June 2018

BID INITIATIVE ZAMBIA MIDLINE REPORT

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Contents

List of figures

List of tables

Abbreviations

DHIO	District Health Information Officer
DHIS	District Health Information System/Software
DPT	Diphtheria-pertussis-tetanus
DPT3	Diphtheria-pertussis-tetanus third dose
HCW	health care worker
HIA2	health information aggregation Form 2
M&E	monitoring and evaluation
MCH	maternal and child health
MOH	Ministry of Health
QR	quick response
ZEIR	Zambia Electronic Immunization Registry

Acknowledgments

Executive summary

BID Initiative background

The BID Initiative in Zambia is led by the Zambian Ministry of Health (MOH) in partnership with PATH and funded by the Bill & Melinda Gates Foundation. The BID Initiative is grounded in the belief that better data, plus better decisions, will lead to better health outcomes. The BID Initiative 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 use solutions, including information technology tools and change management activities to foster an environment conducive to data use for decision-making. Together with the Zambian MOH, BID partnered with Ona to implement Open Smart Register Platform (OpenSRP) as the Zambia Electronic Immunization Registry (ZEIR) platform. ZEIR is integrated with data use interventions, including peer network platforms, data use guides and job aids, on-site 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 midline evaluation

This report presents findings from a midline evaluation of data collected at baseline and midline of BID implementation in sampled health facilities from the first six implementation districts in Southern Province—Choma, Kazungula, Kalomo, Livingstone, Mazabuka, and Zimba. Data collection took place between November 2016 and March 2018. The results of this evaluation describe the initial state (baseline) of data quality and data use practices in participating health facilities and districts, which are then compared to the progress made after the introduction of data quality and data use interventions. Midline data collection was conducted four months after introduction of the BID interventions; the aim of the evaluation was to evaluate the short-term changes in immunization data quality and data use after interventions were rolled out.

In Zambia, the new data quality and data use interventions were first implemented in Livingstone and Kazungula, which initially received these interventions without the implementation of ZEIR. Implementation of the full suite of interventions (including ZEIR) occurred in Mazabuka, Zimba, Kalomo, and Choma, in that order. Implementation of the full suite of interventions continued for the remaining seven districts of Southern Province (Chikakanta, Gwembe, Monze, Namwala, Pemba, Siavonga, and Sinazongwe), which was completed in March 2018.

The midline evaluation focused on the following key areas:

- ❖ Immunization data availability, completeness, and accuracy.
- ❖ Data use for management decisions among key users of immunization data, including health facility in-charges, maternal and child health nurses, and district health officers.

❖ 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.

The findings and conclusions included in this report refer exclusively to the health facilities sampled in the six districts mentioned above; the conclusions should not be generalized to other facilities in the other provinces of Zambia. The results reflect the situation of the selected facilities during the time period mentioned above.

Methodology

The evaluation is based on a pretest and posttest design to compare the state of data quality and use in the first implementation districts before and after the introduction of interventions. 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; these metrics included the availability, completeness, and accuracy of the data. At midline, data quality was measured through data extracted from ZEIR. The evaluation measured data use and perceptions of data quality through surveys of health care workers (HCWs) at baseline and midline. The BID team surveyed HCWs at both the facility and district levels who directly use immunization data.

This report presents data from 89 facilities where data were collected at baseline (prior to the introduction of interventions) and midline (approximately four months after the introduction of interventions).

Summary of findings

The introduction of the data quality and data use interventions produced the following key improvements:

❖ For the facilities that were actively using ZEIR, the system ensured the availability, reporting, and completeness of immunization data elements, as well as internal accuracy as the data were aggregated across different levels of reporting. This was an improvement from baseline findings, where all districts had issues of availability of source documents, issues of completeness of the health information aggregation Form 2 (HIA2) reports, and high discrepancies between data in the tally sheets and in HIA2 reports.

❖ All facilities sampled at midline had been using ZEIR for at least three months. Nearly all HCWs (94 percent) felt that they had "good" or "excellent" system use capacity. More than two-thirds (69 percent) felt that they had capacity to use data generated from the system.

❖ After introduction of the data quality and data use interventions, a reduction was observed in the data quality barriers that impeded data use at facility and district levels. At baseline, the most common barrier to data use was poor data accuracy, cited by 56 percent of HCWs; at midline, only 21 percent of HCWs cited poor data accuracy as a barrier. There were notable declines in other facility barriers, including missing data (53 percent to 35 percent), late or no data (38 percent to 15 percent), and data that were confusing or not well presented (36 percent to 18 percent). At the district level, there were reductions across data quality barriers, although to a lesser extent than at the facility level.

❖ Perceptions of data quality improved at midline, as did overall confidence levels in the coverage data. The percentage of in-charges who reported that their immunization data accuracy was

"excellent" more than tripled from 11 percent at baseline to 35 percent at midline. There were also increases in perceived data completeness, timeliness, and overall confidence in the data.

❖ Midline results showed improvements in the percentage of facilities that were able to identify areas with the lowest coverage of the third dose of diphtheria-pertussis-tetanus vaccine (DPT3) (from 59 percent to 87 percent), defaulters (from 67 percent to 94 percent), and vaccine stock levels (from 72 percent to 91 percent). A 23 percentage increase was noted in the number of HCWs who took action based on these data. Improvements were also seen at the district level: the percentage of district health information officers who could identify facilities with low DPT3 coverage in their district increased from 60 percent to 80 percent, and those who took action on the low coverage data increased from 20 percent to 60 percent.

❖ Higher levels of the health system have consistently emphasized and encouraged a culture of data use and high-quality reporting; these expectations have been clear among facility staff. This was sustained and further strengthened at the time of midline, with increases in the percentage of facility in-charges who reported that the higher levels emphasized data quality (89 percent to 97 percent), promoted data use (85 percent to 90 percent), and communicated expectations of data quality and use (81 percent to 91 percent).

❖ Results showed an increase in the number of, and attendance rates for, data review meetings held in the district. Nearly all HCWs who were interviewed at midline (99 percent) were aware of these meetings, up from 80 percent at baseline.

❖ At baseline, 62 percent of facility in-charges reported communicating with peer facilities; this did not change substantially at midline (57 percent). However, among those in-charges who were communicating with peers, at midline, there was an increase in the number who reported improvements in their knowledge, skills, and motivation as a result of their peer interactions.

Summary of recommendations

❖ Higher-level (district, provincial, and national) staff should continue communicating expectations and encouraging high-quality data and a culture of data use at all times.

❖ Higher-level staff should continue facilitating and encouraging health facility staff to attend meetings where data quality and data use issues are discussed.

❖ Higher-level staff should encourage the discussion and sharing of experiences on immunization challenges and successes over existing peer networks, such as WhatsApp groups. They also should consider employing a district mentor to lead and guide focused discussions.

❖ Higher-level staff should encourage the consistent use of ZEIR to reduce challenges related to missing or inaccurate source documents or reports.

❖ As district-level ZEIR dashboards are introduced, it will be important to monitor their rollout, get feedback from district staff, and understand the district staff's perception of the data quality, as this can determine whether they will use the data for decision-making.

❖ The MOH and the BID Initiative team should develop a comprehensive plan to sustain the use of ZEIR among health workers at all levels. This could include ensuring districts incorporate sustainability measures into their annual work plans. This will support sustained use of the system and facilitate the transition to paperless.

BID Initiative background

The context and challenges

Routine immunizations and new vaccine introductions have proven to be among 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.

The universal immunization of children against vaccine-preventable diseases is crucial to reducing infant and child mortality. Data on differences in immunization coverage among subgroups of the population are useful for program planning and targeting resources to areas most in need. Additionally, information on immunization coverage is important in monitoring and evaluating the Expanded Programme on Immunization.

The Zambian Ministry of Health (MOH) has partnered with the BID Initiative to address the following data-related challenges to immunization service delivery, which they have jointly identified:

- ❖ Incomplete or untimely data.
- ❖ Multiple vertical data collection systems.
- ❖ Complex data collection forms and tools.
- ❖ Insufficient supply chains and logistics management.
- ❖ Inadequate capacity for data management and use throughout all levels of the health system.
- ❖ Inaccurate or uncertain denominators for calculating immunization rates.
- ❖ Difficulty in identifying children who do not start immunization or who drop out (defaulter tracing).
- ❖ Lack of unique identifiers for infants.
- ❖ Poor data visibility at the facility level.

The BID Initiative in Zambia is led by the MOH, in partnership with PATH. It is funded by the Bill & Melinda 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 Zambia, the BID Initiative has introduced this suite of solutions in all health facilities in Southern Province and there are plans to scale implementation of these solutions nationwide.

The solutions: data quality and data use interventions

In order to address immunization data quality and data use challenges, the BID Initiative, together with the MOH, developed the standards-based Zambia Electronic Immunization Register (ZEIR) to track children and their vaccination records. The system uses quick response (QR) codes as unique identification for immunized children. This simplifies how health care workers (HCWs) track children who are due for vaccines and allows HCWs to track children receiving vaccines at different facilities. ZEIR also improves data visibility across all levels of the health system to prevent stockouts, reduce wastage, and allow for proper planning and distribution of vaccines, commodities, and services.

ZEIR was deployed along with data use interventions in the form of messenger platforms, such as WhatsApp, which foster peer learning and networking among HCWs. This encourages HCWs to share their experiences, challenges, and approaches to addressing different implementation issues. Data use campaigns, on-site mentorship, and targeted supportive supervision were also designed, tested, and implemented alongside ZEIR trainings. Together, these interventions foster sustainable, positive system changes in the way immunization services are planned, executed, supervised, and reported.

Overview of the midline evaluation report

This report contains an overview of the BID Initiative, a summary of the midline evaluation purpose and methodology, key findings on data quality and data use changes at midline, the evaluation conclusions, lessons learned, and recommendations. Appendix 1 includes additional evaluation findings to supplement those in the main body of the report. Appendix 2 provides additional details about the evaluation design, methodology, and limitations.

Purpose of the midline evaluation

This report presents findings from a midline evaluation of the contribution of the BID Initiative to changes in data quality and data use. The midline evaluation is based on data collected at baseline and midline of BID implementation in sampled health facilities from the first six implementation districts in Southern Province—Choma, Kazungula, Kalomo, Livingstone, Mazabuka, and Zimba.

Prior to the implementation of data quality and data use intervention in Zambia, baseline data were collected to assess the pre-intervention levels of data quality and data use for informed decision-making. These data provided a baseline against which data quality and data use outcomes could be measured. Midline data collection was conducted four months after introduction of the BID interventions; the aim of the evaluation was to evaluate the short-term changes in immunization data quality and data use after interventions were rolled out.

The midline 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 staff, district health officers, and provincial health officers.

❖ 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 findings will be used by MOH staff, BID staff, and other interested stakeholders to measure the extent to which these interventions are improving immunization data quality and use, better target future interventions, and adapt the implementation of interventions as necessary to other districts 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 generate evidence on how the data quality and data use interventions that are advanced by the BID Initiative and the government of Zambia address issues in immunization service delivery. The findings will also be shared with the Southern Province Health Office, districts, and facilities where the data were collected.

Methodology

The evaluation is based on a pretest and posttest design to compare the state of data quality and use in the first implementation districts 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. The key metrics included the availability, completeness, and accuracy of the data. At midline, data quality was measured through data extracted from ZEIR.

The evaluation measured data use and perceptions of data quality through surveys of HCWs at baseline and midline. The BID team surveyed HCWs at both the facility and district levels who directly use immunization data. One individual, either the facility in-charge or maternal and child health (MCH) nurse who oversees immunization service delivery, was interviewed in each sampled facility. At the district level, the staff who were interviewed included the district health information officer; the district medical officer, or district nursing officer, or maternal and child health coordinator; and the cold chain officer or pharmacist.

This report presents data based on a sample of 89 facilities across the first six implementation districts where data were collected at baseline and midline. The six districts were Livingstone, Kazungula, Mazabuka, Zimba, Kalomo, and Choma. Facilities were categorized into four strata: 1) urban high-volume, 2) urban low-volume, 3) rural high-volume, and 4) rural low-volume facilities; these categories were based on the country's classification of urban versus rural facilities and the volume of children immunized per month. Results are presented in aggregate or by stratum. Results are not intended to be representative of the entire Southern Province. Refer to Appendix 2 for additional details about the methodology, sample size, and limitations.

![BID INITIATIVE logo - Better data. Better decisions. Better health.]

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.

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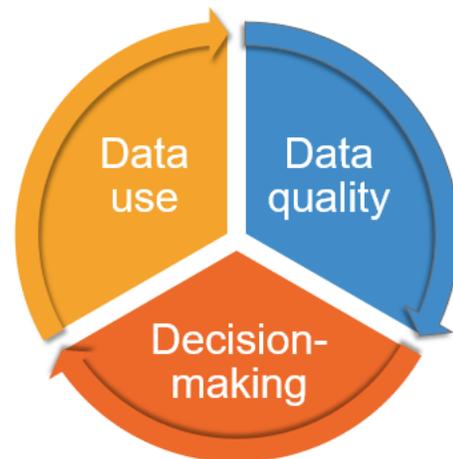
Figure 1. Cycle of data use, data quality, and decision-making.

