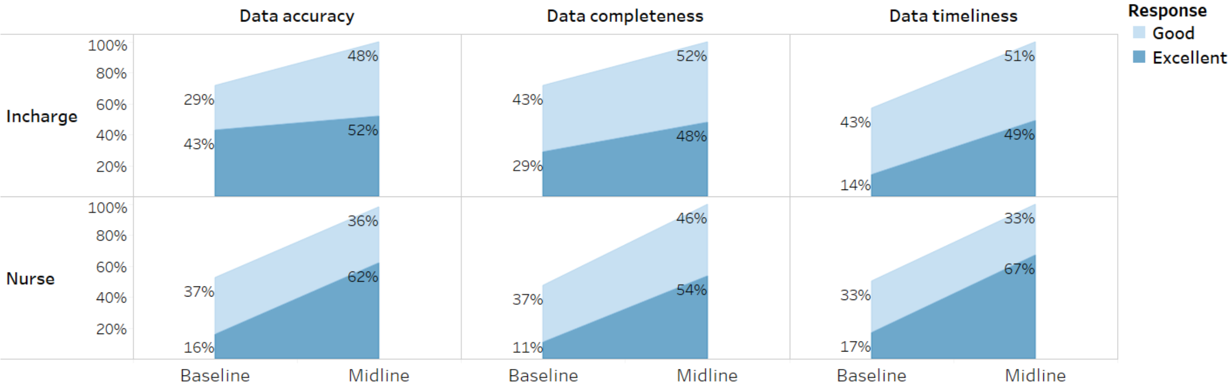


Figure 15. Perceptions of data quality in Tanga Region.



After the introduction of new interventions, health workers reported a large increase in their perceptions of data quality, as defined by the timeliness, accuracy, and completeness of EIR data. At baseline, the majority of nurses and in-charges did not think that data quality were “excellent.” For instance, before interventions were introduced, only 5 percent of nurses thought data accuracy and completeness were “excellent” in Arusha (Figure 14). This indicates that HCWs were aware of data quality issues, but may not have had the tools or motivation to address them. As HCWs continued to use the EIR, their perceptions of data quality improved. By endline, 100 percent of in-charges and nurses reported that data quality was “good” or “excellent” in Arusha. Tanga saw similar trends, though baseline data perceptions were slightly better in the region (Figure 15). Only 16 percent of nurses rated data accuracy as “excellent”; 11 percent perceived data completeness to be “excellent,” and 17 percent thought data timeliness were “excellent.” One hundred percent of in-charges and nurses in Tanga rated data quality as “good” or “excellent” by midline.

At the district level, there are also improving perceptions of data quality in the data generated by the EIR (Figures 16 and 17). At baseline, not a single DIVO in Arusha or Tanga rated data completeness or timeliness as “excellent.” By midline in both regions, there were large improvements in the percentage of

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[g] At midline and endline, all HCWs were asked to rate their perceptions of the accuracy, completeness, and timeliness of the immunization data from the new system on a four-point scale ranging from poor to excellent. However, at baseline only those HCWs that were able to identify DPT3 coverage were asked to rate their perceptions of the quality of those coverage data (so the baseline responses are a subset of all HCWs).

DIVOs who rated data quality aspects as “good” or “excellent.” Although there was a slight decrease in quality ratings from midline to endline in Arusha (likely due to switching from TIIS to TImR), 83 percent of DIVOs still thought the data quality of the new system was “good” or “excellent” across all dimensions (accuracy, completeness, and timeliness) at endline (Figure 16). There were improvements across all data quality dimensions in Tanga from baseline to midline, most notably in the percentage of DIVOs who rated the data quality as “excellent” (Figure 17).

Figure 16. Perceptions of data quality in Arusha Region.

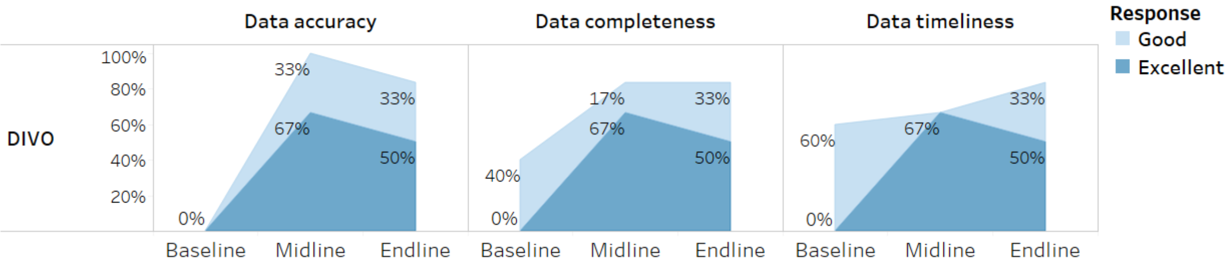
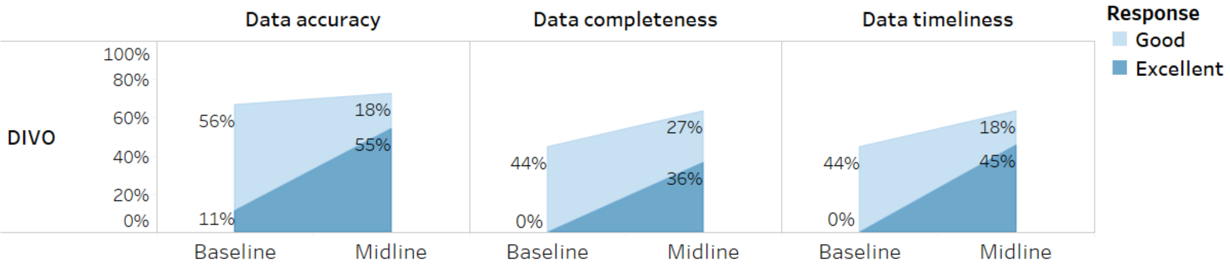


Figure 17. Perceptions of data quality in Tanga Region.



Cyclic relationship between data quality and use

As the quality of the data improves, we expect HCWs’ confidence in the data to increase, and they will be more likely to use it to make decisions. As HCWs increasingly use the data, they will see the value in using it to inform their planning, outreach, and service delivery and will be more likely to care about the quality of data. Thus, the data use reinforces the data quality and promotes more informed decision-making.

Data use

Having access to timely, accurate data on defaulters, vaccine coverage, and vaccine stock is essential for in-charges and nurses to effectively do their day-to-day work and to take action to address un- or under-vaccinated children. The introduction of data quality and data use interventions is intended to give HCWs the ability to use data to inform their day-to-day work. To measure how data use is changing over time, we designed survey questions around three scenarios where we would expect HCWs to use data to inform their actions:

- Identifying defaulters[h] within their catchment area.
- Identifying areas within their catchment area with low DPT3 coverage.
- Identifying current vaccine stock levels in their facility.

For each real world scenario, the survey asked HCWs if they could use their data to identify defaulters, low DPT3 coverage, and current vaccine stock levels over the previous three months. Although there may be other ways that HCWs are using data, framing survey questions around these scenarios gave us a standardized measure of data use that could be applied across facilities.

Arusha Region

At baseline in Arusha Region, the majority of in-charges and nurses could not identify low DPT coverage areas (77 and 57 percent, respectively) or immunization defaulters (64 and 50 percent, respectively)—indicated by the red bars in Figures 18 and 19. However, the majority of in-charges and nurses could identify stock data (68 and 93 percent, respectively) regardless of whether they were taking action on it—indicated by the light blue and dark blue bars in Figures 18 and 19.

Midline saw significant increases in the ability of HCWs to identify low coverage areas and defaulters, with nearly all HCWs who could identify the data also taking action based on it. At midline the new EIR was the main data source used to identify defaulters, compared to the child registers used at baseline. In the old paper-based system, a HCW would have to page through the patient register in order to identify individual children who missed a vaccine, but the new EIR simplifies this process by generating a list of defaulters with their caregivers' contact information for easy follow-up.

These increases were maintained at endline for immunization coverage and defaulter tracking, with some slight fluctuation. From baseline to endline, the percentage of in-charges in Arusha who could identify the data for coverage and defaulters more than doubled and the subset who also took action on those data more than tripled (Figure 18). Among nurses in Arusha, the percentage who could identify the data for coverage and defaulters nearly doubled from baseline to endline and the subset who also took action on those data more than doubled (Figure 19).

Stock management data, however, followed a different pattern. At baseline, the ability of in-charges and nurses to identify their current stock balance was much higher than their ability to identify coverage or defaulters. This left less room for improvement with the new interventions; however, there was still an increase in the ability to identify vaccine stock levels among in-charges (from 68 to 81 percent at midline). Among both nurses and in-charges, the ability to identify stock data decreased between baseline and endline, from 68 to 64 percent among in-charges and from 93 to 77 percent among nurses. This is likely due to challenges with VIMS and TImR integration. Fluctuations may have also been the result of data migration from TIIS to TImR, inaccurate stock reports in TImR, or because of HCW turnover due to the changes in certification.

