Assessing the Effectiveness of a Web-Based Vaccine Information Management System on Immunization-Related Data Functions

An Implementation Research Study in Tanzania

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Table of Contents

List of Tables

Abbreviations

CCEIT	cold chain equipment inventory tool
cMYP	comprehensive multi-year plan
DIVO	district immunization and vaccine officer
DVDMT	district vaccine data management tool
EIR	electronic immunization registry
HCW	health care worker
HMIS	health management information system
IVD	Immunization and Vaccine Development
JSI	John Snow, Inc.
LMIS	logistics management information system
MCSP	Maternal and Child Survival Program
MOHCDGEC	Ministry of Health, Community Development, Gender, Elderly and Children
RIVO	regional immunization and vaccine officer
SMT	stock management tool
VIMS	vaccine information management system
WHO	World Health Organization

Executive Summary

Background

In Tanzania, the Maternal and Child Survival Program (MCSP) provides technical support to the Ministry of Health, Community Development, Gender, Elderly, and Children (MOHCDGEC) in seven regions focused on ensuring that all women, newborns, and children who are most in need have equitable access to quality health care services to save lives.

The Immunization and Vaccine Development (IVD) Program of the MOHCDGEC has focused significant system strengthening efforts on improving information and data management. The MOHCDGEC recognizes that consistent availability of timely and accurate program data is critical for monitoring and improving immunization program performance.

In the past, IVD has primarily collected program-related data through the use of three tools: a district vaccine data management tool (DVDMT), a stock management tool (SMT), and a cold chain equipment inventory management tool (CCEIT). However, recent assessments have indicated that the quality, consistency, accessibility, and timely availability of data from these tools could be improved. Therefore, the IVD piloted a new vaccine information management system (VIMS) that combines the three tools and streamlines data collection into one visualization platform to reduce the duplication of efforts for data management required by health workers.

VIMS was developed under IVD leadership by John Snow, Inc. (JSI)/DELIVER and in partnership with the Clinton Health Access Initiative, PATH, World Health Organization (WHO), and MCSP. The new data management system provides IVD program stakeholders with a web-based "one-stop" source of information on vaccine and immunization commodities, cold chain assets, and routine immunization data. Beginning in August 2016, IVD piloted VIMS in 44 councils/districts in seven Tanzania mainland regions (Arusha, Dar es Salaam, Lindi, Mtwara, Mwanza, Njombe, and Tabora).

Study and Methods

After one year of piloting, IVD commissioned this implementation research study to examine the effectiveness of VIMS in improving immunization program data quality compared to the DVDMT, SMT, and CCEIT systems. The specific study objectives are to: (1) determine changes in data quality caused by VIMS use by comparing data quality indicators between VIMS pilot and non-pilot districts; (2) explore the usability of the VIMS system by asking VIMS users to describe their experience using it; and (3) explore the information management experiences of staff in non-VIMS districts.

Results and Discussion

Most VIMS users reported feeling positively toward the new system, saying that it is easy to use and streamlines multiple data collection and reporting functions, easing the burden on health workers for data collection. Respondents liked that VIMS allows auto-calculations and can generate real-time reports; prevents submission of incomplete reports; makes it easy to detect reporting errors; is accessible anywhere that you have an internet connection; has the potential to make stock status management easier; and provides dashboard displays of statistics and trends that are helpful in decision-making.

However, despite positive reception from users, results from this phase of the rollout indicated efforts are still needed to improve IVD program data reporting accuracy, consistency, or timeliness relative to the current DVDMT/SMT/CCEIT-based system. These results were similar to findings for the district performance in vaccine stock management compared to use of the DVDMT/SMT/CCEIT systems. Several operational, infrastructural, and/or study-related factors may help explain why this was the case. The assessment provides an opportunity to identify gaps and lessons that will feed into the next phase of the rollout.

Beyond easing the data collection burden, for Tanzania to see additional benefits of using VIMS that other countries, such as Ethiopia and Paskistan,[1] have observed implementing similar electronic vaccine logistics management information systems (LMISs), further adjustments and investments in VIMS refinement and training/mentoring support for VIMS users are needed. These investments would also ensure data visibility for essential logistics data although not as extensive as VIMS.