Status of implementation at midline

Implementation of the new data quality and data use interventions began in Southern Province. Data use interventions were first rolled out in Livingstone and Kazungula districts for a period of three months before ZEIR was introduced. The team rolled out data use interventions between August 2016 and January 2017 for these two districts alone as they awaited the development of ZEIR; hence, the rollout dates in Livingstone and Kazungula were different from those in the other districts (Table 6 in Appendix 2). Following the introduction of interventions in Livingstone and Kazungula, implementation of the full suite of interventions (including ZEIR) occurred in Mazabuka, Zimba, Kalomo, and Choma, in that order.

ZEIR was tested in select facilities (which were excluded from baseline and midline data collection). The first major release of ZEIR was its introduction in facilities in July 2017. ZEIR was only introduced in the facilities once it met the basic requirements for data entry; but even after the initial introduction, there were development iterations that required updates at facilities later on. Most of the ZEIR modules were added later on as implementation continued in the districts. One of the most important components of ZEIR, the stock module, was added in August 2017.

At the time of midline data collection, ZEIR was still missing some of the planned functionality, such as interoperability with the DHIS 2 (District Health Information System/Software 2). This missing functionality meant that, at the time of midline data collection, the reporting process was not yet automated; as a result, ZEIR was not ensuring that reports were submitted to the district in a timely manner. This also meant that districts lacked visibility into the data captured in ZEIR, since the dashboards were not yet accessible. These requirements are still in development and will be included in the final version of ZEIR.

Given the delay in the start of, and the time required for, ZEIR system design, development, testing, and introduction, the implementation timeline was compressed. As a result, there was more emphasis on the use of ZEIR and data use within a facility compared to peer learning, such as sharing experiences with data in ZEIR across facilities. This also affected the sample selection for the evaluation, which was designed to include facilities sampled from all districts in Southern Province; given the shortened timeline, it was only possible to collect baseline and midline data in the first six implementation districts.

For now, HCWs are running parallel systems—both the legacy paper system and electronic system using ZEIR. This parallel process will be the case until the Zambian MOH gives a go-ahead for facilities to stop using the paper system completely. The midline results presented below are based on the use of ZEIR in its current stage of development and other BID data use interventions as explained earlier.

Midline evaluation findings

This section presents the key findings, starting with characterizing the data quality challenges at baseline and explaining how the introduction of ZEIR and the current state at midline are addressing those data quality challenges. This is followed by midline results on changing perceptions of data quality and use of data to inform action. Finally, this section ends with midline results on the supporting culture necessary to sustain data quality and use.

Data quality

At baseline, health facilities relied on routine immunization data captured on paper-based source documents (tally sheets, stock ledgers, and monthly health information aggregation Form 2 [HIA2] reports). The evaluation measured the quality of these baseline data in terms of the availability, completeness, and accuracy of the data. Data from source documents were collected for the three months prior to the implementation of interventions. See Appendix 2 for more details on the evaluation methodology and data sources. We present these baseline data quality findings and discuss how the introduction of data quality and data use interventions, especially ZEIR, has addressed the major data quality challenges at midline.

Data availability

At baseline, limited availability of paper-based source documents, including the HIA2 reports, stock ledgers, and tally sheets, was a challenge at the facility level. The HIA2 monthly report is the main source of immunization data in the traditional paper-based reporting system; it is used to report from the facility to the district level and on up through higher levels of the health system. Tally sheets are used to record the number of children vaccinated; then, data from the tally sheets are aggregated and used to complete the HIA2 report. Stock ledgers record the vaccines received and used at the facility level, as well as any vaccine wastage. At baseline, these forms were the main sources of data to inform service delivery planning so the evaluation assessed the availability of these forms for the previous three months.[a]

The HIA2 forms were most likely to be available at health facilities for the three-month period prior to the implementation of interventions, followed by tally sheets, and then stock ledgers (Figure 2). This pattern is similar across districts (see district-level results in Appendix 1). The urban high-volume facilities had the highest percentage of source documents available, followed by urban low-volume facilities. This may be because the urban facilities are closer to the district health office, so they are less likely to run out of paper source documents for record keeping.

There are separate stock ledgers for each vaccine; Figure 2 shows the availability of diphtheria-pertussis-tetanus (DPT) vaccine stock ledgers. The majority of stock ledgers were unavailable at health facilities, particularly at the rural facilities. The low stock ledger availability was mostly attributed to the fact that information from the stock ledger did not directly feed into the HIA2 report. Hence, HCWs had a tendency to not pay much attention to it. This poses a challenge to stock management and accountability, since it implies that stock information is not recorded consistently. Without all source documents on hand, facilities

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[a] Under-5 child registers are another paper-based source document used at facility level to capture the full details of each child receiving immunization services; however, the baseline evaluation did not capture data from the registers since tally sheets were supposed to be the main source document to capture the absolute number of children seen.

do not have access to their data from the most recent months to know their coverages and performance, which makes data use difficult.

At midline, HCWs had access to ZEIR in which they can pull up the electronic data on any child whose information was entered into the system. Thus, as long as each child's information was entered into ZEIR as he or she was seen at the facility, there were no instances of missing source data. Once HCWs can move away from parallel reporting systems and solely rely on ZEIR, they will no longer have to fill out paper-based source documents and worry about storing or archiving those documents. Instead, they will enter data electronically for each child as they are seen, and those data can be accessed at any time within the system.

Above the health facility level, ZEIR is designed to directly transmit data to DHIS. This would enable the MOH to access data from ZEIR directly through DHIS 2, as well as through an open-source data visualization platform called Superset. Currently, ZEIR data are transmitted to a separate instance of DHIS 2, but there are plans to directly transmit data from the ZEIR to the national DHIS2; this would strengthen the capacity of DHIS 2 to provide more accurate and complete data in real time compared to transferring data from facilities on paper and then entering the data into DHIS2 at district level.

Figure 2. Overall availability of source documents (HIA2, tally sheets, and stock ledgers), by stratum, at baseline.

	Tally sheets		Stock ledgers		HIA2 forms	
	Available	Unavailable	Available	Unavailable	Available	Unavailable
Urban high-volume	80%	20%	42%	58%	80%	20%
Urban low-volume	72%	28%	30%	70%	76%	24%
Rural high-volume	59%	41%	10%	90%	69%	31%
Rural low-volume	62%	38%	7%	93%	70%	30%
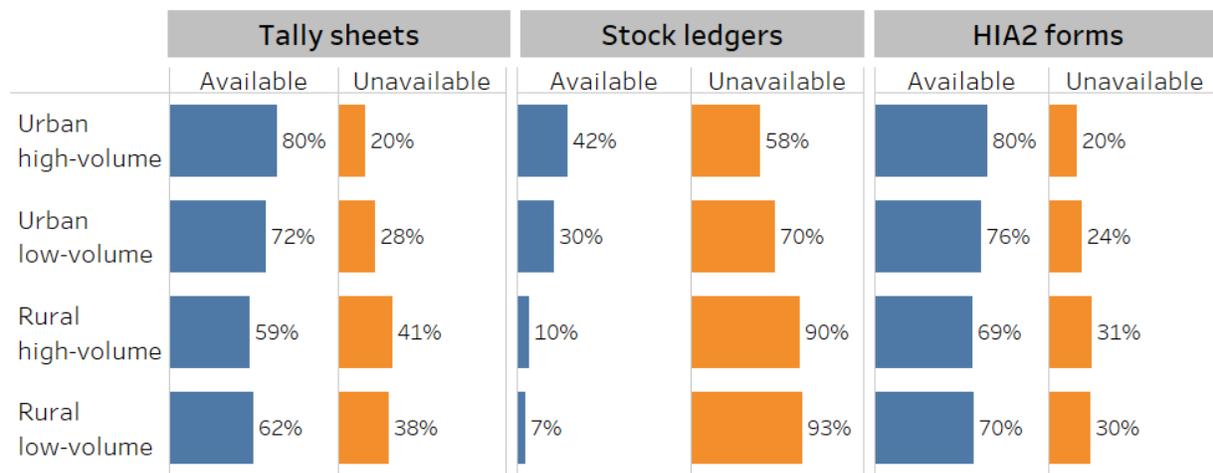
Abbreviations: HIA2, health information aggregation Form 2.

Data reporting accuracy

At baseline, there were challenges with the internal accuracy in the different source documents, measured by comparing the number of children vaccinated according to the tally sheets with the aggregate number of children vaccinated as reported in the HIA2. HCWs are expected to fill out tally sheets and child registers for each child vaccinated and must update stock ledgers with changes in vaccine stock. The tally sheets then are used to aggregate the data and complete the HIA2 monthly report at the end of the month.

For each facility that had a tally sheet and HIA2 report available for the same month, we compared the total number of tallies with the total number of children vaccinated according to the HIA2 report. Huge discrepancies between tally sheet and HIA2 values were noted across facilities for all vaccines administered. Figure 3 shows the results for the third dose of diphtheria-pertussis-tetanus (DPT3) vaccination for children less than one year of age. The highest absolute discrepancies were seen in rural high-volume facilities, where 1,969 children were reported to have received DPT3 according to the HIA2

forms, but only 630 DPT3 tallies were recorded. There were also large discrepancies in urban high-volume and rural low-volume facilities. Urban low-volume facilities had the smallest absolute difference but also the smallest number of children vaccinated to compare between HIA2 forms and tally sheets.

Considering the number of children who appear on the tally sheets as a fraction of those who are recorded on the HIA2 forms, the urban health facilities performed better than the rural health facilities. In urban high-volume facilities 53 percent of children recorded on the HIA2 form were tallied for DPT3 vaccination (368/698), compared to 57 percent in urban low-volume (134/236), 32 percent in rural high-volume (630/1969), and 27 percent in rural low-volume facilities (173/641). This pattern was similar across other vaccine doses (see Appendix 1).

Figure 3. Number of recorded DPT3 doses administered in the HIA2 versus tally sheets, by stratum, at baseline.
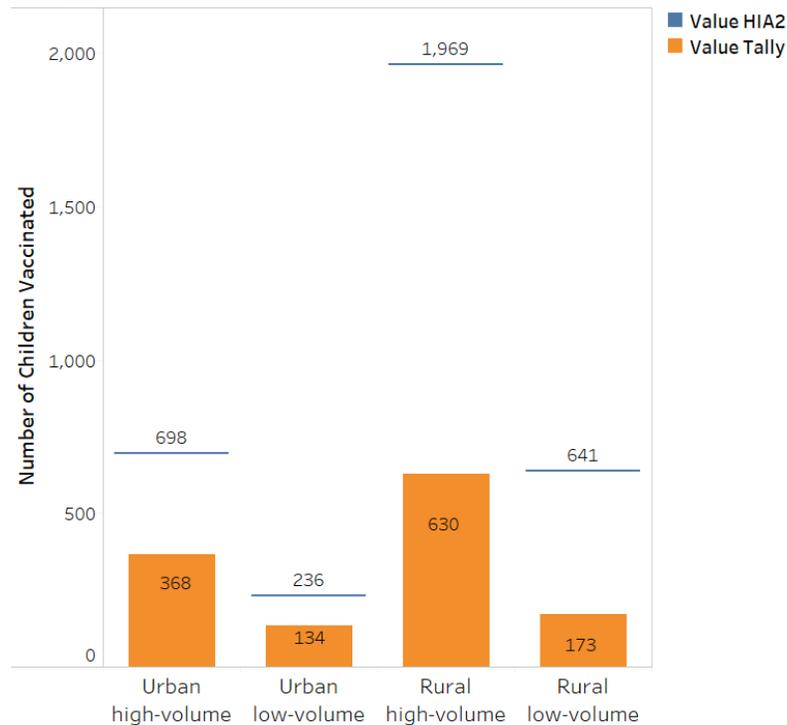
Abbreviations: DPT3, third dose of diphtheria-pertussis-tetanus vaccine; HIA2, health information aggregation Form 2.

These discrepancies imply that facilities are not keeping accurate records; either the tally sheets are not capturing each vaccine administered or the numbers entered into the HIA2 report are over-reported. Facilities have often reported having stockouts of tally sheets; but even when the forms were available, there was poor data accuracy between tally and HIA2 figures. It is possible that some pages of the tally sheets were missing for the baseline comparison (for example, the outreach tally sheets may have been stored separately) or the facilities ran out of tally sheets and used other papers that were misplaced.

At midline, there were still remaining challenges with accuracy, given that HCWs were using parallel systems. When facilities fully transition to using ZEIR, HCWs will no longer have to fill out paper-based source documents and aggregate them into a report at the end of the month. Instead, they will enter data electronically for each child as they are seen, and those data will automatically be aggregated within the

system. Thus, as long as each child is entered into ZEIR, there will be no discrepancies between the facility records and the aggregate numbers at district level and above.

Data reporting completeness

Since the HIA2 monthly report is the main source of immunization information for the district level and above, an incomplete report can compromise the quality of the data and limit its use for decision-making. At baseline, the completeness of the HIA2 monthly reports was assessed by comparing the number of filled data fields against the number of required fields in each report available at the facility over the past three months. The completeness calculation specifically focused on the immunization fields (section 1.3) in the HIA2 report and could only be calculated for those reports that were available at the sampled facilities at baseline.

Figure 4. Completeness of HIA2 immunization fields, by district, at baseline.