Among DIVOs in Arusha Region, there was a different pattern of data use changes. At baseline, nearly all (5 of 6) DIVOs could identify low coverage facilities in their district, but only one-third (2 of 6) of DIVOs could identify stock levels at facilities. At endline, all DIVOs reported that they could identify and took action on low coverage facilities in their district and nearly all (5 of 6) DIVOs reported that they could identify and took action on stock levels at facilities in their district.

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[h] The term "defaulter" refers to a child who missed scheduled vaccinations for any reason, including but not limited to health facility problems, such as cancelled sessions or vaccine stock outs.

Figure 18. Percent of in-charges taking action based on data in Arusha Region.

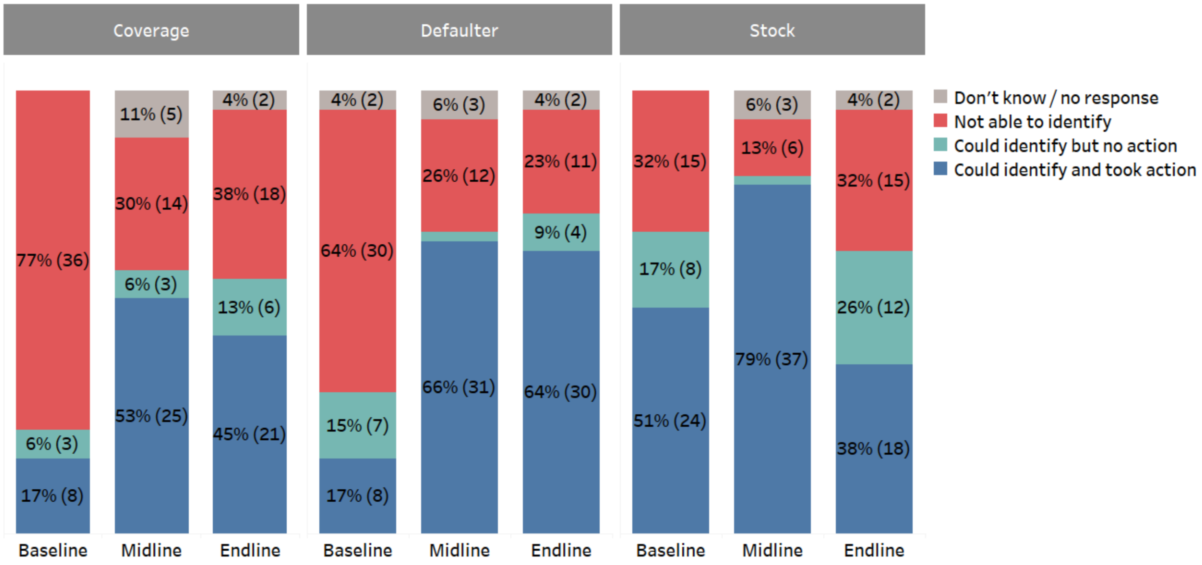
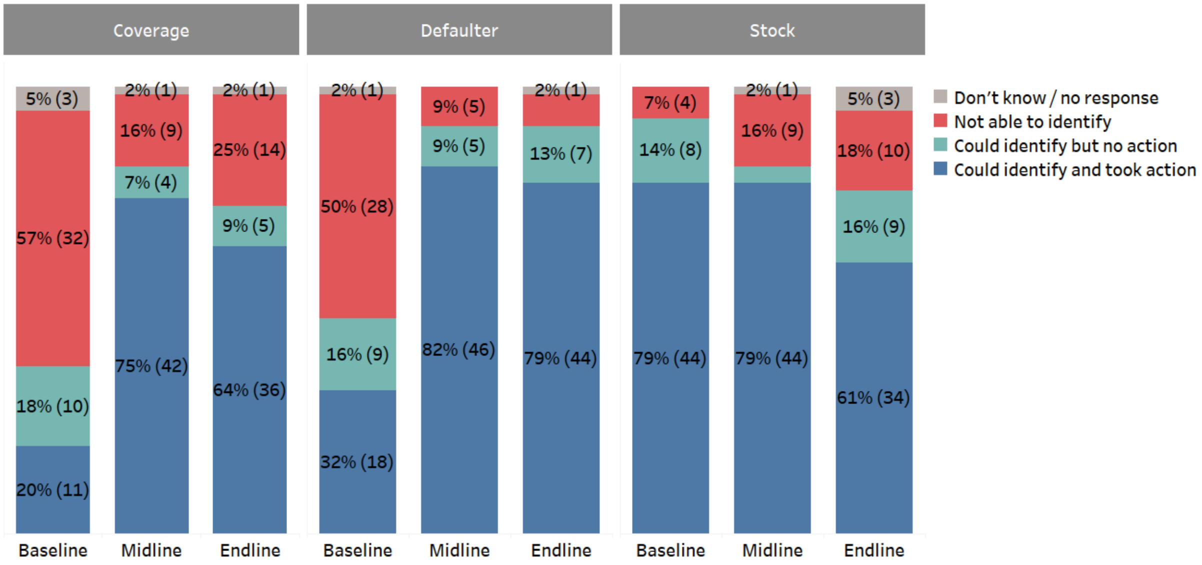


Figure 19. Percent of nurses taking action based on data in Arusha Region.



Tanga Region

At baseline, facility in-charges reported lower levels of action than nurses in Tanga Region (Figures 20 and 21). Only 13 percent of in-charges acted on defaulter data, compared to 24 percent of nurses. Even fewer were able to identify and act on low DPT coverage areas; 10 percent reported being able to identify and act on DPT coverage data, as compared to 21 percent of nurses. Between baseline and midline the percentage of nurses and in-charges taking action based on their data increased for each data use scenario. After interventions were introduced, there were large improvements in data use practices. There was more than a four-fold increase among in-charges who reportedly took action based on their coverage and defaulter data, and more than a two-fold increase among nurses who took action on coverage and defaulter data. As was the case in Arusha, trends related to identification and use of stock data followed a different pattern. The ability to identify current stock levels was highest among the three data use scenarios at baseline, for both nurses and in-charges. Nurses experienced only a moderate increase in their ability to identify stock levels, from 82 percent at baseline to 90 percent at endline (Figure 21). In-charges, on the other hand, actually saw a reduction in their ability to identify stock levels, from 70 to 62 percent (Figure 20). As in Arusha, this may be due to the challenges encountered in the stock management integration between TImR and VIMS, the accuracy issues with TImR stock reports, and HCW turnover due to changes in certification policy.

Similar to the DIVO results in Arusha Region, at baseline more DIVOs in Tanga (9 of 11) could identify and took action on facility-level coverage data compared to those who could identify and took action on stock data (5 of 11). At endline, the largest improvements were seen in the stock data use scenario where nearly all DIVOs (10 of 11) reported that they could identify and took action on the stock levels at facilities in their district.

Figure 20. Percent of in-charges taking action based on data in Tanga Region.