Conclusion and Recommendations

To maximize the benefit of future investments, the following recommendations can be made to improving the VIMS tool and VIMS implementation in Tanzania:

- Refine the VIMS tool as needed to address technical issues identified by users in this study (e.g., simplifying certain processes, functions, or displays and making error messages more clear and user-friendly).

- Provide follow-up training and frequent on-the-job training to VIMS users (including health facility workers, the sources of data entered into VIMS) at all levels and focusing on competency-based training to build skills. In addition, prioritizing inclusion of VIMS-related items in supportive supervision visits (and in supportive supervision checklists) at sub-national levels.

- Increase the provision of feedback on IVD program performance from the national to sub-national levels (and vice versa), so that users can be engaged in a discussion about data, data use in decision-making, and continuous performance monitoring and improvement.

- Update VIMS as needed to accommodate new vaccines. According to the 2016-2020 cMYP, Tanzania will introduce seven new vaccines (IPV, bOPV, HepB BD, Yellow fever, HPV, MenA, Malaria) by December 2020. Continuous updating of VIMS to include new vaccines will ensure that it stays relevant and useful to IVD stakeholders.

- Advocate for/mobilizing additional resources to further integrate VIMS with the health management information system (HMIS)/DHIS2, such that these data management systems are streamlined and linked.

- Continue to document VIMS scale-up to inform future Tanzanian implementation as well as potential VIMS adoption and adaptation in other countries.

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[1] USAID, DELIVER PROJECT. 2015. *eLMIS Selection Guide: Electronically Managing Your Supply Chain Information.* (http://www.jsi.com/JSIInternet/Inc/Common/_download_pub.cfm?id=16187&lid=3)

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Background

In Tanzania, the Maternal and Child Survival Program (MCSP) provides technical support to the Ministry of Health, Community Development, Gender, Elderly, and Children (MOHCDGEC) in seven regions focused on ensuring that all women, newborns and children most in need have equitable access to quality health care services to save lives.

Tanzania's immunization program has been described as "one of the best performing in Africa with more than 90% of children completing three doses of diphtheria-tetanus-pertussis-hepatitis B- Hemophilus influenza type b vaccine"[2] from 2010-2014 and having an under-1 immunization coverage rate "over 90% for all antigens" during this same period.[3] Still, Tanzania's efforts to improve its national immunization program's performance are ongoing. The Immunization and Vaccine Development (IVD) Program of the Tanzania MOHCDGEC has focused its system strengthening efforts on information and data management, recognizing that consistent availability of timely and accurate program data is critical for monitoring and improving immunization program performance. The IVD prioritized strong information and data management systems in its 2016-2020 comprehensive multi-year plan (cMYP), where it included "adopt and update new technology in cold chain, supply chain, and data" as one of four major efforts to be undertaken.

In the past, IVD has primarily collected program-related data through the use of three different tools: a district vaccine data management tool (DVDMT), a stock management tool (SMT), and a cold chain equipment inventory management tool (CCEIT). District immunization and vaccine officers (DIVOs) and regional immunization and vaccine officers (RIVOs) use these tools to collect, aggregate, and report data up through the system to national-level managers. Stakeholders at all levels then use reported data to monitor and maintain IVD program performance.

Recent assessments have indicated that the quality, consistency, accessibility, and timely availability of data from the DVDMT, SMT, and CCEIT systems could be improved. In 2014, JSI/DELIVER conducted a baseline study on the quality of Tanzania's immunization program data.[4] Study findings revealed that, at that time, the accessibility, visibility, timeliness, and transparency of immunization program data varied from "poor" to "moderate." Reporting at health facilities and district and regional vaccine stores was low, with rates at 62%, 77%, and 63%, respectively.

In 2015, a comprehensive immunization program review and GAVI Joint Appraisal (reviewing data from approximately 700 facilities in five regions) found data consistency and validation issues across the multiple data collection tools, and highlighted additional challenges associated with having "parallel reporting systems for immunization coverage data (HMIS and IVD)," which placed "additional burden on health workers."[5] IVD also reported that only 29% of facilities reported data in a timely manner (i.e., reporting to the districts by the fifth day of each month) for nine or more months of 2015. Other findings from this assessment included:

- For the national-level IVD program manager: No quick and easy access to accurate stock and coverage data for planning and reporting; no early warnings of potential stock-outs or vaccine expirations; no easy way to share information to help with program alignment.

- For RIVOs: Tedious data compilation processes for reporting; difficulty downloading large data files.