Abbreviations: HIA2, health information aggregation Form 2.
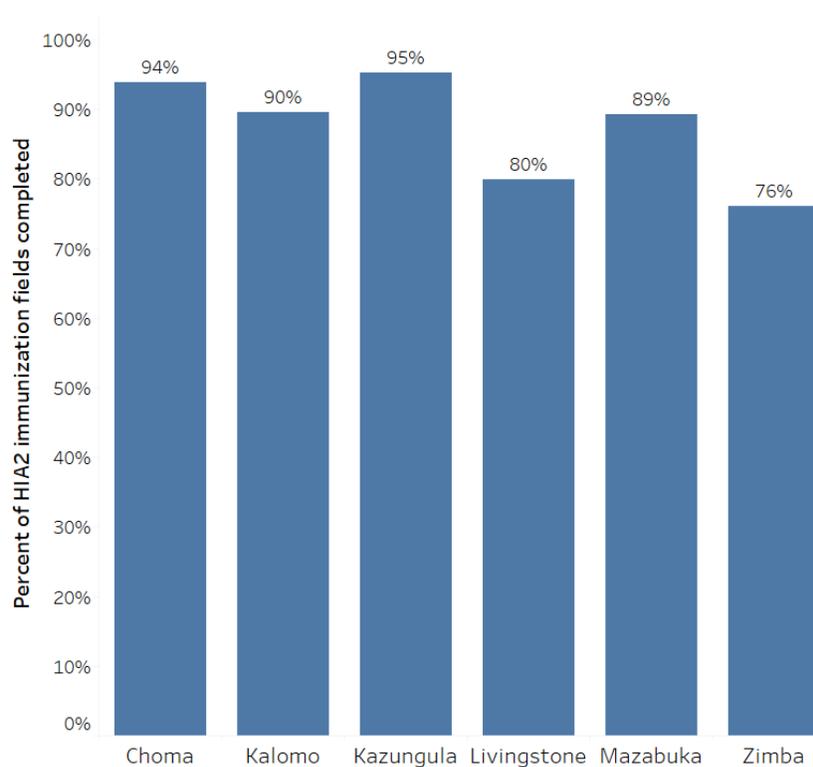
Among the HIA2 reports available at the sampled health facilities at baseline, the average completeness of immunization fields ranged from 76 percent in Zimba district to 95 percent in Kazungula district (Figure 4). Across all available HIA2 forms in the six districts, an average of 88 percent of the immunization fields were completed. Thus, even when HIA2 reports were available at health facilities, there were still issues of missing data in the aggregate reports in all districts.

When viewed by the sampling strata (Figure 5), it is clear that low-volume facilities have slightly lower completion rates compared to high-volume facilities. This may be because low-volume facilities are more likely to vaccinate zero children for a vaccine dose in a given month; instead of entering zero on the HIA2 form, they may leave that field blank, which would count as incomplete. Low-volume facilities may also wait to open vaccine vials until they have multiple children present to receive that vaccine in order to limit open vial vaccine wastage. This could also result in some vaccines not being given every month.

Figure 5. Completeness of HIA2 immunization fields, by stratum.

Abbreviations: HIA2, health information aggregation Form 2.
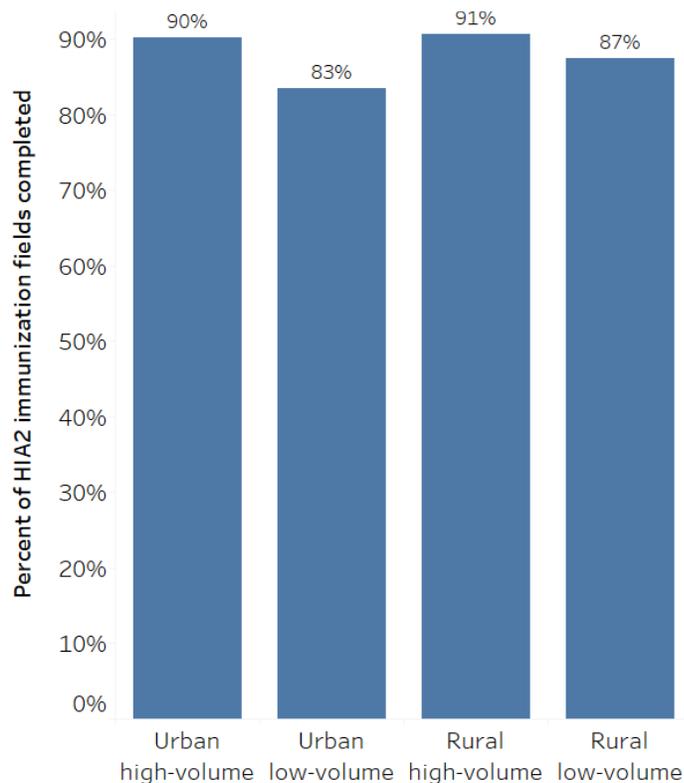
At midline, ZEIR was introduced in facilities. ZEIR has built-in data quality checks that do not allow HCWs to skip required fields or enter data that are not valid based on the system's predetermined rules. For example, date of birth is a required field for a child's immunization schedule and a child cannot be registered in ZEIR without a valid date of birth being entered. ZEIR also has validation rules; for example, the date a vaccine dose is administered cannot be prior to the child's date of birth. ZEIR's required fields and validation rules ensure the completion of all individual fields as HCWs enter data. Thus, the essential data needed for tracking performance and planning service delivery are filled. In addition, the introduction of interventions, such as the data use guides, are meant to encourage facility staff to conduct internal quality audits and to encourage HCWs to take an interest in visualizing and using the existing data within their health facilities, which should then result in improved data quality.

Facilities submitting HIA2 reports

Late or missing reports are among the key data quality issues that HCWs and district health information officers (DHIOs) in all districts face. Without timely and complete data, HCWs and district health personnel are limited in their decision-making. DHIOs receive HIA2 reports from each health facility in their district and enter those data into the DHIS 2. Reports are considered to be on time if they are received by the district before or by the seventh day of the following month and district-level data entry should occur by the 21st of the month. The DHIS 2 captures whether district-level data entry occurs on time, but districts may or may not have a register noting exactly when the facility reports were received. Here we present whether facility HIA2 reports were submitted to the district health office regardless of the timeliness based on DHIS 2 data.

Data quality findings presented to this point in the report were based on data sources available at the facility level for the 89 sampled facilities across six districts. This analysis, presented in Figure 6, uses district-level data from DHIS 2 and includes all 174 facilities in the same six districts. Results are presented by quarter for 2016 and 2017.

On average, across districts, 81 percent of facility HIA2 reports were submitted to the district in 2016; this increased only slightly to 83 percent in 2017 (Figure 6). Zimba district (66 percent) had the lowest reporting rate in 2017 and Kalomo district (89 percent) had the highest.

At midline, facility HCW were still required to submit paper-based HIA2 reports to the district. However, ZEIR is designed to address reporting challenges by simplifying data entry, automating reports, and making these reports available in real time. Some of this functionality, including the automated reports to the district and integration with the DHIS 2, was not in place as of the midline data collection (see p. 8 for implementation status at midline) so it could not be assessed. As facilities transition away from using paper-based reporting systems to using ZEIR, the logistic issues related to submitting paper reports will be eliminated. Facilities with reliable internet connections will have data available in real time. Even those with limited connectivity will sync their data once per month, which will be an improvement in report submission, assuming integration with the DHIS 2.

Figure 6. Percentage of facilities that submitted HIA2 reports, by district, 2016 to 2017.
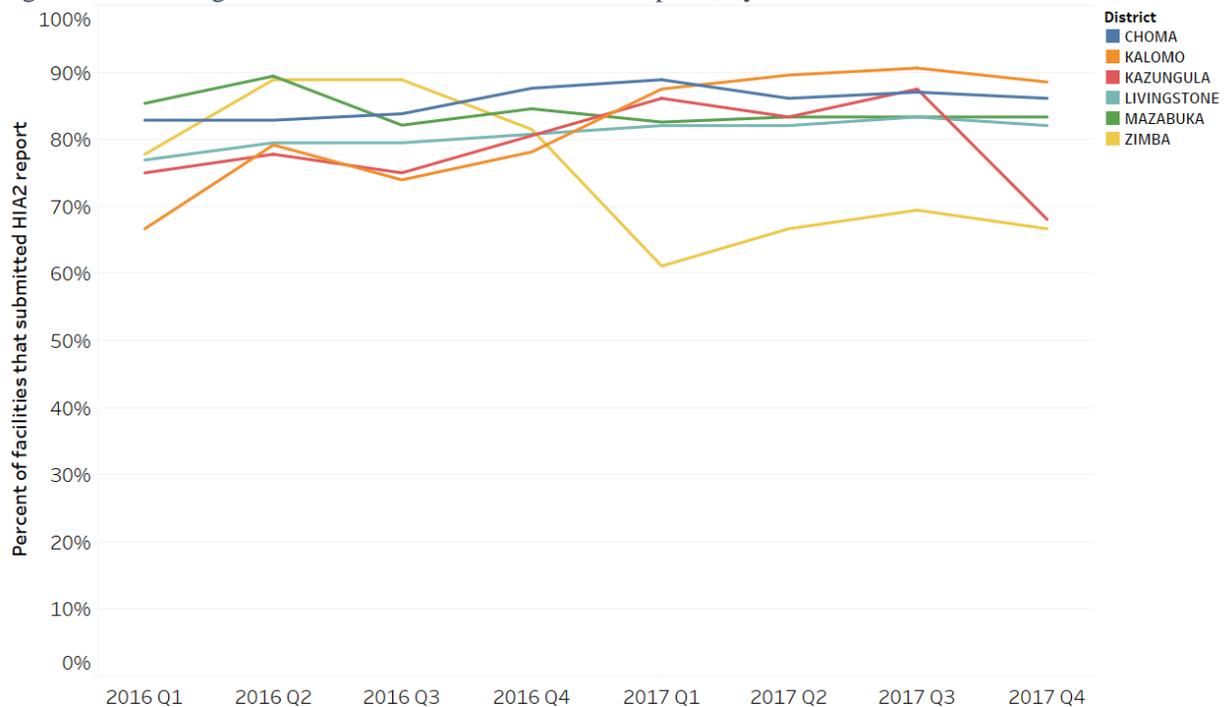
Abbreviations: HIA2, health information aggregation Form 2; Q, quarter.

ZEIR use and capacity

The introduction of ZEIR is designed to improve data quality and use. Each health facility has a tablet to enter data on each child who comes to receive vaccinations as well as monthly weighing as part of growth monitoring for children under five years of age. One of the key challenges identified by the Expanded Programme on Immunization was the lack of unique identifiers for children who received vaccination. Because of this, it was difficult for HCWs to identify duplicates, confirm the target population, or track children who received vaccines at different facilities, which in turn made it difficult to identify defaulters.

ZEIR links individual registration details (including the child's name, the mother's name, and the date of birth) with a QR code that is unique to each child. With these QR codes, HCWs cannot incorrectly vaccinate the same child twice for the same vaccine dose; HCWs can use this unique identifier to track children who receive vaccines at multiple facilities, as well as individual defaulters. ZEIR also has built-in validation checks that avoid duplicate entries or invalid data entries. ZEIR has been designed to automate reporting,

so that HCWs no longer have to do manual calculations and entry of records, which could potentially compromise the quality of the data.

As of March 2018, ZEIR is active in 291 health facilities in Southern Province. Based on user feedback, the design of ZEIR continues to be improved to include new features, such as integration with the DHIS 2 and district-level dashboards. Once all of the intended features are fully developed, and HCWs consistently use ZEIR, the quality of the data and levels of data use are expected to improve further. Additionally, HCWs' confidence in the data is expected to increase, together with their capacity to use data to make decisions.

More than 97 percent of the sampled facilities reported using ZEIR for over four months at the time of midline data collection (Figure 7). It is expected that the impact of the data use interventions and ZEIR will be realized even more over time as facility staff become more comfortable with ZEIR, transition to paperless reporting, are supported by a strengthened data use culture, and demand more 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 ZEIR, therefore, can only be an effective solution to address data quality and use if it is used consistently by HCWs across all levels.