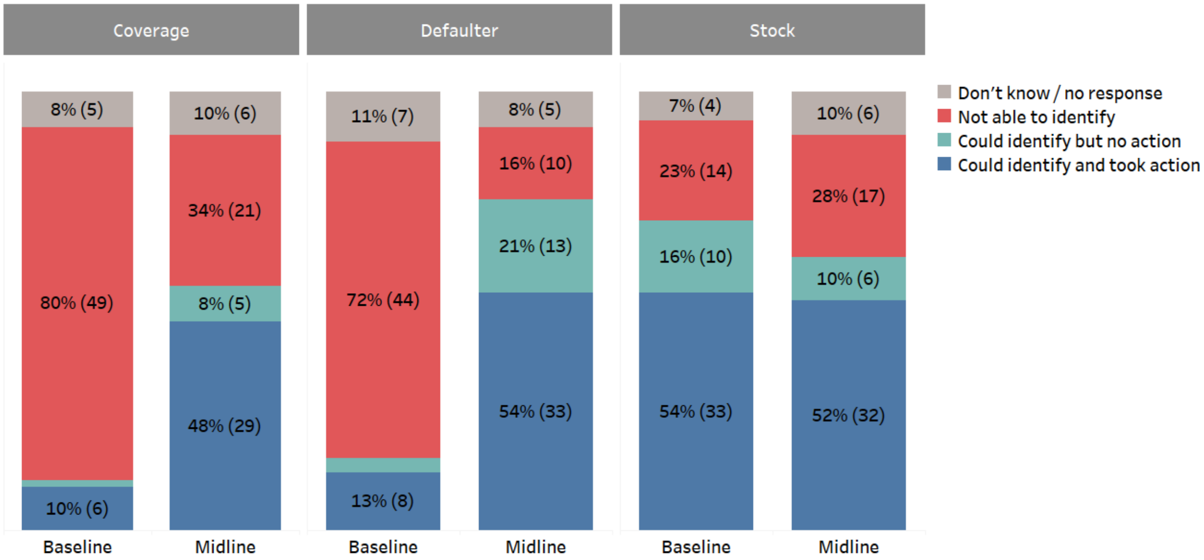
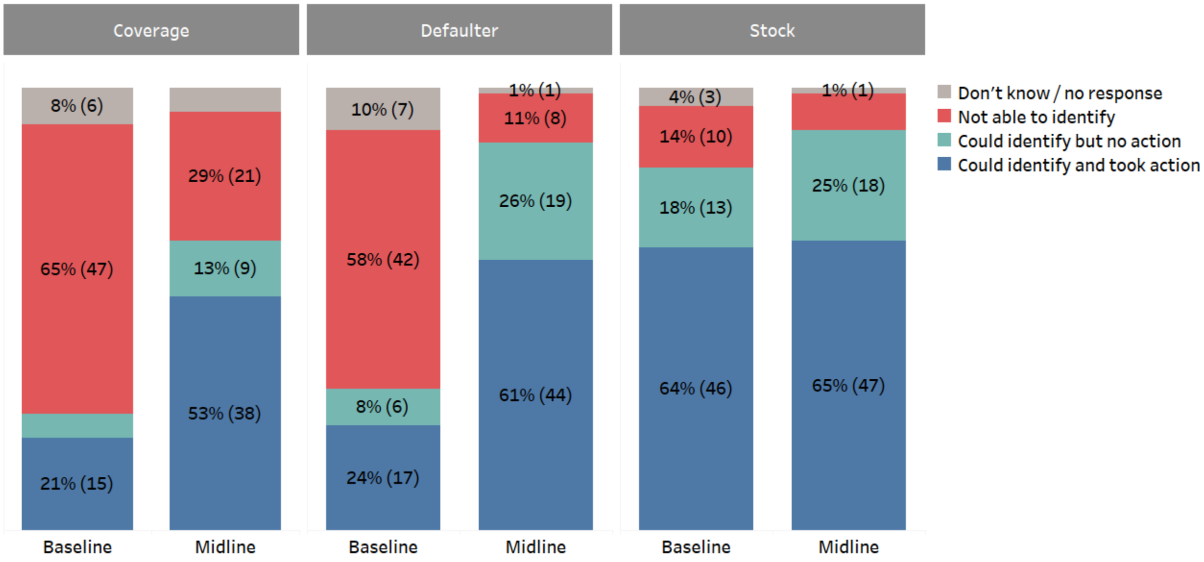


Figure 21. Percent of nurses taking action based on data in Tanga Region.

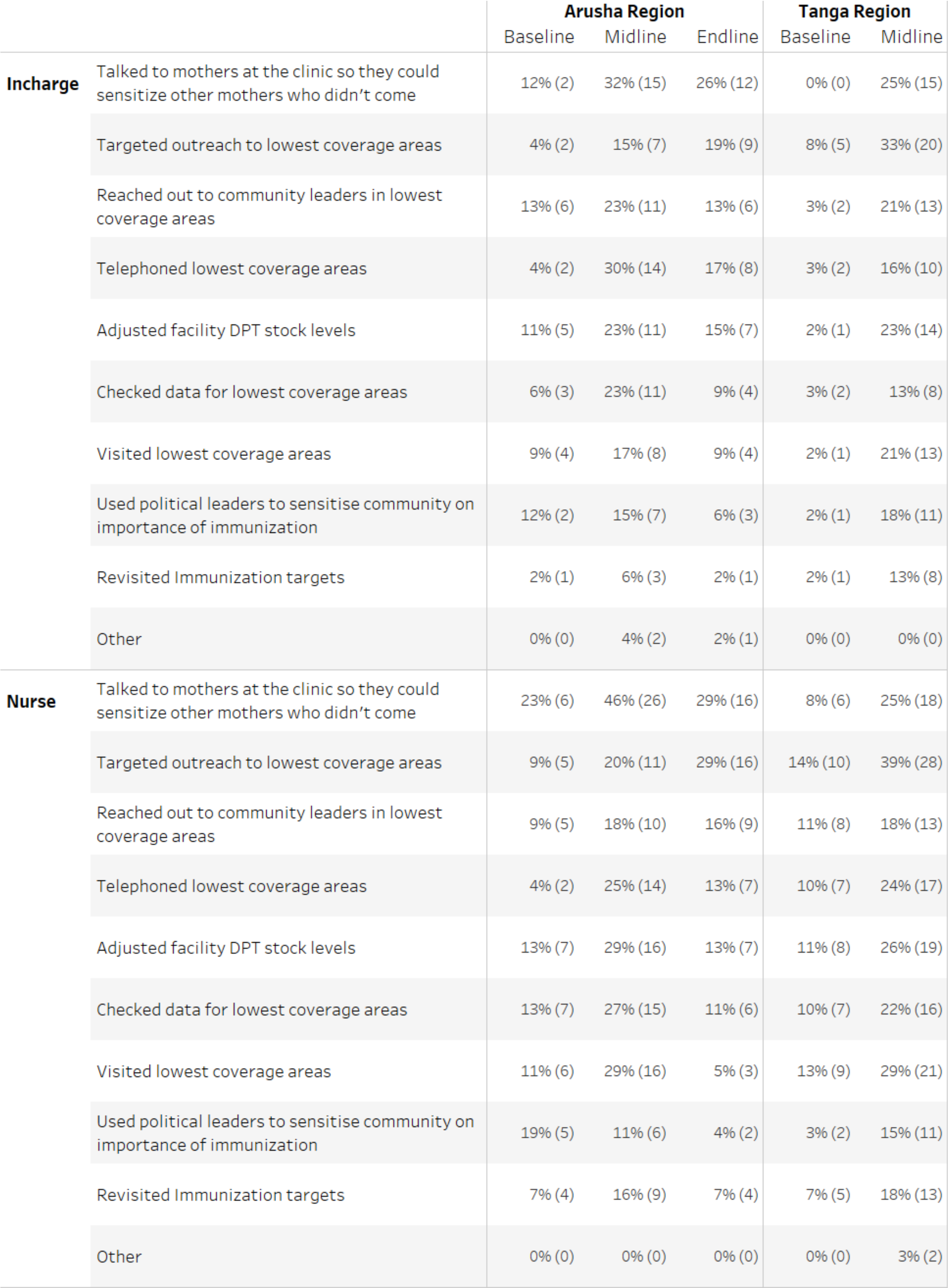


Types of actions taken

Tables 1, 2, and 3 list the most common actions that facility HCWs reported taking in relation to their DPT3 coverage data, defaulter data, and stock data, respectively. From baseline to endline, there were large increases in the overall percentage of HCWs taking action and the types of actions that were most commonly taken changed. For example, liaising with community leaders and using community workers for tracing were the most common actions taken to address defaulters at baseline in Arusha; by endline, HCWs were much more likely to make phone calls to mothers using their phone number registered in the EIR (Table 2). In Tanga, the most common action based on defaulter data was conducting outreach sessions.

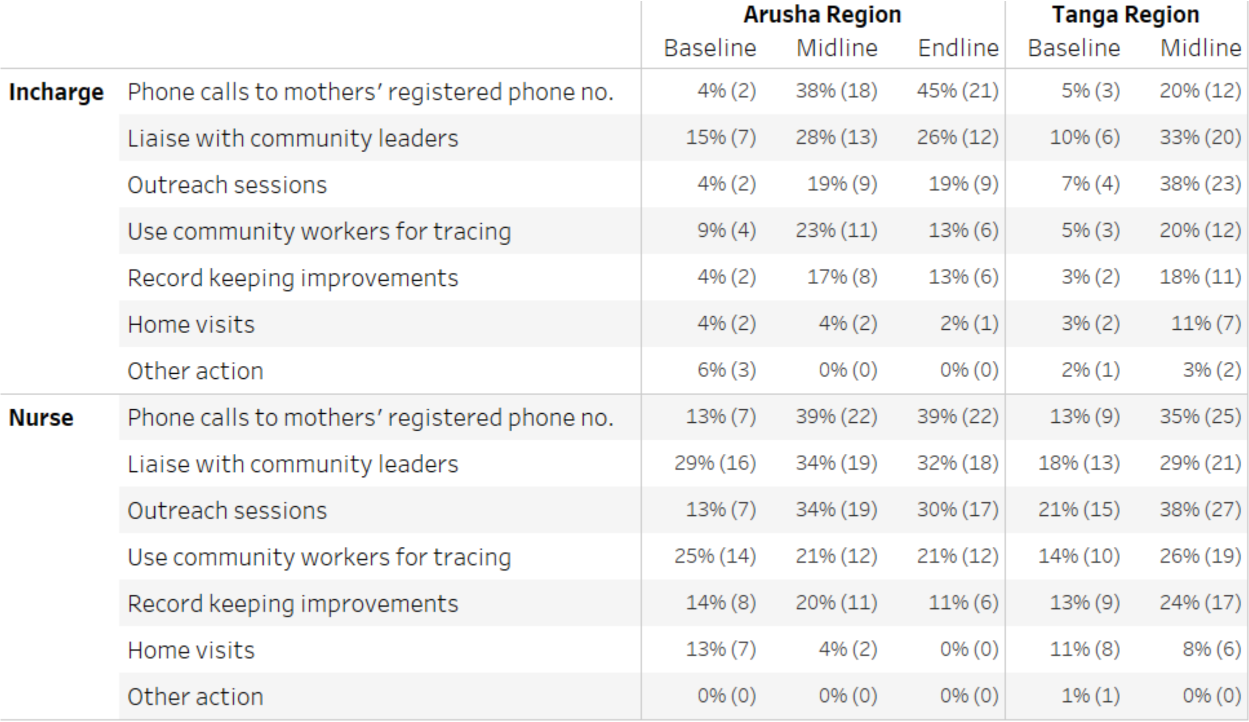
Common actions based on DPT3 coverage data in both regions were talking to mothers who came to the clinic to enlist them to help sensitize other mothers who did not come, targeting outreach services to low coverage areas, and adjusting DPT facility stock levels (Table 1). The most common action based on stock data was requesting a change in stock from the district (Table 3). In addition to the responses included in the survey, there may be other ways that HCWs were using data and other types of evidence-based actions that were taken.