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[2] D Lyimo D, Kamugisha C, Yohana E, et al. 2017. Improving the efficiency and standards of a National Immunization Program Review: lessons learnt from United Republic of Tanzania. *Pan Afr Med J.* 28:209.

[3] MOHCDGEC. 2016. Immunization and Vaccine Development Programme, *2016 - 2020 Comprehensive Multi-Year Plan*.

[4] Rosen J, Spisak C, Mwencha M, Watson N, Kisoka N, Mberesero H 2015. Round one Report. Evaluating the Introduction of an Electronic Logistics Management Information System and a Logistics Management Unit: Impact on the Performance and Cost of the Public Health Supply Chain in Tanzania. Arlington, Va.: USAID, DELIVER PROJECT, Task Order 4.

[5] MOHCDGEC. 2015. Tanzania Comprehensive Immunization Program Review integrated with VPD Surveillance & Immunization financing review, Post Introduction Evaluation of MR +MCV2 and GAVI Joint Appraisal.

- For DIVOs: Inefficient double entry of stock information in both paper ledgers and electronic forms; misalignment between the complex and large electronic forms and monthly facility reports; difficulty uploading large data files.

- For logistics officers/store managers: Regularly incomplete or erroneous supply chain data; frequently "lost" vaccine lot numbers and expiry dates as vaccines move throughout the supply chain; data management tools that are not integrated with each other; regular vaccine stock-outs at regional, district, and health facility levels despite inventory being available at national level.

- For health care workers (HCWs): Staff not questioning/analyzing accuracy of facility-level data (e.g., clinic currently shows a 400% coverage rate); inaccurate vaccine stock balances as ledger entries are not always made; difficulty in calculating accurate immunization coverage rates due to lack of updated district population estimates.

Linked to these and other similar findings, both the comprehensive immunization program review and the cMYP recommended strengthening the IVD's information system. Both documents specifically mentioned pursuing vaccine immunization management system (VIMS) as a priority intervention, drawing on the evidence that an electronic LMIS can provide quicker access to more accurate data and analytics, to make informed decisions to improve the performance of the supply chain. As an example, in both Pakistan[6] and Ethiopia,[7] the LMIS has made vaccine stock data visible, increased government accountability for vaccines, and improved cold chain data visibility. These improvements have led to better planning, monitoring, and management.

Vaccine Information Management System

Under the leadership of IVD, VIMS was developed by John Snow, Inc. (JSI)/DELIVER, in partnership with the Clinton Health Access Initiative, PATH, World Health Organization (WHO), and the MCSP. Built off the existing Tanzania electronic logistics management information system (LMIS) code base, VIMS combines the DVDMT, SMT, and CCEIT systems into one data collection and visualization platform. Rather than relying on multiple data management tools, VIMS provides IVD program stakeholders with a web-based "one-stop" source of information on vaccine and immunization commodities, cold chain assets, and routine immunization data. Table 1 shows a comparison of VIMS, DVDMT, SMT, and CCEIT.

Table 1. Summary of data collection systems/tools

Tool/ System	Data Captured	Characteristics
DVDMT	Routine monthly immunization data from health facilities to track population immunization coverage rates	- Paper-based data compiled at health facilities and sent to district level for aggregation - Excel-based at district-level; data sent to upper levels via email - Double-entry between paper and electronic forms - Some misalignment between facility reports and electronic forms; some duplication between the DVDMT, SMT, and CCEIT resulting in additional/tedious work for health workers completing these tools - Some duplication (and discrepancy) between data collected by IVD and by health management information system (HMIS) units

Tool/ System	Data Captured	Characteristics
SMT	Data on vaccine stock and immunization commodities to support effective supply chain functions such as requisitioning, order processing, and forecasting	• Web-based • Some duplication between the DVDMT, SMT, and CCEIT resulting in additional/tedious work for health workers completing these tools • Double-entry between paper and electronic forms
CCEIT	Data on cold chain equipment to support effective management throughout the supply chain	• Web-based • Some duplication between the DVDMT, SMT, and CCEIT resulting in additional/tedious work for health workers completing these tools
VIMS	Logistics data, routine immunization data, and cold chain inventory data	• Web-based • Combines functions of multiple systems (DVDMT, SMT, and CCEIT) into one integrated platform–a "one-stop" resource • Produces automated data dashboards, standard reports, and customizable reports for real-time data visualization • Features/functions can be tailored for users at different levels of health system

In 2016, the IVD began piloting VIMS that was developed to facilitate improved vaccine and immunization data collection, reporting, and quality, with the broader goal being to improve vaccine delivery and cold chain management in pilot areas.