Figure 7. Length of Zambia Electronic Immunization Register use at midline.
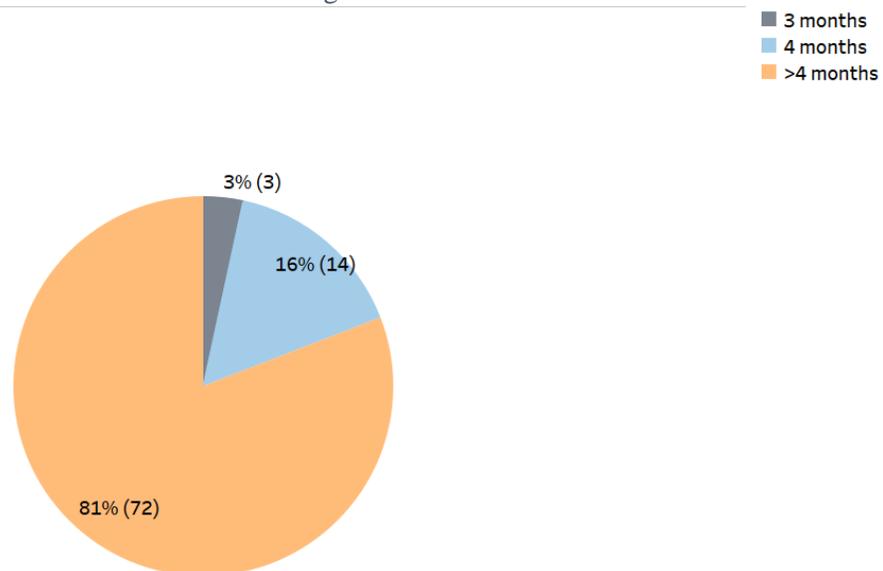
At midline, HCWs were asked to report on their capacity in using ZEIR. Over 94 percent reported their system use capacity to be "good" or "excellent"; 69 percent reported good or excellent data use capacity (using data generated from ZEIR); and 37 percent reported good or excellent system troubleshooting capacity (Figure 8). We expected that these capacities would be acquired in a staged manner: First, HCWs who used ZEIR would achieve greater system use capacity as they became comfortable using ZEIR and entering data into the system. As HCWs continue to become more comfortable with the basic skills to interact with the system, we expect they will increasingly use the data emerging from the system to inform decisions, which in turn will strengthen the quality of that data. As use of the system and feedback loops from the district mature over time, we expect to see an improvement in the capacity to use the system itself, as well as to use data generated from the system. Facility HCWs are not required to become excellent at system troubleshooting, as there are specific point persons at the district level who are supposed to play this

role. BID has also set up an external helpdesk where facility staff can access help in case they need system troubleshooting.

Figure 8. Facility health care worker capacity to use the Zambia Electronic Immunization Register at midline.
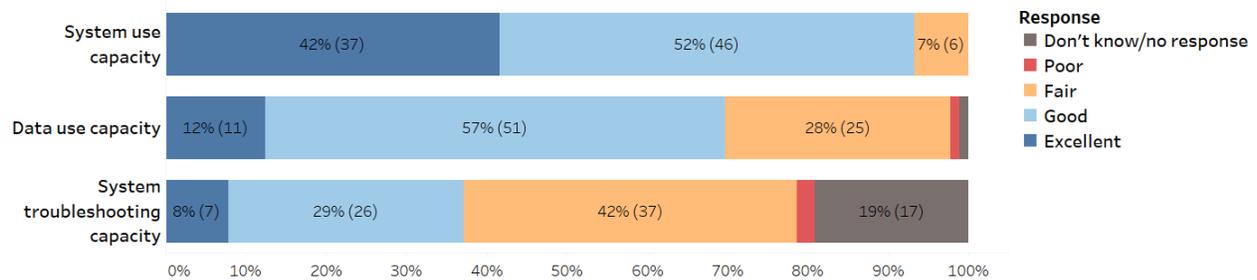
Data use to inform decisions

As HCWs have used ZEIR for data collection, the quality of data has improved. The survey of HCWs at baseline and midline showed that, as the new interventions were rolled out, some of the quality challenges that had been barriers to data use were breaking down and HCWs' perceptions of the quality of their data were improving. Notable improvements were seen in the percentage of HCWs who were able to use their data and took action based on these data. Again, the premise is that this is a reinforcing cycle: as the quality of data increases, HCWs will be more likely to use the data. As they use and see the value of the data, they will be more motivated to maintain high-quality data.

Barriers to data use

Prior to the introduction of the new interventions, there were many issues in the quality of Zambia's immunization data in DHIS 2, especially at the facility level, including accuracy issues, incomplete or missing data, and late reporting. HCWs who provide immunization services in clinics were overwhelmed with a lot of paperwork and paper reporting systems, coupled with staff shortages. They often had difficulties in interpreting data properly due to the lack of user-friendly tools and paper systems. Additionally, since feedback mechanisms were not well incorporated into existing systems, HCWs did not often realize the benefits to their work of having timely, accurate, and complete data.

At baseline (Figure 9), the most common barriers to using data in the previous quarter at the facility level included poor data accuracy (named by 56 percent of facility staff), missing data (53 percent), late or no data (38 percent), and data that were confusing or not well presented (36 percent). Other barriers to data use were cited by 16 percent of facility HCWs, such as shortages of child health cards and tally sheets, which made it difficult to compile reports at the end of the day.

Figure 9. Barriers to using data among facility health care workers at baseline versus midline.

Barrier	Period	% of "Yes" responses
Poor accuracy	Baseline	56% (50)
	Midline	21% (19)
Missing data	Baseline	53% (47)
	Midline	35% (31)
Late or No data	Baseline	38% (34)
	Midline	15% (13)
Confusing/Not well-presented data	Baseline	36% (32)
	Midline	18% (16)
Other barriers	Baseline	16% (14)
	Midline	2% (2)
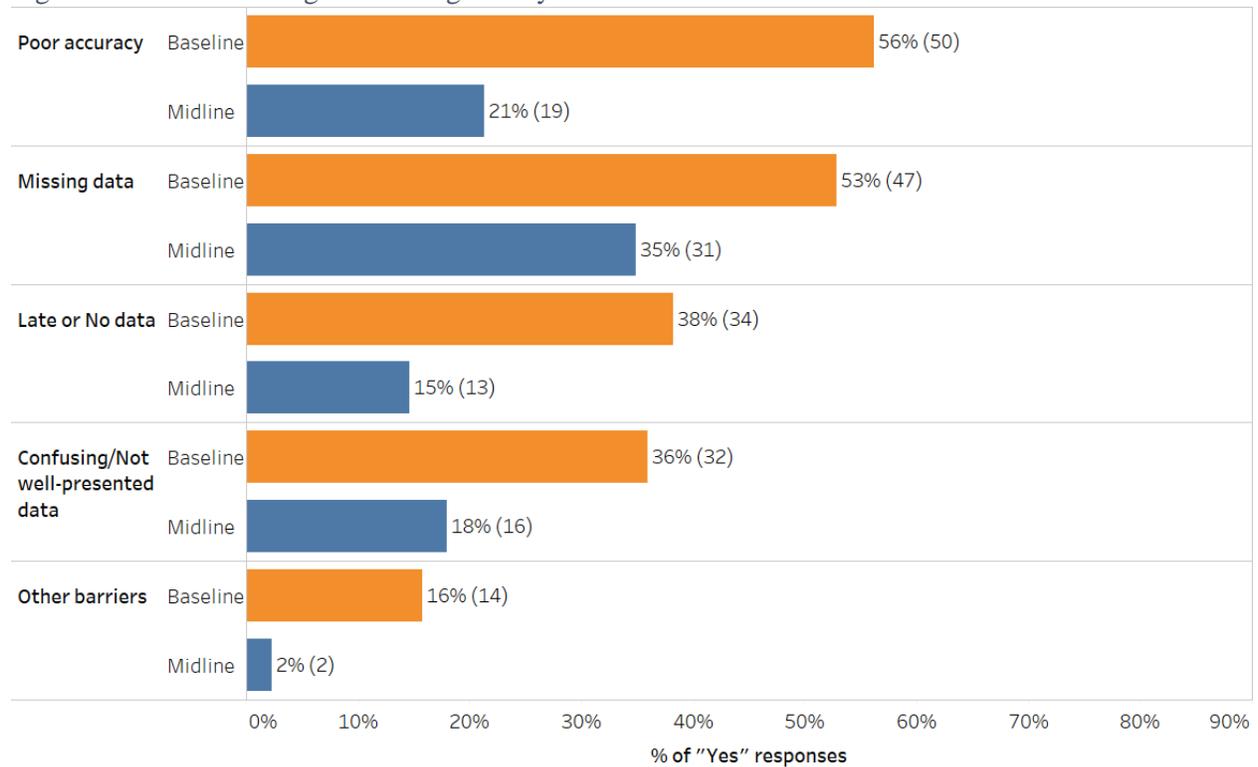
Barriers to data use were even more common at the district level: 75 percent of district staff (DHIOs, maternal and child health coordinators, cold chain officers) who were interviewed had faced barriers to data use due to poor data accuracy or data that were confusing or not well presented; 83 percent encountered late or no data; 50 percent encountered missing data; and 33 percent encountered other barriers, such as the use of incorrect denominators and missing outreach data (Figure 10).

However, at midline, after introduction of the data quality and data use interventions, there were decreases in nearly all barriers at facility and district levels. At facility level, the greatest improvement was a reduction in the percentage of HCWs who faced poor accuracy as a barrier. In addition, the percentage of HCWs held back by missing data, late or no data, or confusing/not well-presented data all declined (Figure 9). The reduction in barriers was less pronounced at the district level, although there were also reductions in the percentage of district staff who encountered poor accuracy, late or no data, or data that were confusing/not well presented (Figure 10).

Although most facility barriers substantially declined at midline, more than one in three in-charges still reported missing data as a barrier to data use. Instances of missing data were experienced at midline possibly due to the fact that data entry into ZEIR was not consistent in some of the facilities; this could have been a result of using the parallel systems of paper and electronic reporting. Additionally, at some point during one of the ZEIR system upgrades, some facilities experienced loss of patient data in ZEIR and some facilities had syncing issues. These, however, were software glitches, which were later rectified by the developers. Now, as long as data are synced with ZEIR, they can always be retrieved or restored by an authorized user.

Figure 10. Barriers to using data among district staff at baseline versus midline.

Poor accuracy
- Baseline: 75% (9)
- Midline: 58% (7)

Missing data
- Baseline: 50% (6)
- Midline: 50% (6)

Late or No data
- Baseline: 83% (10)
- Midline: 67% (8)

Confusing/Not well-presented data
- Baseline: 75% (9)
- Midline: 58% (7)

Other barriers
- Baseline: 33% (4)
- Midline: 25% (3)

% of "Yes" responses
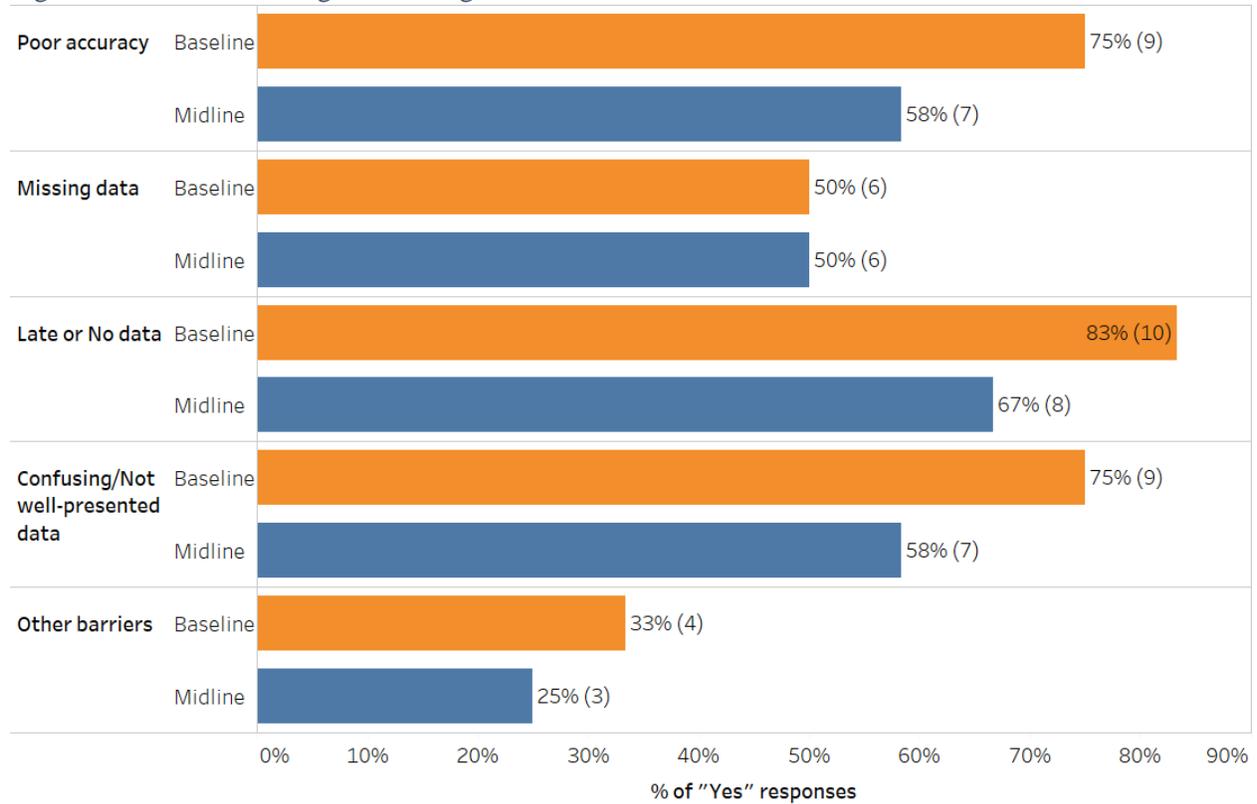
Perceptions of data quality

At the same time that the data quality barriers that inhibit data use are breaking down, perceptions of data quality are improving. The evaluation assessed how facility in-charges and district staff perceived the quality of the immunization data they were using, since this likely impacted how and if they used the data to inform their decisions and actions. HCWs were asked how they felt about the accuracy, timeliness, and completeness of their immunization data, as well as their overall confidence levels in the data at baseline and midline.

At midline, we saw increases in facility HCWs reporting "good" or "excellent" scores across all aspects of data quality (Figure 11). The percentage of HCWs who reported that their immunization data accuracy was "excellent" more than tripled from 11 percent at baseline to 35 percent at midline. There were also increases in perceived data completeness, timeliness, and overall confidence in the data.