Table 1. Percentage (and number) of facility health care workers who reported taking a given action in the last quarter based on their DPT3 coverage data.



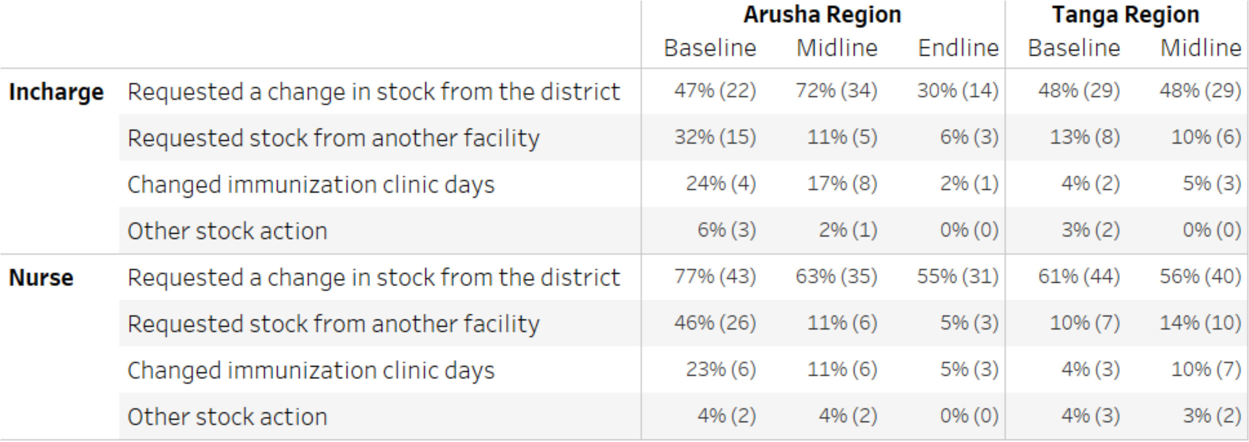
		Arusha Region			Tanga Region	
		Baseline	Midline	Endline	Baseline	Midline
Incharge	Talked to mothers at the clinic so they could sensitize other mothers who didn't come	12% (2)	32% (15)	26% (12)	0% (0)	25% (15)
	Targeted outreach to lowest coverage areas	4% (2)	15% (7)	19% (9)	8% (5)	33% (20)
	Reached out to community leaders in lowest coverage areas	13% (6)	23% (11)	13% (6)	3% (2)	21% (13)
	Telephoned lowest coverage areas	4% (2)	30% (14)	17% (8)	3% (2)	16% (10)
	Adjusted facility DPT stock levels	11% (5)	23% (11)	15% (7)	2% (1)	23% (14)
	Checked data for lowest coverage areas	6% (3)	23% (11)	9% (4)	3% (2)	13% (8)
	Visited lowest coverage areas	9% (4)	17% (8)	9% (4)	2% (1)	21% (13)
	Used political leaders to sensitise community on importance of immunization	12% (2)	15% (7)	6% (3)	2% (1)	18% (11)
	Revisited Immunization targets	2% (1)	6% (3)	2% (1)	2% (1)	13% (8)
	Other	0% (0)	4% (2)	2% (1)	0% (0)	0% (0)
Nurse	Talked to mothers at the clinic so they could sensitize other mothers who didn't come	23% (6)	46% (26)	29% (16)	8% (6)	25% (18)
	Targeted outreach to lowest coverage areas	9% (5)	20% (11)	29% (16)	14% (10)	39% (28)
	Reached out to community leaders in lowest coverage areas	9% (5)	18% (10)	16% (9)	11% (8)	18% (13)
	Telephoned lowest coverage areas	4% (2)	25% (14)	13% (7)	10% (7)	24% (17)
	Adjusted facility DPT stock levels	13% (7)	29% (16)	13% (7)	11% (8)	26% (19)
	Checked data for lowest coverage areas	13% (7)	27% (15)	11% (6)	10% (7)	22% (16)
	Visited lowest coverage areas	11% (6)	29% (16)	5% (3)	13% (9)	29% (21)
	Used political leaders to sensitise community on importance of immunization	19% (5)	11% (6)	4% (2)	3% (2)	15% (11)
	Revisited Immunization targets	7% (4)	16% (9)	7% (4)	7% (5)	18% (13)
	Other	0% (0)	0% (0)	0% (0)	0% (0)	3% (2)

Table 2. Percentage (and number) of facility health care workers who reported taking a given action in the last quarter based on their defaulter data.



		Arusha Region			Tanga Region	
		Baseline	Midline	Endline	Baseline	Midline
Incharge	Phone calls to mothers' registered phone no.	4% (2)	38% (18)	45% (21)	5% (3)	20% (12)
	Liaise with community leaders	15% (7)	28% (13)	26% (12)	10% (6)	33% (20)
	Outreach sessions	4% (2)	19% (9)	19% (9)	7% (4)	38% (23)
	Use community workers for tracing	9% (4)	23% (11)	13% (6)	5% (3)	20% (12)
	Record keeping improvements	4% (2)	17% (8)	13% (6)	3% (2)	18% (11)
	Home visits	4% (2)	4% (2)	2% (1)	3% (2)	11% (7)
	Other action	6% (3)	0% (0)	0% (0)	2% (1)	3% (2)
Nurse	Phone calls to mothers' registered phone no.	13% (7)	39% (22)	39% (22)	13% (9)	35% (25)
	Liaise with community leaders	29% (16)	34% (19)	32% (18)	18% (13)	29% (21)
	Outreach sessions	13% (7)	34% (19)	30% (17)	21% (15)	38% (27)
	Use community workers for tracing	25% (14)	21% (12)	21% (12)	14% (10)	26% (19)
	Record keeping improvements	14% (8)	20% (11)	11% (6)	13% (9)	24% (17)
	Home visits	13% (7)	4% (2)	0% (0)	11% (8)	8% (6)
	Other action	0% (0)	0% (0)	0% (0)	1% (1)	0% (0)

Table 3. Percentage (and number) of facility health care workers who reported taking a given action in the last quarter based on their stock data.



		Arusha Region			Tanga Region	
		Baseline	Midline	Endline	Baseline	Midline
Incharge	Requested a change in stock from the district	47% (22)	72% (34)	30% (14)	48% (29)	48% (29)
	Requested stock from another facility	32% (15)	11% (5)	6% (3)	13% (8)	10% (6)
	Changed immunization clinic days	24% (4)	17% (8)	2% (1)	4% (2)	5% (3)
	Other stock action	6% (3)	2% (1)	0% (0)	3% (2)	0% (0)
Nurse	Requested a change in stock from the district	77% (43)	63% (35)	55% (31)	61% (44)	56% (40)
	Requested stock from another facility	46% (26)	11% (6)	5% (3)	10% (7)	14% (10)
	Changed immunization clinic days	23% (6)	11% (6)	5% (3)	4% (3)	10% (7)
	Other stock action	4% (2)	4% (2)	0% (0)	4% (3)	3% (2)