VIMS piloting began in 44 councils/districts in seven Tanzania mainland regions (Arusha, Dar es Salaam, Lindi, Mtwara, Mwanza, Njombe, and Tabora). MCSP developed, reviewed, and printed VIMS training facilitator guides and participant workbooks and supported VIMS training-of-trainers workshops for national counterparts. MCSP then supported training of RIVOs and DIVOs from the seven VIMS pilot regions. In all pilot areas, MCSP supported orientation of health facility workers on use of newly-developed IVD monthly report forms to improve their capture of immunization data. During the piloting period, RIVOs and DIVOs (and others as needed) in VIMS regions were asked to manage routine immunization-related data using both VIMS and the DVDMT, SMT, CCEIT (the latter to remain consistent with non-VIMS areas).

Implementation Research Study

After 1 year of VIMS piloting, in 2017, IVD commissioned this implementation research study to examine the effectiveness of VIMS in improving immunization program data quality and usefulness of IVD program data relative to the DVDMT, SMT, and CCEIT system by comparing VIMS pilot and non-pilot districts. MCSP, working in collaboration with local Tanzanian researchers, funded and led the study. The objective of this study was to assess the effectiveness of VIMS in improving immunization program-related data quality, analysis, and visualization and to understand and document users' experience in managing immunization-related data using VIMS. Specifically, we sought to:

• Determine changes in data quality caused by VIMS use by comparing data quality indicators between VIMS pilot and non-pilot districts. Through facility and stock management data reviews, we examined:

  • Reporting accuracy ratio between facility- and district-level data for select indicators.

  • Consistency between district- and regional-level data for select indicators.

  • Districts' vaccine stock management performance (occurrence of understocking/overstocking).

  • Timeliness in district-level data reporting, defined as submission of reports from the districts to the regions before the 15th day of the reporting month.

- Assess the usability of the VIMS system. VIMS users were asked to describe their experience using VIMS to forecast and manage stock and to compare it with previous information management methods (e.g., data collection using multiple files).

- Explore and document experiences and challenges among staff in charge of immunization-related services and data management in non-VIMS districts.

Methods

Study Design

This cross-sectional, post-test study featured a non-randomized intervention/control design. The study comprised an intervention and a control arm with four regions in each. The intervention arm included four of the seven VIMS pilot regions from Tanzania mainland: Arusha, Mtwara, Mwanza, Njombe. The control arm included four non-VIMS pilot regions: Mbeya, Dodoma, Shinyanga, Tanga. Within each region, three districts were convenience sampled for inclusion: (1) the district that hosts the regional authority; (2) an urban district; and (3) a rural district.

Study Population

RIVOs, DIVOs, assistant DIVOs, and HCWs in study districts/regions whose duties included delivering immunizations and/or immunization-related data management services were eligible to participate in this study. In VIMS districts, we included RIVOs, DIVOs, assistant DIVOs, and HCWs if they had been oriented on the VIMS system and excluded those who had not. In non-VIMS districts, we excluded HCWs uninvolved in delivery of immunization services and immunization-related data management.

Data Collection Methods

We used a combination of qualitative and quantitative tools in this study including interviewer-administered questionnaires and data verification checklists (see Annexes 1 and 2). Because VIMS is intended to have an impact on immunization-related data at the district level and above, we used the district as the unit of analysis for the data verification checklist.

Ethical Consideration

Before study implementation, we obtained ethical clearance from the National Institute for Medical Research and permission to proceed from the relevant regional and district authorities. We also obtained informed consent from participants before their participation in the study (see Annex 3 for consent forms in English and Kiswahili) and explained that participation was voluntary, the study was meant for research purposes, and their responses would be anonymous and confidential. All completed questionnaires and checklists were kept in locked cabinets in the MCSP Tanzania office, and only study investigators had access to them. JSI also received exempt determination status from the JSI Intuitional Review Board in Boston, Massachusetts.