Figure 11. Perceptions of immunization data quality among facility health care workers at baseline versus midline.
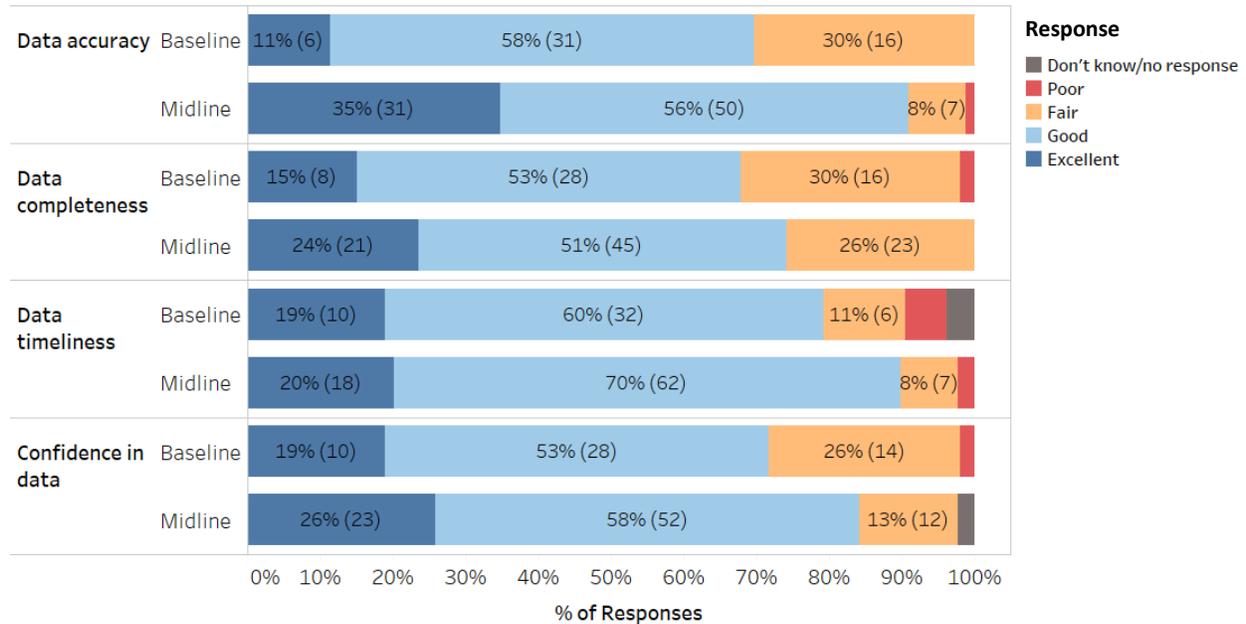
At the district level at midline, eight of twelve district staff reported that they did not use data from ZEIR (Figure 12; see p. 8 which explains that district-level ZEIR dashboards had not yet been introduced at midline). However, among the limited number of district staff who reported that they used data from ZEIR, all thought the data completeness and timeliness were "good" or "excellent"; they also rated their overall confidence in the data as "good" or "excellent." One district staff member perceived the accuracy of ZEIR data to be "fair," and the remaining three rated the data accuracy as "good." As district-level ZEIR dashboards are introduced, it will be important to understand the district staff's perception of the data quality, as this can determine whether they will use the data for decision-making.

Figure 12. Data quality perceptions among district staff at midline.
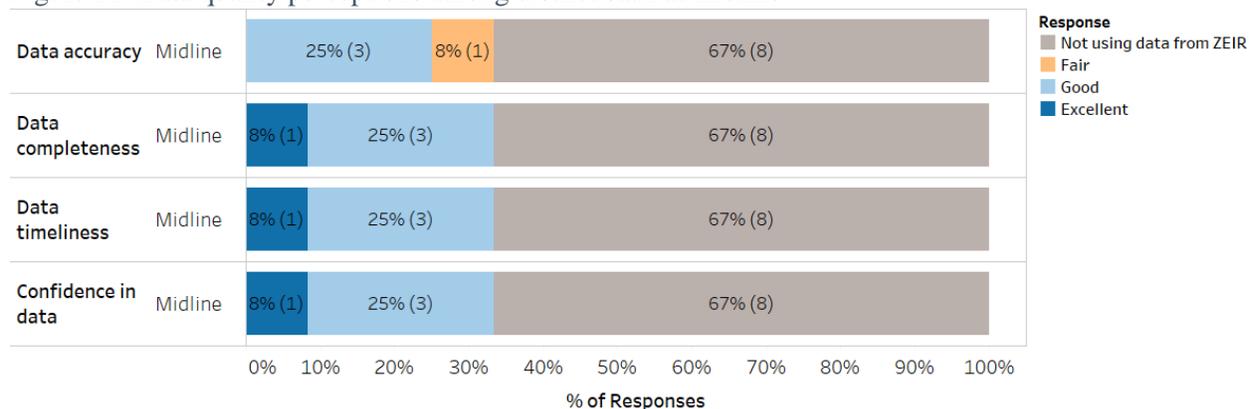
Abbreviations: ZEIR, Zambia Electronic Immunization Register.

The BID Initiative hypothesizes that improved data use will influence data quality, and vice versa. As HCWs at all levels of the health system start to use data more frequently for decision-making, they will

19

begin to recognize the importance of improving the quality of the data they must use. As data quality improves and health workers have increased confidence in these data, they are more likely to value the data and to use them to make decisions, thus creating a virtuous cycle of improvement.

Data visibility and use

To measure the current levels of data visibility and data use, we designed survey questions about three real-world scenarios in which we expect HCWs to use data. These include:

- ❖ Identifying defaulters[b] within their catchment area.
- ❖ Identifying areas within their catchment area with low DPT3 coverage.
- ❖ Identifying current stock levels in their facilities.

The survey asked HCWs if they could use their data to identify defaulters, stock levels, and low DPT3 coverage areas over the previous three months.[c] Among those who said yes, they were asked whether they had taken action based on those data in the previous three months and, if so, what type of action. 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.

At baseline, 59 percent of facility in-charges could identify the areas with the lowest DPT3 coverage, 67 percent could identify defaulters[d], and 72 percent could identify current vaccine stock levels (Figure 13). The baseline results showed the great efforts facilities were already making, despite data quality issues, to identify facility-level data and to take further action based on that information. The ability to identify the data increased after the introduction of data quality and data use interventions to the point where, at midline, approximately nine out of ten in-charges could identify the data for each scenario: coverage, defaulters, and stock. Moreover, there were increases from baseline to midline in the percentage of facility in-charges who took action based on those data for DPT3 coverage (47 percent to 83 percent), defaulters (54 percent to 78 percent), and stock (54 percent to 64 percent) (Figure 13).

Improvements were also seen at the district level among the small number of DHIOs (N=5) from whom we collected both baseline and midline data. At baseline, 60 percent (n=3) of DHIOs could identify low DPT3 coverage facilities in their district. This increased to 80 percent (n=4) at midline. Those who had taken action based on these DPT3 coverage data also increased from 20 percent (n=1) at baseline to 60 percent (n=3) at midline.

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[b] 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 stockouts.

[c] At baseline, when surveys were conducted in person, the health care workers were asked to actually show the data they used as a confirmation of their response. At midline, when surveys were conducted over the phone, this verification was not possible.

[d] Note that identification of defaulters refers to tracing children already registered in the system, as ZEIR can only support identification of defaulters among the registered children (and not the entire catchment population).

Figure 13. Ability to identify low DPT3 coverage areas, defaulters, and vaccine stock levels among facility health care workers at baseline versus midline.

	Coverage		Defaulter		Stock	
	Baseline	Midline	Baseline	Midline	Baseline	Midline

Legend:
- Don't know / no response
- Not able to identify
- Could identify but no action
- Could identify and took action

Coverage — Baseline: 2% (2), 38% (34), 12% (11), 47% (42)
Coverage — Midline: 12% (11), 4% (4), 83% (74)
Defaulter — Baseline: 3% (3), 29% (26), 13% (12), 54% (48)
Defaulter — Midline: 7% (6), 16% (14), 78% (69)
Stock — Baseline: 2% (2), 26% (23), 18% (16), 54% (48)
Stock — Midline: 9% (8), 27% (24), 64% (57)
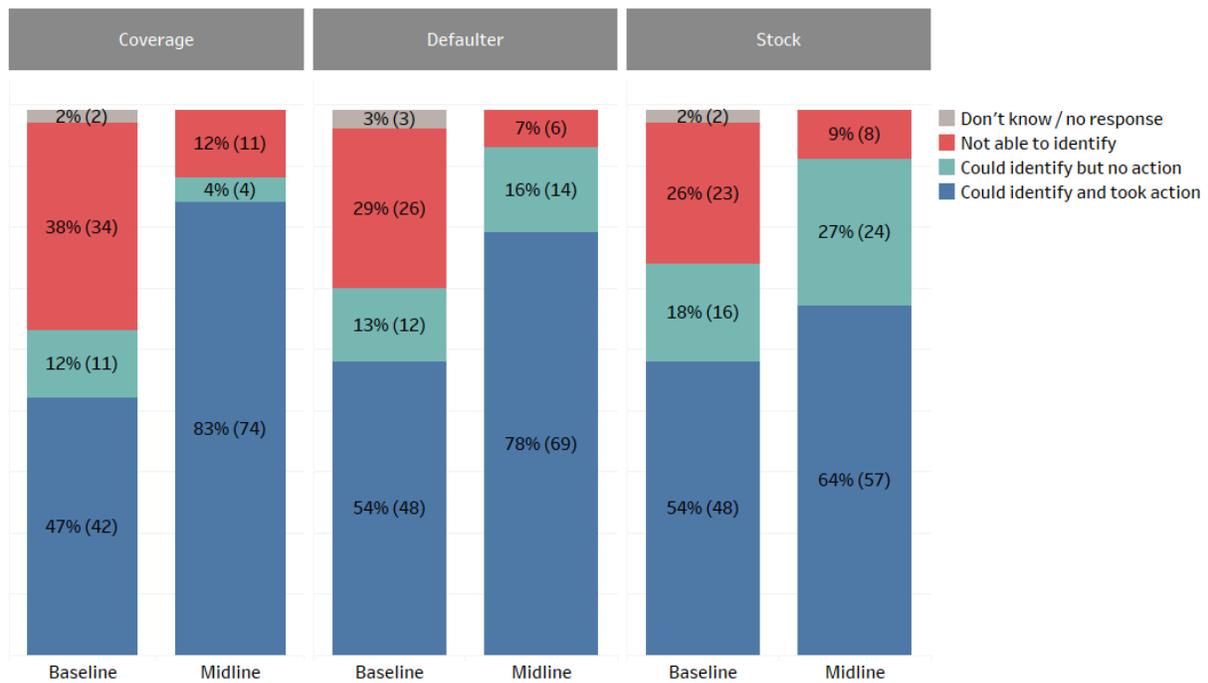
Abbreviations: DPT3, third dose of diphtheria-pertussis-tetanus vaccine.

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 midline, the types of actions that were most commonly taken did not change; in other words, the most common actions at baseline were still the most common actions at midline. However, the percentage of facility HCWs who reported taking each coverage or defaulter action increased. (The percentage of facility HCWs who reported taking each stock action decreased slightly at midline because some respondents who reported taking action on their stock data at midline did not complete the survey question indicating which action(s) they took.)

The most common actions based on DPT3 coverage data were talking to mothers who came to the clinic to enlist them to help sensitize other mothers who did not come, visiting low coverage areas for sensitization, and targeting outreach services to low-coverage areas (Table 1). The most common actions based on defaulter data were using community workers for tracing, conducting outreach sessions, improving record keeping, and liaising with community leaders (Table 2). The most common actions based on stock data were requesting a change in stock from the district or another facility (Table 3).

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.

	Baseline	Midline
Talked to mothers who showed up to clinics so they could sensitize other mothers who didn't show up	46% (41)	82% (73)
Visited lowest coverage areas	46% (41)	75% (67)
Targeted outreach to lowest coverage areas	43% (38)	71% (63)
Checked data for lowest coverage areas	37% (33)	70% (62)
Reached out to community leaders in lowest coverage areas	30% (27)	56% (50)
Adjusted facility DPT stock levels	26% (23)	19% (17)
Revisited immunization targets	20% (18)	18% (16)
Other	18% (16)	13% (12)
Used political leaders to sensitize community on importance of immunization	9% (8)	13% (5)

Abbreviations: DPT, diphtheria-pertussis-tetanus vaccine; DPT3, third dose of diphtheria-pertussis-tetanus vaccine.

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.

	Baseline	Midline
Use community workers for tracing	53% (47)	75% (67)
Outreach sessions	45% (40)	69% (61)
Record keeping improvements	36% (32)	58% (52)
Liaise with community leaders	35% (31)	58% (52)
Home visits	31% (28)	55% (49)
Phone calls using mothers' registered phone numbers	13% (12)	15% (13)
Other defaulter action	9% (8)	4% (4)

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.