Supporting culture

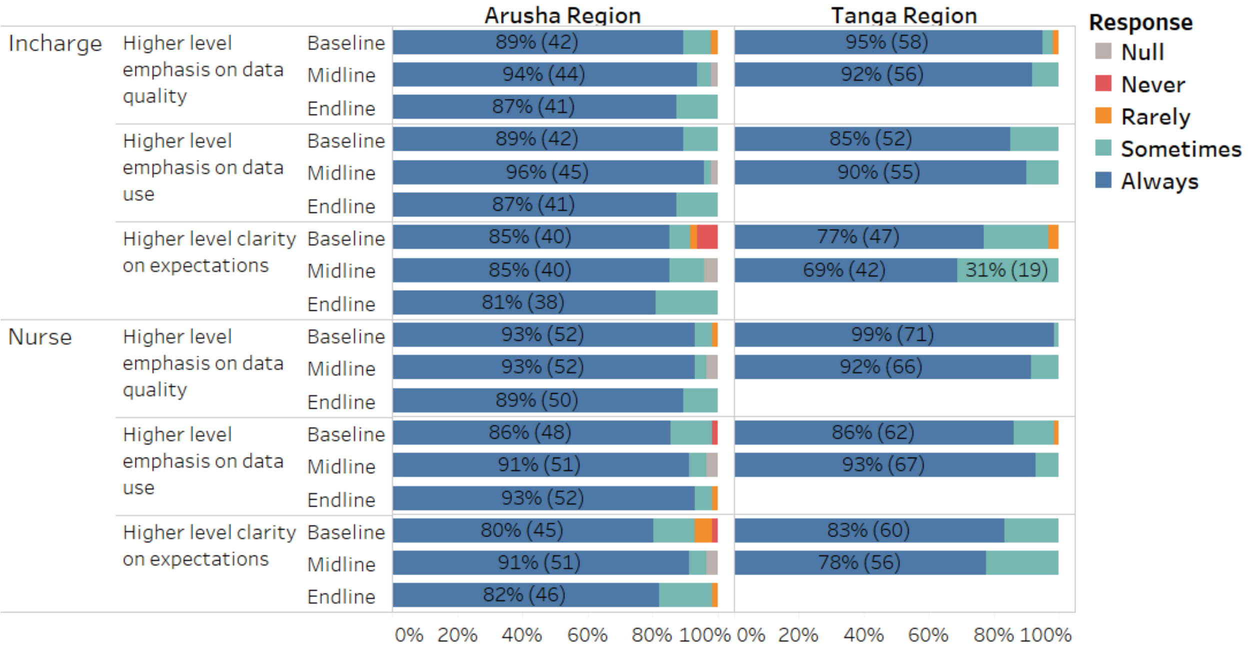
Improvements in data use and decision-making can be sustained by strengthening the culture of data use. The health system, as a whole, must adopt a culture that values and regularly consults data in order to influence change at a facility level. This is, after all, where information is collected and able to make a difference. The evaluation measured the data use culture at two levels: first, the extent to which higher levels of the health system encourage a culture of data use, and second, the extent to which facilities are connected to and learning from their peer facilities.

Strengthening a data use culture at all levels

Higher levels of the health system are instrumental in modeling and encouraging a culture of data use, as well as driving demand for high quality data. In order to achieve this, HCWs must understand their roles and what is expected of them related to producing and using high quality data. The evaluation survey focused on measuring perceptions of the extent to which higher levels of the health system are emphasizing and sharing their expectations about the importance of data quality and use as an integral part of performance management. For HCWs at the facility level, “higher levels” of the health care system refers to the district (DIVO), regional (RIVO), and the national level MOH. For DIVOs, “higher levels” refers to the regional and national level MOH.

At baseline, the large majority of HCWs in both Tanga and Arusha already felt that higher-level health officials “always” put emphasis on data quality and use and were clear about their expectations of facility HCWs (Figure 22). Compared to data quality, there was slightly less of an emphasis on data use at baseline, particularly among nurses. Although there was a high perceived emphasis on data quality and use, the percentage of nurses and in-charges who said they were “always” clear on what was expected of them in terms of data quality and use at baseline, was slightly lower in both regions. There were only minor differences between responses from in-charges and nurses.

Figure 22. Percentage of facility health care workers who felt that higher levels of the health system emphasized data quality and use, and presented clear expectations for the facility.



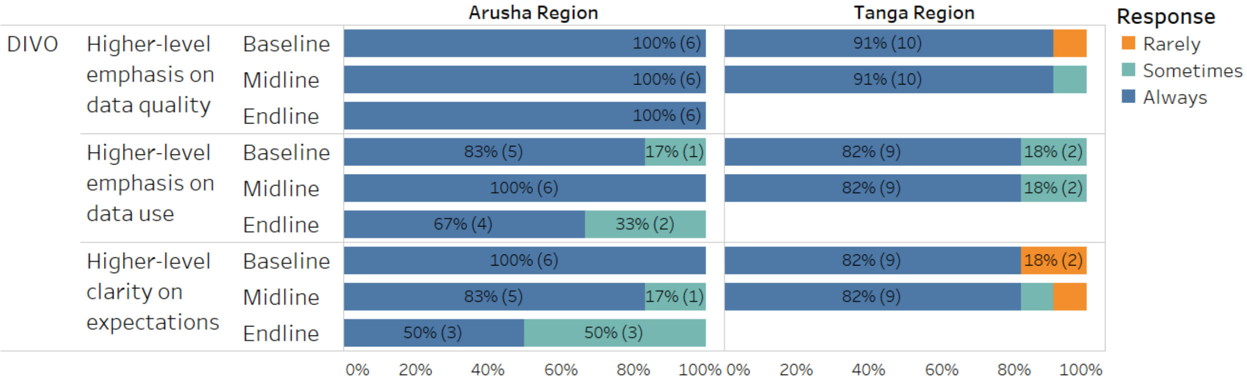
After the introduction of Tanzania’s EIR and other interventions, HCWs saw only small shifts in the emphasis on data quality and use among higher levels of the health system, but no significant changes.

Despite steady trends or slight increases at midline, perceptions of this culture of data quality and use decreased slightly across all three categories among in-charges at endline in Arusha Region. Among nurses, 93 percent of nurses at endline reported higher-level emphasis on data use, as compared to 86 percent at baseline. However, high rates at baseline left little room for improvement.

In Tanga also, responses across all categories remained high between baseline and midline. There were slight decreases among in-charges and nurses on perceived higher-level emphasis on data quality and clarity of expectations, but slight increases in higher-level emphasis on data use. Overall, the culture of data use was generally maintained from baseline to midline. Even so, there is still room for improvement. Clarity about HCW roles and what is expected of them related to data quality and use was lower among both nurses and in-charges in both regions, as compared to the other survey questions. Midline and endline data show there are HCWs who still only "sometimes" feel clear about what is expected of them.

The strong culture of data use was also seen in the district-level responses in Arusha and Tanga (Figure 23). At baseline, nearly all DIVOs in both districts thought higher levels of the health system "always" emphasized data quality and this remained constant at midline and endline. The percentage of DIVOs who thought higher levels "always" emphasized data use was slightly lower at baseline, compared to the emphasis on data quality. In Tanga, there were only minor improvements from baseline to midline across all three questions about higher levels of the health system. However, in Arusha, at endline there was a notable decrease in the percentage of DIVOs who "always" felt that higher levels put emphasis on data use and were "always" clear on expectations of the district. This may be due to the timing of endline data collection in Arusha Region; DIVOs were switching from TIIS to TImR and were beginning to use VIMS which may have raised questions about what was expected of them related to the new systems.

Figure 23. Percentage of DIVOs who felt that higher levels of the health system emphasized data quality and use, and presented clear expectations for the district.



Improving knowledge through peer networking

Finally, data use is also sustained through support from peers, and peer networking is a key intervention for continuing to strengthen the data use culture. The BID Initiative established peer networks through WhatsApp groups that connect HCWs in a district and allow them to share experiences, challenges, questions, and lessons learned. The networks can build knowledge, offer support, and motivate HCWs. During the baseline and midline survey, HCWs were asked about their knowledge of their peer facilities' immunization programs, including the coverage, stock status, and experiences of these facilities.

Before the introduction of the peer-networking interventions, the majority of nurses providing immunization services in Arusha and Tanga had limited or no knowledge about their peer facilities' immunization coverage, vaccine stock status, or efforts to overcome their immunization challenges (represented by the gray bars in Figure 24). Despite the lack of knowledge, more than 80 percent of nurses were interested in understanding how their peer facilities were performing.