Data Processing and Analysis

Data collectors submitted completed data collection materials on a daily basis to the principal investigator from JSI-MCSP Tanzania and the data manager who then passed materials on for data cleaning, coding, and entry into a database. We used various statistical analyses (frequencies and proportions for categorical variables; means, standard deviations, Chi square, t-tests for continuous variables) to compare differences between VIMS and non-VIMS districts, with a p-value of <0.05 used as a cut-off for statistical significance. We analyzed qualitative data by grouping responses and looking for patterns/commonalities.

Results

We conducted this study in July 2017, approximately 12 months after the VIMS pilot was launched in select regions of mainland Tanzania. A total of 16 trained data collectors and four supervisors collected the data.

Reporting Accuracy between Facility and District-Level Data for a Select Performance Indicator

We measured reporting accuracy using the formula shown as Equation 1 (box). According to WHO data quality self-assessment guidelines,[8] an accuracy percentage of 90-100% is regarded as "acceptable/good" whereas a more than 100% implies that health facilities (lower levels) are under-reporting and a value of less than 100% implies that they are over-reporting to the district level.

Equation 1. Operational definition of "reporting accuracy ratio" between facility and district level data

$$\text{Reporting accuracy ratio} = \frac{\text{No. of children vaccinated with Pentavalent 3 reported in all HFs of the district in the past three months}}{\text{No. of children vaccinated with Pentavalent 3 reported by the district in the DVDMT in the same time period}} \cdot 100$$

For this study, we used pentavalent 3 coverage data sent by health facilities to the district level for the previous 3 months (November 2016 to January 2017) as our key performance indicator. We collected data from both the health facilities and their corresponding districts and calculated reporting accuracy for each district (Table 2).

For the most part, districts in both VIMS and non-VIMS regions had between or near 90-100% accuracy for the period under review. However, some districts in both VIMS and non-VIMS regions, reported accuracy well outside the desired range. (e.g., Mtwara district in VIMS arm; Bahi, Dodoma MC, and Shinyanga DC districts in non-VIMS arm).

Table 2. Data accuracy between facility and district level for total number of children vaccinated for pentavalent 3 in each district from November 2016-January 2017

System	Region	District	Data Accuracy Percentage		
			Nov-16	Dec-16	Jan-17
VIMS	ARUSHA	ARUSHA DC	100%	100%	100%
		KARATU	100%	103%	101%
		LONGIDO	100%	117%	100%
	MTWARA	MASASI DC	99%	104%	129%
		MTWARA	221%	354%	104%
		NANYUMBU	112%	104%	100%
	NJOMBE	LUDEWA	117%	NR	100%
		NJOMBE TC	101%	102%	103%

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[8] WHO. 2005. The immunization data quality self-assessment (DQS) tool. (www.who.int/vaccines-documents/)

System	Region	District	Data Accuracy Percentage		
			Nov-16	Dec-16	Jan-17
NON-VIMS	MWANZA	WANG'ING'OMBE	100%	99%	100%
		ILEMELA	100%	100%	100%
		MISUNGWI	100%	108%	107%
		SENGEREMA	100%	105%	102%
	MBEYA	KYELA	100%	100%	100%
		RUNGWE	100%	101%	100%
		MBEYA DC	99%	101%	104%
	DODOMA	BAHI	127%	134%	97%
	TANGA	MPWAPWA	100%	100%	100%
		DODOMA MC	115%	87%	94%
		TANGA CC	106%	104%	102%
		MUHEZA	101%	97%	100%
		LUSHOTO	103%	116%	102%
	SHINYANGA	SHINYANGA DC	169%	98%	239%
		KISHAPU	106%	109%	108%
		KAHAMA TC	100%	103%	103%

Data consistency between district- and regional-level data for select performance indicators

We measured data consistency using the formula shown as Equation 2. We used the total number of children vaccinated with pentavalent 1 and 3 as our key performance indicators and referenced data for a 6-month period (November 2016 to April 2017). Data was considered to be consistent between the district and regional levels in any month with at least 90%

Equation 2. Operational definition of "data consistency" between district- and regional-level data

$$\text{Data consistency} = \frac{\text{\# of months of consistent data}}{12 \text{ total months}}$$

where a "month of consistent data" is defined as the "total number of children vaccinated for pentavalent 1 and 3 as found in the district DVDMT in a given month is the same as or within 90% of the total number of children recorded in the regional level VIMS or DVDMT for these indicators in the same month."