	Baseline	Midline
Requested a change in stock (more or less) from the district	39% (35)	34% (30)
Requested stock from another facility	22% (20)	15% (13)
Changed immunization clinic days	19% (17)	2% (2)
Other stock action	7% (6)	0% (0)

Supporting culture

The midline evaluation results showed improvements in the percentage of HCWs who could identify their data related to coverage, defaulters, and stock and who have used those data to inform their actions to improve service delivery. These actions at the facility level need to be supported and sustained by a broader culture of data use.

Support from higher levels of the health system

The motivation to improve data quality and use comes from both the higher levels of the health system and from the health facility staff themselves. The evaluation survey focused on measuring the extent to which higher levels of the health system emphasized data quality and use as integral parts of performance management, as well as the extent to which they shared their expectations on data quality and data use. For HCWs at the facility level, the term "higher levels" of the health care system refers to the district-, provincial-, and the national-level MOH.

Baseline results showed that the large majority of facility HCWs "always" felt that higher levels of the health system emphasized data quality and use, and were clear on their expectations (Figure 14). At midline, there were even further improvements, with 97 percent of facility HCWs "always" feeling an emphasis on data quality and 90 percent "always" feeling an emphasis on data use.

Nearly all district staff who were surveyed (92 percent; N=12) also felt that higher levels of the health system (provincial and national) "always" emphasized data quality and data use. To a lesser extent, 83 percent of district staff felt that higher levels were clear about their expectations on data quality and data use. There was no change from baseline to midline in district staff's responses, indicating that the strong culture of data use was maintained.

These results indicate the level of effort and commitment that the Zambian MOH has invested to ensure that data quality and use remain high-priority areas in the health system.

Figure 14. Percentage of facility health care workers who felt that higher levels of the health system (district to national) emphasized data quality and data use, and presented clear expectations for the facility.
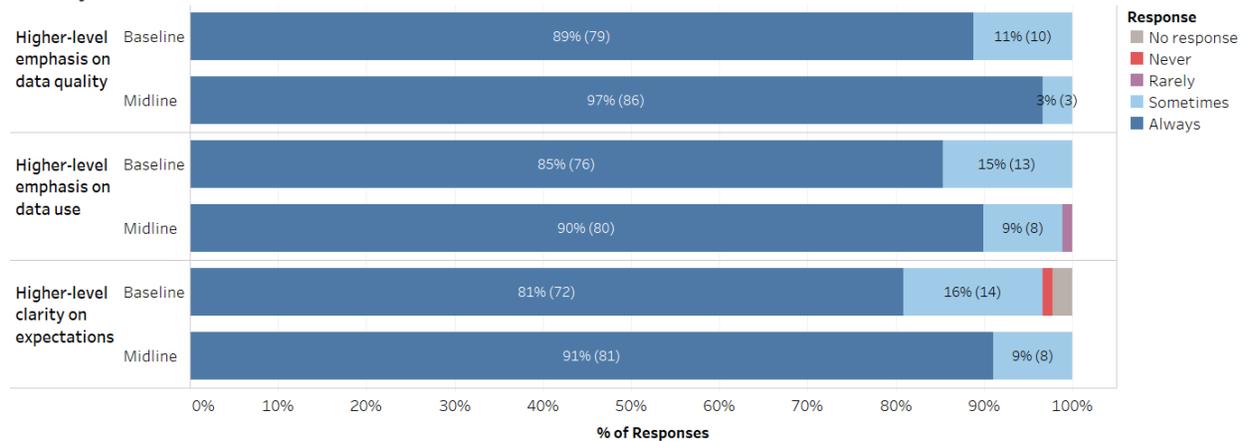
Data review meetings

Data review meetings were effective platforms for discussing immunization data indicators and issues of data quality and use. HCWs reported whether they were aware of the routine data review meetings that happened in their districts and if they had attended a data review meeting in the previous quarter. The percentage of facility HCWs who were aware of data review meetings that occurred in their district increased from 80 percent at baseline to 99 percent at midline. There was also a large increase in the percentage of facility HCWs who had attended a data review meeting in the last quarter, from 46 percent to 73 percent (Figure 15).

Figure 15. Facility health care worker awareness of and attendance in data review meetings.
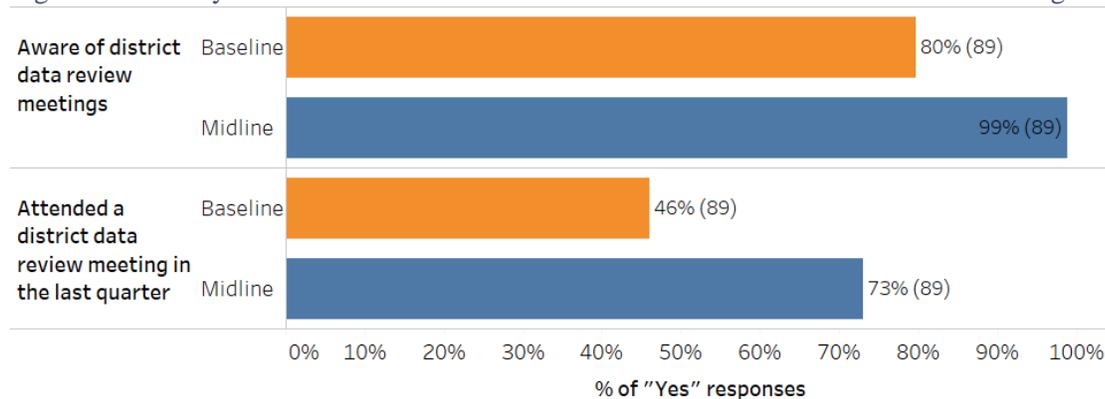
The frequency of data review meetings is dependent on the availability of resources at the district level; sometimes, meetings were not held because of lack of resources. With the absence of such meetings, it is difficult to discuss immunization-related challenges and feedback will not reach the intended audience. As a result, HCWs will not realize the benefits to their work of having timely, accurate, and complete data.

At baseline, only two of five DHIOs reported holding quarterly data review meetings for their district in the previous 12 months. At midline, four of five DHIOs reported that they held a data review meeting in the previous quarter. This indicates that the frequency of data review meetings is improving. District staff gave examples of how information was used to make decisions in these data review meetings, such as using

facility data to determine the amount of vaccine stock to pick up from the national level or asking facility staff to work on action plans based on the data received.

Again, the BID Initiative not only emphasizes the importance of being able to identify issues in the service delivery system, it also encourages health staff to make actionable decisions based on the information available. Data quality and data use interventions strive to improve service delivery by creating a culture of data use.

Peer networks

Data quality and use are also sustained through support and motivation from peers. Peer networking is a key intervention for strengthening the data use culture. The BID Initiative aimed to establish peer networks through WhatsApp groups that would connect HCWs in a district and allow them to share experiences, challenges, questions, and lessons learned. The networks were intended to build knowledge, offer support, and motivate HCWs. However, during implementation, we found that there were many existing WhatsApp groups to connect HCWs at both district and facility levels. Rather than duplicating these groups, the intervention shifted to encouraging HCWs to leverage the existing networks to discuss immunization issues and challenges.

At baseline, 62 percent of facilities reported having any communication with peer facilities; this decreased slightly to 57 percent at midline (Figure 16). The fact that no new communication channels were introduced may explain the lack of improvement. Similarly, midline results did not show improvements in knowledge of how peer facilities are overcoming their immunization challenges (Figure 17); this suggests that the HCWs were not using existing channels to discuss challenges.

Figure 16. Facility health care workers who reported having ever communicated with peer facilities.
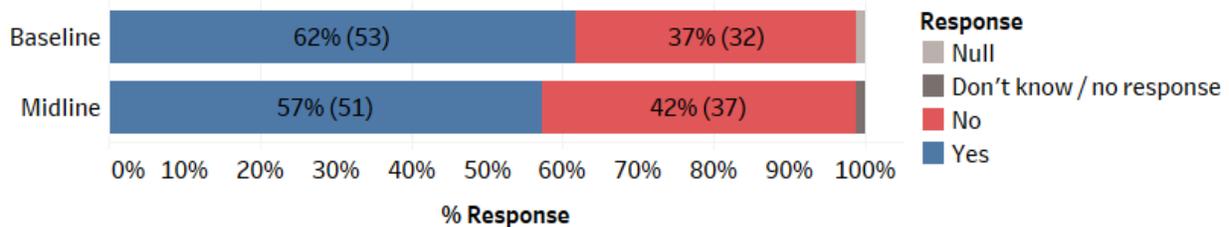
Figure 17. The majority of facilities disagree that they "know how their peer facilities overcome their immunization challenges."
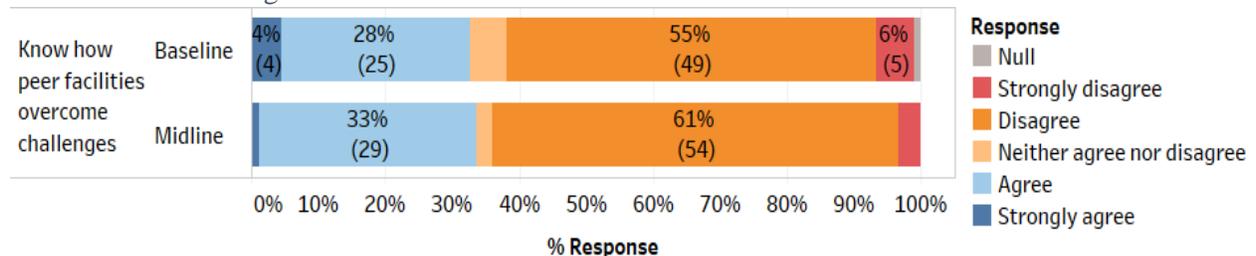
Among those facility in-charges who did communicate with peer facilities, the midline results showed improvements in the percentage of facility in-charges who "agree" or "strongly agree" that peer communication had increased their knowledge (74 percent to 93 percent), motivation (69 percent to 87 percent), and skills (77 percent to 87 percent) (Figure 18). This may indicate that although more facilities

are not engaging in peer communication, among those that are, the quality of the interactions may be improving in terms of increasing knowledge, motivation, and skills.

Figure 18. The majority of facilities agreed that their knowledge, motivation, and skills had increased as a result of peer communication.
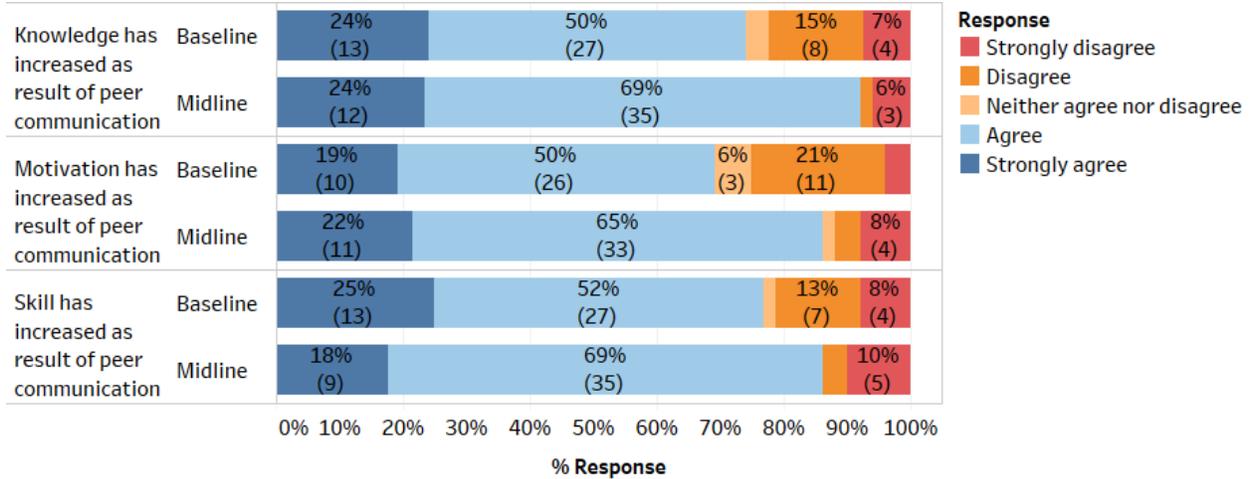
Conclusions

The implementation of data quality and data use interventions in Southern Province has introduced solutions to address the data availability, accuracy, and completeness challenges seen at baseline. This has increased HCWs' confidence in the data, motivating them to use the data in identifying vaccine coverage, defaulters, and stock at facility level. The interventions have raised awareness among HCWs and facilitated data use for service delivery improvements.