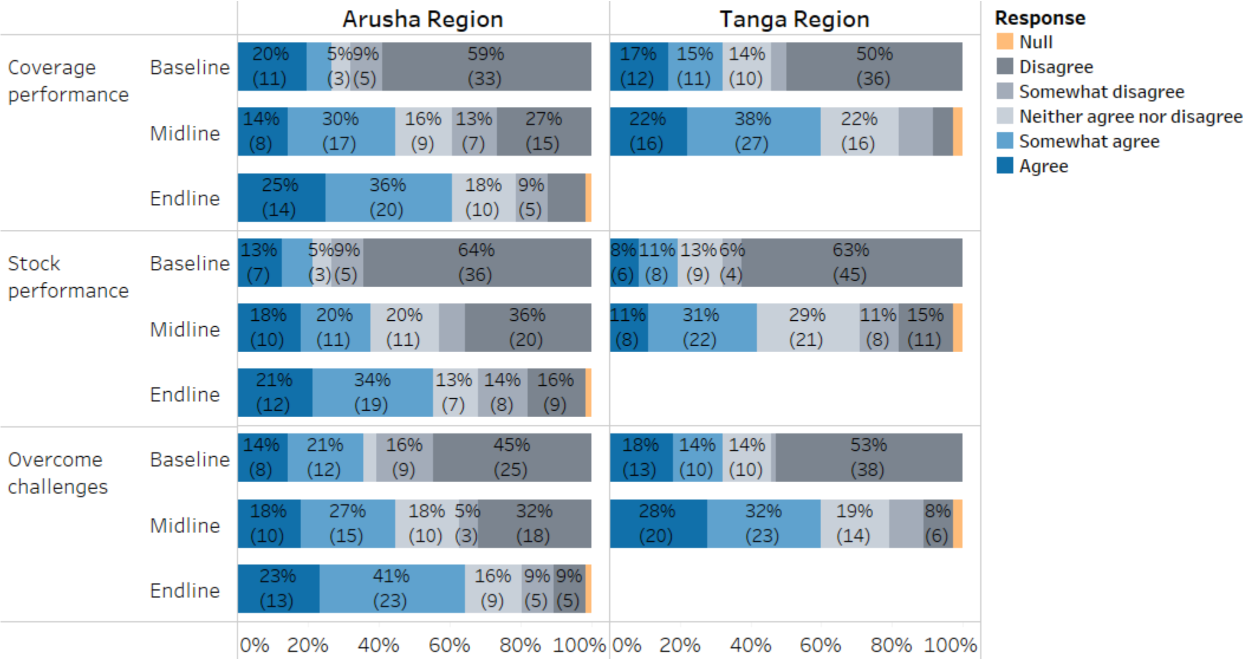
At midline, awareness improved in Arusha and in Tanga. Awareness improved even further in Arusha Region at endline. More than half of nurses in Arusha at endline "agree" or "somewhat agree" that they now know the immunization coverage performance (61 percent) or stock performance (65 percent) of their peer facilities; 64 percent knew how peer facilities were overcoming challenges related to their immunization performance (Figure 24). Tanga saw similar levels of awareness at midline for immunization coverage (60 percent) and the challenges faced by neighboring facilities (60 percent). Only knowledge of stock status remained lower, at 42 percent.

Examples of WhatsApp group interactions

- HCWs shared information about how to fill out the monthly IVD report. Group members shared pictures of a job aid to guide others completing the report and helped clarify questions from others, resulting in improved reporting accuracy.
- A nurse shared a child vaccination card that had been incorrectly filled out which sparked a discussion on the challenges of data reporting errors. The RIVO responded to request the nurse resend a picture of the corrected card, thereby holding the nurse accountable for the data quality improvement and ensuring learning for others.
- RIVOs and immunization mentors have sent data visualizations, such as graphs of routine district-level immunization performance, missing reports requiring follow up, and information on performance trends. This has been used to flag issues to discuss during supportive supervision visits.

Nurses may have greater insight into their peer facilities through their direct interactions via district WhatsApp groups, as well as through their engagement with District Data Use Mentors (DDUMs) who share cross-facility learning and experience.

Figure 24. Immunization nurses' knowledge on peer facility coverage performance, stock performance, and how they overcome challenges.



Conclusions

Prior to the implementation of interventions in the Arusha and Tanga Regions, there were observed data quality challenges, poor perceptions of data quality, and limited use of data for decision-making. The evaluation results show that after the implementation of data quality and use interventions, there have been improvements. The EIS allows HCWs to rely on the data to know who should receive immunization services, where these individuals are located, and what specific vaccinations they need. The interventions have raised awareness among HCWs and facilitated data use for service delivery improvements.

Specifically, the following are key findings realized after the implementation of the interventions in the Arusha and Tanga Regions:

- The large majority of nurses and in-charges in Arusha and Tanga regions report having average, high, or extremely high capacity in using the new system and using data generated from it. Results show a moderate increase in the system and data use capacity of nurses and in-charges between midline and endline in Arusha Region—likely due to system migration from TIIS to TImR, which occurred at the same time as the endline data collection and required HCWs to reorient themselves to the new EIR. Nurses reported a slightly higher capacity than in-charges in both Arusha and Tanga, in part because they use data most frequently, on a daily basis.

- More than 80 percent of nurses reported having ever used data from the new system at midline in Tanga and endline in Arusha. Among in-charges, 62 percent at endline in Arusha and 69 percent at midline in Tanga reported having ever used data from the new system. Again, nurses were more likely to report using the data because it is part of their daily work in delivering and recording immunizations.

- All HCWs surveyed in Arusha Region, including both in-charges and nurses, reported "good" or "excellent" immunization data quality by endline. The same was true of HCWs in Tanga Region, according to midline data. This is an improvement from baseline findings, where the majority of nurses and in-charges thought the data quality was "good" or "fair." Among those facilities actively using the EIR, the system ensures timeliness of reporting, completeness of reported data elements, and internal accuracy as the data are aggregated across different levels of reporting.

- As data quality improves, HCWs are more likely to use it for decision-making. There were substantial increases in the ability of in-charges and nurses to identify coverage and defaulter data in both Arusha and Tanga. Among nurses in Tanga, for instance, there was more than a two-fold increase in those who reported taking action on coverage and defaulter data. Improvements were not as pronounced for stock management data; however, this is likely due to challenges with VIMS and TImR integration.

- Even before interventions were introduced, there was already a high perceived emphasis on data quality and use in Tanzania among both in-charges and nurses. Midline and endline data therefore saw only small shifts in the emphasis on data quality and use among higher levels of the health system. Among nurses, for instance, 93 percent initially reported higher level emphasis on data use, as compared to 86 percent at endline. Despite this, there is still some room for improvement.

Overall, these are important improvements in data quality and data use. The Arusha Region was the BID Initiative's first demonstration region, followed by the Tanga Region. Tanga therefore benefitted from Arusha's learnings and the implementation approach continues to improve in each subsequent district based on lessons learned. In fact, as of May 2018, 33 facilities in Tanga Region have transitioned away from using paper forms to only using the EIS; this shows the district buy-in to using the new EIS and without the burden of parallel systems we expect to see more rapid improvements in data quality and use.

In addition to Arusha and Tanga Regions, by May 2018, the BID implementation team has supported rollout to all 312 facilities in Kilimanjaro Region. The implementation approach has improved by ensuring training alignment between TImR and VIMS, introducing TImR in all facilities from the start (no paper-based facilities or TIIS), receiving support from other regions where rollout has occurred – which has improved HCW buy-in, and leveraging the regional health management team and MOH to lead discussions for increased ownership.

Recommendations

As the data quality and data use interventions are scaled up in Tanzania, and shared with other countries, the evaluation has identified recommendations to inform future monitoring, evaluation, and implementation. Some of these recommendations are restated from the BID Initiative monitoring and evaluation midline report, as they continue to be relevant.

Recommendations for monitoring and evaluation:

- **Ensure consistent use of the EIR among health facilities by tracking system usage and building follow-up mechanisms.** In order to see data quality improvements in all facilities, all facilities must be using the EIR consistently. It is critical to have a way to track system usage, and this should be in place before attempts are made to track improvements in data quality.
- **Design new approaches to measure HCWs' capacities in using the system.** Individual capacity to use the EIR is an important determinant of system usage; however, the evaluation was only able to assess self-reported capacity. In future evaluations, we recommend exploring other ways to assess HCW system-use capacity using, for example, direct observation.
- **Continue using data use scenarios as a measure of data use and data-driven decision-making, but consider other complementary metrics.** It is difficult to measure data use in a systematic way across HCWs and facilities, when HCWs may use data in different ways to make different types of decisions. In order to measure data use in a comparable way across HCWs, the data use scenarios developed by the BID team worked well as a core set of measures. However, these could also be complemented by more open-ended, qualitative data collection on other types of data use or data-driven decision-making that occur at facilities and districts. The current data use scenarios could also be validated by documentation or EIR data, as applicable.
- **Plan to evaluate the consistency between parallel systems when introducing an EIR.** Future monitoring and evaluation of the introduction of EIRs should include a measure of data accuracy and consistency by comparing data in the child health development card and the data in the EIR.

Recommendations for implementation:

- **Work with MOHCDGEC to develop guidelines to encourage data use and to support the transition from paper to electronic in order to eliminate parallel reporting systems.** Transitioning to paperless data collection and reporting as soon as possible should alleviate HCW burden associated with parallel reporting systems and thereby improve consistent system usage.

Facilities have demonstrated that they are able to maintain the EIR and value this new system. The transition from paper to full electronic data collection has already started with 33 facilities in Tanga Region beginning paperless implementation in March 2018. This process needs to be accompanied by clear guidelines that support HCWs across all levels of the health system to use their data as part of their reporting process. The guidelines will provide motivation for HCWs to continue to use the EIR as well as clear steps to transition from paper to electronic.