Summary of the midline evaluation findings

The following improvements were realized after the implementation of the interventions:

- ❖ For the facilities that were actively using ZEIR, the system ensured the availability, reporting, and completeness of immunization data elements, as well as internal accuracy as the data were aggregated across different levels of reporting. This was an improvement from baseline findings, where all districts had issues of availability of source documents, issues of completeness of the health information aggregation Form 2 (HIA2) reports, and high discrepancies between data in the tally sheets and in HIA2 reports.
- ❖ All facilities sampled at midline had been using ZEIR for at least three months. Nearly all HCWs (94 percent) felt that they had "good" or "excellent" system use capacity. More than two-thirds (69 percent) felt that they had capacity to use data generated from the system.
- ❖ After introduction of the data quality and data use interventions, a reduction was observed in the data quality barriers that impeded data use at facility and district levels. At baseline, the most common barrier to data use was poor data accuracy, cited by 56 percent of HCWs; at midline, only 21 percent of HCWs cited poor data accuracy as a barrier. There were notable declines in other facility barriers, including missing data (53 percent to 35 percent), late or no data (38 percent to 15 percent), and data that were confusing or not well presented (36 percent to 18 percent). At the district level, there were reductions across data quality barriers, although to a lesser extent than at the facility level.
- ❖ Perceptions of data quality improved at midline, as did overall confidence levels in the coverage data. The percentage of in-charges who reported that their immunization data accuracy was "excellent" more than tripled from 11 percent at baseline to 35 percent at midline. There were also increases in perceived data completeness, timeliness, and overall confidence in the data.
- ❖ Midline results showed improvements in the percentage of facilities that were able to identify areas with the lowest coverage of the third dose of diphtheria-pertussis-tetanus vaccine (DPT3) (from 59 percent to 87 percent), defaulters (from 67 percent to 94 percent), and vaccine stock levels (from 72 percent to 91 percent). A 23 percentage increase was noted in the number of HCWs who took action based on these data. Improvements were also seen at the district level: the percentage of district health information officers who could identify facilities with low DPT3 coverage in their district increased from 60 percent to 80 percent, and those who took action on the low coverage data increased from 20 percent to 60 percent.
- ❖ Higher levels of the health system have consistently emphasized and encouraged a culture of data use and high-quality reporting; these expectations have been clear among facility staff. This was sustained and further strengthened at the time of midline, with increases in the percentage of facility in-charges who reported that the higher levels emphasized data quality (89 percent to 97

percent), promoted data use (85 percent to 90 percent), and communicated expectations of data quality and use (81 percent to 91 percent).

- ❖ Results showed an increase in the number of, and attendance rates for, data review meetings held in the district. Nearly all HCWs who were interviewed at midline (99 percent) were aware of these meetings, up from 80 percent at baseline.
- ❖ At baseline, 62 percent of facility in-charges reported communicating with peer facilities; this did not change substantially at midline (57 percent). However, among those in-charges who were communicating with peers, at midline, there was an increase in the number who reported improvements in their knowledge, skills, and motivation as a result of their peer interactions.

Recommendations

- ❖ Higher-level (district, provincial, and national) staff should continue communicating expectations and encouraging high-quality data and a culture of data use at all times.
- ❖ Higher-level staff should facilitate and encourage health facility staff to attend meetings where data quality and data use issues are discussed in order to sustain the supporting culture around the new data quality and use interventions.
- ❖ Higher-level staff should encourage the discussion and sharing of experiences on immunization challenges and success over existing peer networks, such as WhatsApp groups. They also should consider employing a district mentor to lead and guide focused discussions.
- ❖ Higher-level staff should encourage the consistent use of ZEIR to reduce challenges related to missing or inaccurate source documents or reports.
- ❖ As district-level ZEIR dashboards are introduced, it will be important to monitor their rollout, get feedback from district staff, and understand the district staff's perception of the data quality, as this can determine whether they will use the data for decision-making.
- ❖ The MOH and the BID Initiative team should develop a comprehensive plan to sustain the use of ZEIR among health workers at all levels. This could include ensuring districts incorporate sustainability measures into their annual work plans. This will support sustained use of the system and facilitate the transition to paperless.

Appendix 1: Additional evaluation findings

Additional details on the evaluation findings related to data quality at baseline are included in this appendix.

Data availability by district

The availability of health information aggregation Form 2 (HIA2) across districts at baseline ranged from 64 percent to 77 percent availability (Figure 19). This was followed by tally sheets, the availability of which ranged between 52 percent and 92 percent availability. Stock ledgers were the least available, ranging between 0 percent and 53 percent availability.

Figure 19. Availability of source documents at baseline, by district.
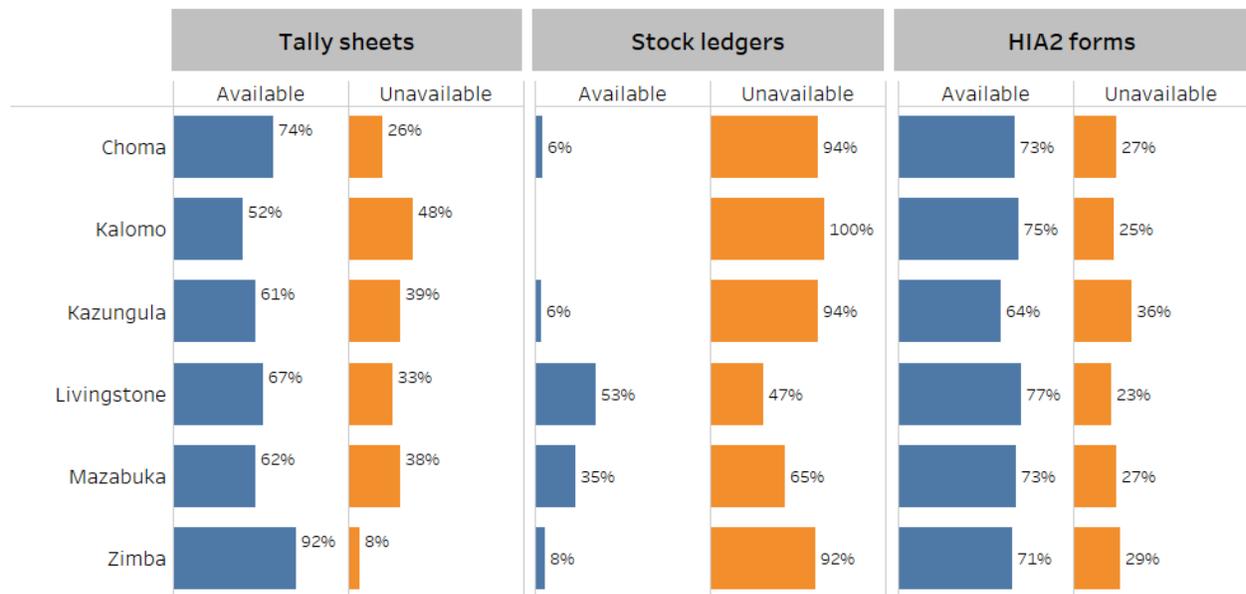
Abbreviations: HIA2, health information aggregation Form 2.

Data reporting accuracy by district and vaccine

For each facility that had a tally sheet and HIA2 report available for the same month, the baseline evaluation compared the total number of tallies with the total number of children vaccinated according to the HIA2 report. Huge discrepancies between tally sheet and HIA2 values were noted across facilities for all vaccines administered. Figure 20 shows results by district; Livingstone had the lowest absolute discrepancies at baseline and Kalomo had the highest. Figure 21 shows results by stratum and vaccine dose for selected vaccine doses; the discrepancies are similar across vaccine doses within the same stratum, with the exception of the birth dose of oral polio vaccine, which is generally lower than other doses.

Figure 20. Number of recorded DPT3 doses administered in the HIA2 versus tally sheets, by district, at baseline.
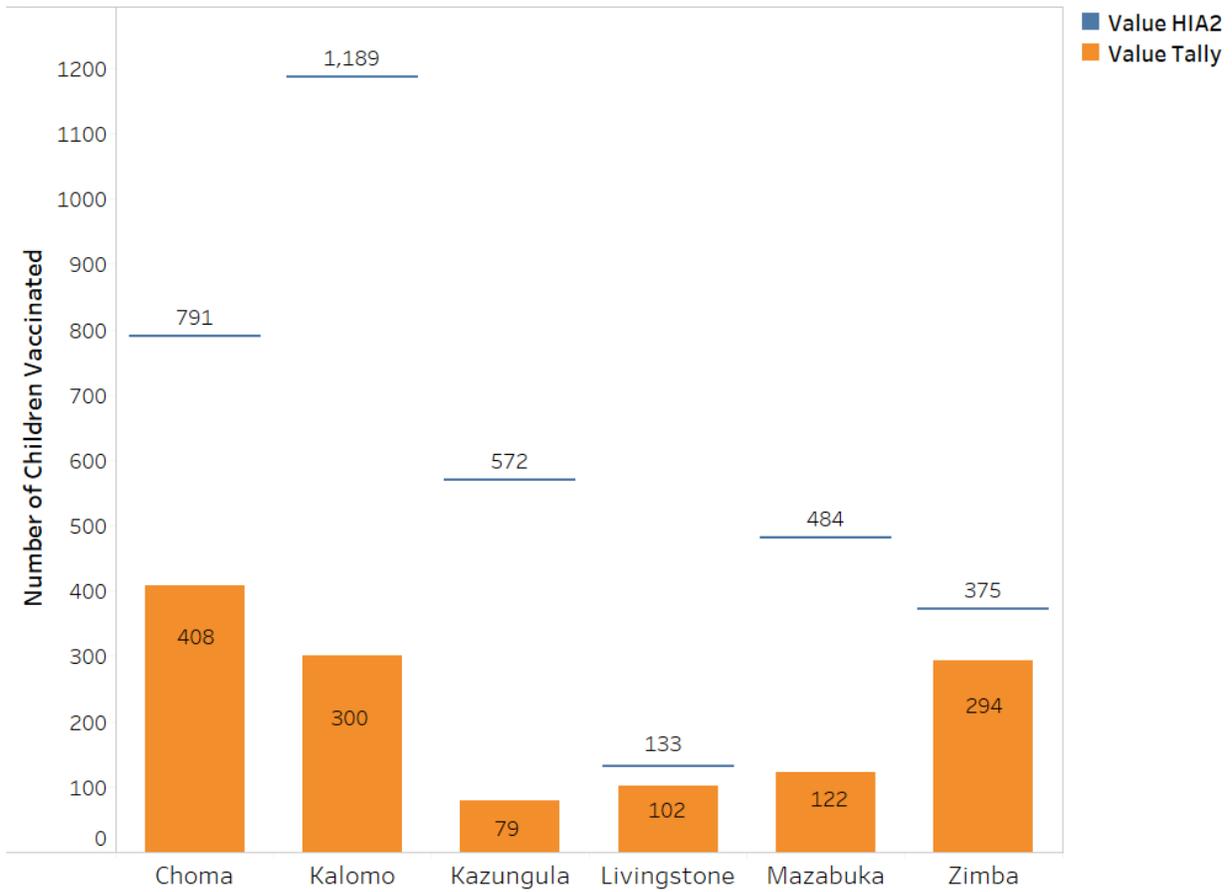
Abbreviations: DPT3, third dose of diphtheria-pertussis-tetanus vaccine; HIA2, health information aggregation Form 2.

Figure 21. Number of recorded doses administered in the HIA2 versus tally sheets, by stratum and vaccine dose, at baseline.
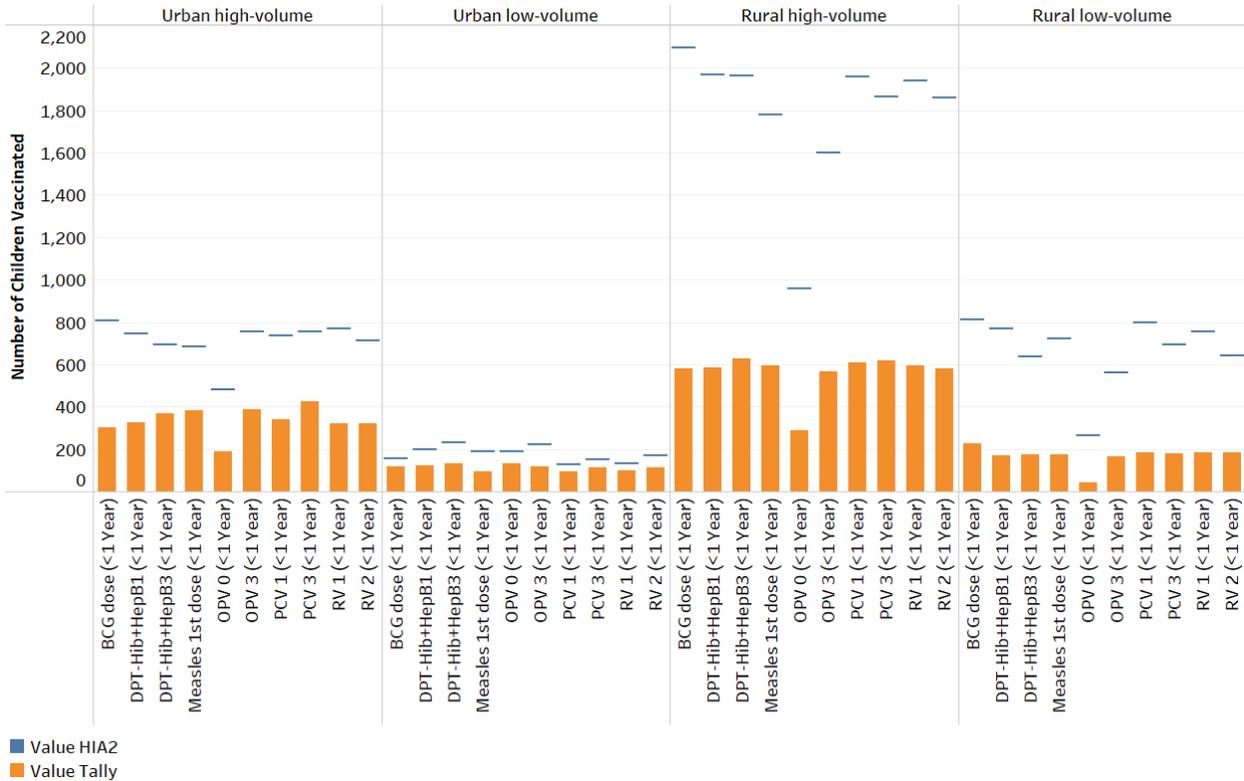
Abbreviations: BCG, bacille Calmette-Guerin vaccine; DPT-Hib+HepB1, first dose of pentavalent vaccine; DPT-Hib+HepB3, third dose of pentavalent vaccine; HIA2, health information aggregation Form 2; OPV 0, birth dose of oral polio vaccine; OPV 3, third dose of oral polio vaccine; PCV 1, first dose of pneumococcal conjugate vaccine; PCV 3, third dose of pneumococcal conjugate vaccine; RV 1, first dose of rotavirus vaccine; RV 2, second dose of rotavirus vaccine.

Appendix 2: Evaluation design, methodology, and limitations

The data collection process was aligned with intervention implementation activities. As staff visited facilities for implementation, they also conducted data collection activities. Data quality and data use interventions were implemented in a phased approach, starting with Livingstone, followed by Kazungula, Mazabuka, Zimba, Kalomo, and Choma (in that order). The interventions were first introduced at the district level before they were rolled out within each facility in that district. Since implementation occurred in phases, baseline 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"[e] in a district/facility prior to introduction of interventions.

The data were collected at district and health facility levels in order to gather information related to outcomes 1 and 2 of the BID Initiative monitoring and evaluation (M&E) framework (data quality and data use, respectively). The data were collected using both quantitative (data quality assessments and surveys) and qualitative (key informant semistructured interviews) data collection approaches.

The data quality indicators were developed by collecting immunization information from source documents at the facility level. These documents included immunization tally sheets, health center immunization reporting forms (the health information aggregation Form 2, or HIA2), and stock control cards. The information in the source documents was used to conduct a routine data quality assessment, which used an adapted version of the tool available from the MEASURE Evaluation. The routine data quality assessment tool was used to assess data accuracy, completeness, and timeliness of selected indicators that are included in monthly health system reports. Data from the HIA2 reports were compared with what was in the tally sheets. Ideally, data from tally sheets should be the same as those entered in the HIA2 report forms. Audited data also provided a picture of the data quality on the ground before the implementations began. Baseline data were collected (backdated) from the three months preceding the month of data collection (depending on the availability of the data) in order to get more representative averages.

Data use indicators were informed by data collected through key informant interviews using structured questionnaires. The BID team surveyed HCWs at both the facility and district levels who directly use immunization data. One individual, either the facility in-charge or maternal and child health (MCH) nurse who oversees immunization service delivery, was interviewed in each sampled facility. At the district level, the staff who were interviewed included the district health information officer; the district medical officer, or district nursing officer, or maternal and child health coordinator; and the cold chain officer or pharmacist.

Key evaluation team members included:

❖ Chipo Zulu, M&E lead, BID Initiative Zambia.
❖ Emily Carnahan, M&E lead, BID Initiative Seattle.
❖ Brivine Sikapande, principal M&E officer, Zambian Ministry of Health (MOH).

The M&E lead in Zambia coordinated and oversaw data collection, pretested tools, prepared the study protocol, and submitted the study to local authorities for ethical clearance. The M&E lead in Zambia worked in collaboration with the M&E lead from Seattle to design the data collection tools, visualize and interpret the results, and write the report. The principal M&E officer from the M&E department of the MOH

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[e] Touches are facility 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.

provided guidance on the design of data collection tools, refined questions, and ensured any indicator definitions were aligned with definitions used by the MOH.

Sampling strategy

At the outset of the BID Initiative, the team had planned to collect data in a sample of 176 facilities across all districts in Southern Province at baseline, midline, and endline (planned for 12 months following initial implementation). Baseline data were collected in all districts in Southern Province. However, given the project timeline, it was only possible to collect midline data in the sampled facilities in the first six implementation districts. For this reason, this report presents findings based on baseline and midline data collection in those six districts alone.

Planned sample

There are 269 facilities across the 13 districts in Southern Province, with the number of facilities in each district ranging from 8 to 37 facilities. The sample design took into account the fact that we expected different data challenges and different effects of the new interventions in certain types of facilities. We therefore wanted to stratify the sample by those facility types to understand the effects of the interventions in each type. These stratifications included urban versus rural facilities (based on the country's classification) and high versus medium/low volume. Volume refers to the number of children immunized per month. This resulted in four sampling strata:

1. Urban high-volume facilities.
2. Urban low-volume facilities.
3. Rural high-volume facilities.
4. Rural low-volume facilities.

After excluding the facilities that tested the early versions of the Zambia Electronic Immunization Register (ZEIR), there remained 265 facilities in Southern Province; 11 percent were urban high-volume, 7 percent urban low-volume, 37 percent rural high-volume, and 45 percent rural low-volume facilities. Based on a 5 percent margin of error and 80 percent confidence interval, we sampled 175 of the 265 facilities. In order to have a sample that was representative of each of the four strata, we calculated the distribution of facilities in each of the four strata by district (e.g., what percent of urban high-volume facilities are in each district). We then multiplied that fraction of facilities by the total sample needed (175 facilities) to determine how many facilities to sample in each district/stratum. We randomly sampled facilities within each district/stratum.

Actual sample

Due to project timelines, it was only possible to collect midline data for the first six implementation districts of Southern Province. The original sample selection from these districts was maintained, which was composed of 99 facilities (Table 4). Data were collected from Livingstone, Kazungula, Zimba, Mazabuka, Kalomo, and Choma districts.

Table 4 lists the number of facilities sampled and the number of facilities where the team collected both baseline and midline data. We could not collect data in all sampled facilities due to unavailability of source documents at the facility and/or unavailability of health workers to participate in interviews. However, baseline and midline data were collected in 89 out of the 99 sampled facilities. In Zimba district, data were

collected at two additional facilities to replace facilities where we could not collect data but were in the same sampling frame. The 89 facilities where baseline and midline data were collected represented 50 percent of the originally planned sample for the entire province. For this reason, we present findings by district and/or stratum in the report but do not presume this sample is representative of the province as a whole, as originally intended.

Figure 22 shows the number of facilities sampled per district and colored by stratum.

Among the 89 facilities, the same individual responded to the baseline and midline survey in 62 (70 percent) facilities. This is noted as a limitation that may affect comparability between baseline and midline results.

Table 4. Sample of facilities collected, by district.

District	Total # of facilities receiving interventions	# of facilities sampled	# of facilities covered at both baseline and midline
Livingstone	21	12	11
Kazungula	22	13	12
Mazabuka	40	27	21
Zimba	11	6	8
Kalomo	30	20	19
Choma	30	21	18
Total	154	99	89

Figure 22. District sample distribution, by stratum.
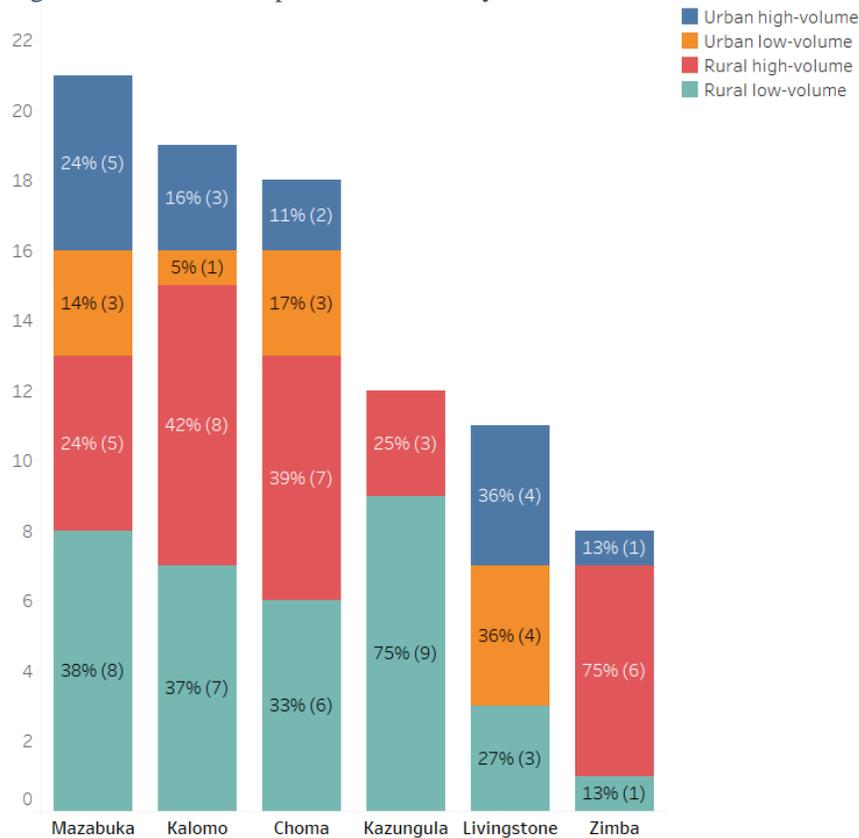
Data collection timelines

Baseline data collection occurred during the first touch of the implementation rollout in a given district. The baseline period focused on the three months prior to implementation. Midline data collection was planned to occur four months following the implementation and/or ZEIR go-live date (whichever was later). This was to allow facilities to have four months of experience using and applying the new data quality and data use interventions. Table 5 specifies the implementation rollout period and baseline and midline data collection periods for each district.

Table 5. Timeline of rollout and data collection.

District	Touch rollout period	Baseline data collection period	ZEIR go-live date	Midline data collection period
Livingstone	November 2016–August 2017	August–October 2016	July 2017	November–December 2017
Kazungula	February–August 2017	November 2016–January 2017	July 2017	November–December 2017
Mazabuka	July–August 2017	April–June 2017	August 2017	December 2017
Zimba	August 2017	May–July 2017	August 2017	December 2017
Kalomo	September 2017	June–August 2017	September 2017	February 2018
Choma	October 2017	July–September 2017	October 2017	February 2018

Abbreviations: ZEIR, Zambia Electronic Immunization Register.

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 Bill & Melinda Gates Foundation, Mott MacDonald, and representatives from Zambia's MOH. The survey tools were pretested before use.

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 visualized in Tableau 10.5.

Ethical considerations

The BID staff ensured that the baseline evaluation conformed to the highest ethical standards. BID staff ensured compliance with the Zambian research standards by submitting the data collection protocol and tools to the National Health Research Ethics Committee and the Zambian Institutional Review Board for approval. The data collection teams were also trained and certified in research ethics prior to collecting data.

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 questionnaire.

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. 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 in calculating the facility immunization coverage, thereby improving data visibility and reducing the frequency of stockouts and vaccine wastage. They will also help to improve planning and distribution of vaccines across all levels.

Limitations of the methodology

The following limitations were encountered during the evaluation:

- ❖ The evaluation design aimed for pre- and post-comparison of the quality of immunization data and the behavior of HCWs as they used data for decision-making at district and facility levels. But this method was limited because it only established the contribution (and not the impact) of interventions to improvements in data quality and use. We did not have data from nonintervention districts for comparison. Moreover, we were not able to disentangle the contribution of the BID Initiative data quality and data use interventions from the effects of other activities to support data quality and use in Southern Province.
- ❖ Given the BID Initiative's phased implementation strategy and rolling baseline approach to data collection, 17 percent (15/89) of facility HCWs 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 behaviors or perceptions at baseline.
- ❖ While the BID Initiative is focused on improving immunization data quality and use, it is difficult to systematically measure if and how HCWs are using data to improve the performance of their facilities. 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 survey of HCWs at facility and district levels relied on self-reported data, which are subject to bias. For some facilities, a different individual responded to the survey at baseline and midline, which may have undermined the comparability of responses or may have reduced bias. In 70 percent of facilities, the same respondent took the baseline and midline surveys. This was addressed by using the facility as the unit of analysis.
- ❖ At baseline, the surveys were conducted in person by PATH staff through one-on-one interviews. At midline, the surveys were conducted over the phone by PATH staff through one-on-one interviews, since it was not feasible to visit all sampled facilities. It is possible that this slight variation in data collection methods could have affected the results.
- ❖ Since data collection was done on a rolling basis, the baseline data were not collected through the same time period for the sampled facilities. This may have affected baseline results, as data quality and data use practices may have changed over time.
- ❖ At the outset of the BID Initiative, the team had planned to collect data in a sample of facilities across all districts in Southern Province at baseline, midline, and endline (planned for 12 months following initial implementation). Baseline data were collected in all districts in Southern Province.

However, given the project timeline, it was only possible to collect midline data in the sampled facilities in the first six implementation districts. For this reason, this report presents findings based on baseline and midline data collection in those six districts alone.

❖ Among the six districts where data were collected, the original sample included 99 facilities but the BID team only collected data from 89 facilities. In ten facilities (10 percent of the sample), data were not collected because HCWs were unavailable or declined participation in the survey.

❖ A routine data quality assessment was conducted off-site using photos of the source documents. In some cases, it was difficult to read the data due to illegible handwriting. In such circumstances, we had to drop some data that were not legible.

References

[1] World Health Organization (WHO), United Nations Children's Fund (UNICEF), World Bank. *State of the World's Vaccines and Immunization*. 3rd ed. Geneva: World Health Organization; 2009.