- **As part of the sustainability strategy, work with MOHCDGEC, and PORALG to come up with a mechanism in which DDUMs can continue to support facilities to use the EIR.** DDUMs play an important role in providing close follow-up and support to facilities that are having issues or struggling to use the EIR. However, there is a limited budget to facilitate DDUMs to provide this support to facilities. It is difficult for districts to have dedicated budgets for DDUMs to only follow up on immunization activities. There needs to be a mechanism in which DDUMs will be recognized and supported to perform their duties. This may be possible if they are considered as key in health service improvements and not immunization alone.
- **Plan for intensification of targeted supportive supervision during and after the initial stage of EIR rollout and develop a strategy for continued DIVO support.** When new data quality and use interventions are implemented, DIVOs can support HCWs in their district through supportive supervision visits. DIVO self-reported results on capacity in using data from the new system and trouble-shooting system issues show that there is room for improvement in DIVO capacity. The BID team, in collaboration with the DDUMs, must establish a mechanism to continue to build and sustain the capacity of DIVOs so they can adequately support their facilities beyond the initial rollout of the new interventions.

Appendix: Evaluation design, methodology, and limitations

Summary of the evaluation team

BID Initiative staff from Tanzania and Seattle conducted the evaluation in collaboration with the monitoring and evaluation (M&E) manager from the Immunization and Vaccine Development (IVD) Program and regional and district officials.

Key evaluation team members included:

- Robert Kindoli, M&E lead, BID Initiative Tanzania.
- Emily Carnahan, M&E lead, BID Initiative Seattle.
- Stephano Mugeta, Zonal Coordinator and acting M&E lead, BID Initiative Tanzania.
- Delphinus Mujuni, M&E manager, IVD, Ministry of Health, Community Development, Gender, Elderly and Children (MOHCDGEC).
- Ngwengwe Bulula, acting M&E manager, IVD, MOHCDGEC.

The M&E lead from Tanzania coordinated and oversaw data collection. He pretested tools, prepared the study protocol, and submitted the study to local authorities for ethical clearance. The M&E lead from Tanzania and the M&E lead from Seattle collaborated to design the data collection tools, visualized and interpreted the results, and jointly wrote the report. The M&E manager from IVD provided guidance on the design of data collection tools, refined questions, and ensured any indicator definitions were aligned with definitions used by IVD.

Evaluation design

The evaluation is based on a pretest and posttest design in the first two implementation regions before and after the introduction of interventions, including an EIR. This design allows for comparison of data from the same districts, facilities, and/or individual health care workers. The midline data are intended to show short-term changes as compared to the baseline, whereas the endline data are intended to show sustained, longer-term changes. Through this study design, we can understand the contribution of the interventions rolled out to observed changes in data use and data quality.

Evaluation time period

Interventions were implemented over a total of four touches[i] with each facility. Baseline data were collected on the first visit to each district or facility during rollout and measured data quality and data use for the prior three months. Midline data collection was planned for four months after each district's fourth touch to allow sufficient time for the facility to experience multiple rounds of monthly immunization reports using the new EIR. However, in Arusha Region this time frame was adjusted after learning that more than 80 percent of facilities were not using the system on a routine basis at four months. Midline data collection was postponed to ensure that facilities were consistently using the EIR for three to four

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[i] Touches are visits to provide on-the-job training to health workers, strengthen the data use culture, and ensure the smooth implementation of the full package of interventions.

months so that the midline data collection would capture the value of the new system. Initially, HCWs were not using the system consistently in Arusha Region due to lack of close follow-up from the BID Initiative team, lack of ownership and capacity to sustain usage among district officials, and EIR system challenges (bugs). All these challenges were addressed in a revised implementation strategy. Moreover, the HCWs were also expected to use the EIR in parallel to the existing paper-based tools and facing this additional workload, some HCWs focused on data entry in the paper-based tools as opposed to the EIR.

Midline evaluation data were collected in all districts of the Arusha Region over a period of two and one-half months, from June through mid-August 2017. The timing between baseline and midline data collection varied between districts based on implementation schedules, but we ensured a minimum of three months between the end of rollout and midline data collection for each district. Table 1 provides a summary of intervention rollout start dates, end dates, and the timing of baseline and midline data collection by district in Arusha Region.

Table 4. Arusha Region district roll-out schedule and dates for baseline, midline, and endline data collection.

District name	Rollout start date (1st touch)	Rollout end date (4th touch)	Time frame covered by baseline data collection	Midline data collection dates	Endline data collection dates
Arusha City Council	April 27, 2015	October 21, 2016	February–April 2015	June–July 2017	January–February 2018
Meru DC	May 16, 2016	November 4, 2016	February–April 2016	June–July 2017	January–February 2018
Karatu DC	August 9, 2016	April 7, 2017	May–July 2016	June–July 2017	January–February 2018
Longido DC	November 7, 2016	April 7, 2017	August–October 2016	June–July 2017	January–February 2018
Ngorongoro DC	November 28, 2016	April 14, 2017	August–October 2016	June–July 2017	January–February 2018
Monduli DC	February 13, 2017	April 7, 2017	November 2016–January 2017	July–August 2017	January–February 2018
Arusha DC	February 13, 2017	April 7, 2017	November 2016–January 2017	July–August 2017	January–February 2018

Note: DC=District Council.

In Tanga Region, midline data collection took place as planned, approximately four months following implementation in each district. Although we had planned to also collect endline data in Tanga Region, due to the project timelines this was not possible. Table 2 provides a summary of intervention rollout start dates, end dates, and the timing of baseline and midline data collection by district in Tanga Region.

Table 5. Tanga Region district roll-out schedule and dates for baseline and midline data collection.

District name	Rollout start date (1st touch)	Rollout end date (4th touch)	Time frame covered by baseline data collection	Midline data collection dates
Tanga City	July 25, 2017	August 16, 2017	April–June 2017	December 2017–February 2018

Mkinga DC	July 25, 2017	August 16, 2017	April–June 2017	December 2017–February 2018
Muheza DC	July 27, 2017	August 15, 2017	April–June 2017	December 2017–February 2018
Kilindi DC	July 27, 2017	August 14, 2017	April–June 2017	December 2017–February 2018
Lushoto	July 24, 2017	August 23, 2017	April–June 2017	December 2017–February 2018
Pangani	July 24, 2017	August 4, 2017	April–June 2017	December 2017–February 2018
Korogwe TC	July 24, 2017	August 17, 2017	April–June 2017	December 2017–February 2018
Korogwe DC	July 24, 2017	August 17, 2017	April–June 2017	December 2017–February 2018
Handeni DC	July 24, 2017	August 14, 2017	April–June 2017	December 2017–February 2018
Handeni TC	July 24, 2017	August 14, 2017	April–June 2017	December 2017–February 2018

Note: DC= District Council; TC= Town Council.

Sample selection

This evaluation includes health facilities in Arusha Region and Tanga Region, the first two regions of implementation. There are 287 health facilities in Arusha and 327 health facilities in Tanga that provide immunization services and are implementing the data use and data quality interventions.

Arusha Region

In Arusha Region, the BID team collected baseline data in all facilities except six facilities that pilot tested the EIR and three facilities that pilot tested the baseline data collection tools. At midline and endline data were collected from a sample of facilities; the sampling frame included 266 facilities, which represents all facilities where baseline data were collected and three facilities excluded at baseline that were added to the midline sample at the request of our external evaluator. To define the sample size for data collection, we used a 5 percent margin of error with 80 percent confidence. M&E leads assumed a response distribution of 50 percent for the most conservative sample size estimate. This resulted in a sample of 102 facilities out of the 266 total facilities in the sampling frame. The sample of 102 facilities was distributed to districts in proportion to their size, based on the number of facilities within each district. In this way, if 10 percent of facilities in the total sampling frame are in District A, then 10 percent of facilities in the sample will also be from District A. After determining the number of facilities to sample per district, within each district we first included the facilities that were part of the external evaluation to maximize the comparability between the midline evaluation and the external evaluation, and then randomly sampled the remaining facilities. The same sample was used for midline and endline data collection. Table 6 shows the number of facilities sampled in each district.

Tanga Region

In Tanga Region, the sampling frame for baseline and midline data collection included 321 facilities (the total known number of facilities prior to implementation). The sample size was calculated in the same way as for Arusha Region (see above) which resulted in a sample of 127 facilities that were distributed to districts in proportion to their size, based on the number of facilities within each district. Table 6 shows the number of facilities sampled in each district.

Sample presented

For comparability across points of data collection, this report presents data from the subset of facilities where we collected data at each time point. Since results are presented by respondent type (in-charge, nurse) we limited the sample to only those facilities where a nurse was surveyed at each time point, an in-charge was surveyed at each time point, or both a nurse and in-charge were surveyed at each time point. In Arusha Region, there were three time points of data collection (baseline, midline, and endline) compared to only two time points in Tanga Region (baseline and midline). In Arusha Region, there were 64 facilities with all time points of data (see the far right column of Table 6), including 47 in-charge interviews and 56 nurse interviews. In Tanga Region, there 84 facilities with all time points of data, including 61 in-charge interviews and 72 nurse interviews.

The only section of the report that differs from this sample is the "Data quality challenges" section. In this section we present findings from the data quality assessment conducted at baseline, and thus it does not require a comparable sample over time. For this reason, we present results in the "Data quality challenges" section based on the full baseline sample of 231 facilities in Arusha Region and 99 facilities in Tanga Region where data quality assessments were conducted.

Table 6. Sample of baseline and midline data collection by district.

Region	**District**	**Total # facilities receiving interventions**	**# of facilities in sample**	**# of facilities with data collected for all time points**
Arusha	Arusha City Council	58	17	15
Arusha	Arusha DC	49	19	10
Arusha	Karatu DC	41	16	11
Arusha	Longido DC	27	9	8
Arusha	Meru DC	44	16	6
Arusha	Monduli DC	36	13	3
Arusha	Ngorongoro DC	32	12	11
Arusha	**Total**	**286**	**102**	**64**
Tanga	Bumbuli DC	24	9	7
Tanga	Handeni DC	39	15	2
Tanga	Handeni TC	5	2	2
Tanga	Kilindi DC	35	14	14
Tanga	Korogwe DC	46	18	10
Tanga	Korogwe TC	12	5	5
Tanga	Lushoto DC	38	15	5
Tanga	Mkinga DC	29	11	11
Tanga	Muheza DC	46	18	9
Tanga	Pangani DC	19	8	8
Tanga	Tanga City	28	11	11
Tanga	**Total**	**321**	**127**	**84**

Note: DC=District Council; TC=Town Council.

Data sources

The evaluation measured data use and perceptions of data quality through surveys of HCWs at both facility and district levels who are in positions to directly use immunization data. One facility in-charge and one nurse involved in immunization service delivery were interviewed at each facility. Within their facilities, they ensure the quality, collection, collation, and reporting of immunization data to district officials. At the district level, DIVOs were interviewed because they are responsible for supporting facility-level data collection and use, as well as aggregating and reporting immunization data to the regional level.

The HCW surveys were conducted through a structured questionnaire developed by BID M&E leads. At baseline in both regions, the surveys were administered in person by BID staff during facility touches. At midline in Arusha Region, the surveys were printed and sent to health facilities to be self-administered. The surveys were then collected by BID staff (sometimes with support from DIVOs), and data were entered into an electronic version. At midline in Tanga Region and endline in Arusha Region, online surveys were sent to health facilities to be self-administered. In some rare cases, facility HCWs responded to the midline or endline survey in a phone interview with a BID staff member. Their responses were entered directly into the electronic version. At the district level, an online version of the survey was sent to all DIVOs for self-administered completion. All surveys were in Swahili.

At baseline, the key metrics of data quality were measured through review of immunization source documents and reports for the previous three months prior to the introduction of interventions; after the introduction of TImR, data extracted from TImR were used to continue to monitor aspects of data quality. The source documents at baseline included stock ledgers, tally sheets, and IVD reports.

Data quality assurance procedures

The careful design, review, testing and use of data collection tools allowed for data quality assurance. Data collection teams were also trained, supervised, and monitored throughout in a series of quality checks during data entry and processing. Data collection tools were developed by BID staff with review and feedback from the Gates Foundation, Mott MacDonald, and representatives from Tanzania's MOHCDGEC (specifically the IVD program). To ensure consistency and quality, the same survey tools were used during baseline, midline, and endline data collection with limited changes. In each phase of data collection, the survey tools were pretested before use. At midline and endline, pretesting was conducted by BID staff, who cross-checked the translation, skip patterns, and language to make sure that the surveys could be self-administered.

Survey data were entered into an electronic version of the questionnaire, which included data quality checks to minimize data entry errors. Data quality checks were also built into the data aggregation process. If an error was noted, the M&E lead was responsible for following up with BID staff who had been identified as a focal point for each district. These staff would then work to resolve the problem if it was a data entry issue or follow up with HCWs if the issue required additional attention.

Data analysis

Data were cleaned, aggregated, and analyzed in Excel and STATA 13. Data were visualized in Tableau 10.5.3.

Ethical considerations

The BID staff ensured that the evaluation conformed to the highest ethical standards. BID staff ensured compliance with Tanzania's research standards by submitting the data collection protocol and tools to the National Institute for Medical Research, Tanzania's Ethical Clearance Board. It was reviewed and approved in the first submission.

Informed consent of participants

The BID staff designed an informed consent form to accompany all questionnaires. This consent form detailed study objectives and the expected roles of the respondents during data collection. They were assured of their rights to withdraw at any point, before or after the interviews. Informed consent was obtained individually from all respondents who participated in the study. Participants provided their consent by signing the self-administered paper-based questionnaire, answering a survey question indicating consent in the electronic questionnaire, or verbally consenting during phone interviews. Data collectors who conducted in-person or phone interviews were well trained on how to obtain informed consent without jeopardizing the validity of the research.

Confidentiality

All respondents were assured that their information would be kept confidential. No personal identifiers were shared with third parties and/or used in reporting; this includes, but is not limited to, the names of the respondents, the name of the health facility where they worked, and their job title. A codebook was developed for any individual-identifying information and maintained separately from the collected data to avoid matching the data and the identifiers. Data collected from the health facilities were securely stored, and access to the data was restricted to the study team only.

Benefits to the study group

The interventions rolled out through the BID Initiative will benefit all health staff working to collect, analyze, report, and use immunization data. Data use and data quality interventions reduce the workload for HCWs and improve the accuracy and timeliness of all immunization data so that HCWs can make better decisions at all levels of the health system. The interventions will also help to establish a true target population to help with better planning, stock management, and calculation of the facility coverage, thereby improving data visibility and reducing the frequency of stock outs and vaccine wastage. It will also help to improve planning and distribution of vaccines across all levels.

Limitations

The following are limitations of the evaluation design and approach:

- The study design aims for pre- and post-comparison of the quality of immunization data and the behavior of HCWs as they use data for decision-making at district and facility levels. But this method is limited because it only establishes the contribution (and not the impact) of interventions to improvements in data quality and use. We do not have data from nonintervention districts for comparison. Moreover, we are not able to disentangle the contribution of the BID Initiative data quality and use interventions from the effects of other activities to support data quality and use in the implementation regions.
- Given the BID Initiative's phased implementation strategy and rolling baseline approach to data collection, approximately 30 percent of HCWs in Arusha Region and 15 percent of HCWs in Tanga Region had already heard about the BID Initiative at the time of baseline data collection. They likely heard about it from neighboring districts or facilities where implementation had already occurred. This may have influenced their data quality and/or data use behavior at baseline.
- BID staff were unable to interview the same HCWs at each point of data collection due to the rotation schedules of HCWs within facilities, reallocation within the district, and staff turnover. We anticipated this challenge and addressed it by only interviewing HCWs that had been in their role for a minimum of three months so they were familiar with their health facility's immunization practices. In some cases, HCWs were unavailable for interviews so we only present data from those facilities where we have data from each time point to ensure consistency of the sample.
- While the BID Initiative is focused on improving immunization data quality and use, it is difficult to measure if and how HCWs are using data to improve the performance of their facilities. The surveys elicited self-reported levels of data use but there was not a robust way to validate HCW responses. Self-reported data use may also be subject to social desirability bias.
- In line with the above point, measuring data use in a systematic way is challenging. The BID Initiative designed survey questions around three scenarios (identifying areas with low/high coverage, identifying defaulters, and identifying vaccine stock levels) where we would expect HCWs to use data to inform their actions. However, there may be other ways that HCWs are using data apart from these scenarios that the survey did not capture.
- The baseline data quality assessment required taking photos of source documents and entering the data into Excel templates. It was sometimes difficult to read the data due to illegible handwriting; in such circumstances, we had to drop some data that were not legible.
- Multiple data collection methods were used for the HCW surveys which could have affected the results. Baseline survey data were collected through in-person interviews and paper-based surveys, midline survey data in Arusha Region were collected through paper-based surveys and phone interviews, and midline survey data in Tanga Region and endline survey data in Arusha Region were collected through online surveys. The survey questions remained largely the same, but the multiple data collection methods may have effects on the comparability of the findings.
- There was some variation in timelines between when interventions were introduced to a district and when data were collected. For example, Arusha Region had a longer period between baseline and midline as compared to Tanga Region (which is further explained earlier). Some facilities/districts had less time to familiarize themselves with the new system compared to others which may affect their experience with the EIR, and the extent to which it improved data quality

and use. Moreover, the project timeline did not allow for endline data collection in Tanga Region, as originally planned.

References

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