matching data for the two indicators. The denominator was the total number of months of data (6 months of data for pentavalent 1 plus 6 months for pentavalent 3 = 12 total months). Results for each district are shown in Table 3.
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Table 3. Data consistency between district and regional levels for total number of children vaccinated for pentavalent 1 and 3 in each district between November 2016 and April 2017

System	Region	District	Total months of consistent data (%)	Districts with consistent data for more than 90% of period under review
VIMS	ARUSHA	ARUSHA DC	12/12 (100%)	8/12 (75.0%)
		KARATU	12/12 (100%)	
		LONGIDO	11/12 (91.7%)	
	MTWARA	MASASI DC	1/12 (8.3%)	
		MTWARA	2/12 (16.7%)	
		NANYUMBU	12/12 (100%)	
	NJOMBE	LUDEWA	11/12 (91.7%)	
		NJOMBE TC	10/12 (83.3%)	
		WANG'ING'OMBE	12/12 (100%)	
	MWANZA	ILEMELA	12/12 (100%)	
		MISUNGWI	12/12 (100%)	
		SENGEREMA	10/12 (83.3%)	
NON-VIMS	MBEYA	KYELA	12/12 (100%)	5/12 (41.7%)
		RUNGWE	12/12 (100%)	
		MBEYA DC	12/12 (100%)	
	DODOMA	BAHI	0/12 (0%)	
		MPWAPWA	0/12 (0%)	
		DODOMA MC	0/12 (0%)	
	TANGA	TANGA CC	10/12 (83.3%)	
		MUHEZA	10/12 (83.3%)	
		LUSHOTO	10/12 (83.3%)	
	SHINYANGA	SHINYANGA DC	10/12 (83.3%)	
		KISHAPU	12/12 (100%)	
		KAHAMA TC	12/12 (100%)	

Consistency between district- and regional-level pentavalent 1 and 3 data during the period under review was generally high in Arusha, Njombe, and Mwanza regions (VIMS regions) and in Mbeya, Tanga, and Shinyanga regions (non-VIMS). Data consistency was low (and/or data was actually missing) in two of three districts (Masasi DC and Mtwara) of Mtwara region (VIMS) and in all three surveyed districts in Dodoma region (non-VIMS).

Across all VIMS districts, eight of the 12 (75%) had data that met the "consistent" definition over more than 90% of the months surveyed. In the non-VIMS districts, only 41.7% (five of 12 districts) had data that met the "consistent" definition over more than 90% of the months surveyed. However, this difference in data consistency performance between VIMS and non-VIMS districts was not statistically significant (p-value =0.202).

District Performance in Vaccine Stock Management (Understock/Overstock)

To assess district performance in vaccine stock management, we collected data on monthly stock at hand of pentavalent vaccine for each district for the period November 2016 to April 2017 (Table 4). We collected data from the stock ledger reports filed within the VIMS and/or SMT systems and from vaccine ledgers/books. Then, we compared reported data to minimum and maximum vaccine stock targets for each district (targets equaling minimum/maximum stock levels each district is supposed to have at any particular time, based on the district's population size). We classified districts as being "understocked" in any month where its pentavalent vaccine stock on hand was below the minimum stock requirement. We classified districts as being "overstocked" in any month where its pentavalent stock on hand was above the maximum stock requirement. Districts that were not under- or overstocked for the 6 months under review were termed "best performers" in each category.

Table 4. District performance in pentavalent stock management (November 2016 to April 2017)

System	Region	District	Months of overstocks (out of six)	Months of understock (out of six)	Districts without overstock (best performers)	Districts without understock (best performers)
VIMS	ARUSHA	ARUSHA DC	2	2	6/12 (50%)	8/12 (67%)
		KARATU	5	0		
		LONGIDO	6	0		
	MTWARA	MASASI DC	0	0		
		MTWARA	0	0		
		NANYUMBU	0	0		
	NJOMBE	LUDEWA	0	6		
		NJOMBE TC	0	2		
		WANG'ING'OMBE	4	0		
	MWANZA	ILEMELA	3	0		
		MISUNGWI	0	0		
		SENGEREMA	3	1		
NON-VIMS	MBEYA	KYELA	0	0	9/12 (75%)	7/12 (58%)
		RUNGWE	3	0		
		MBEYA DC	2	0		
	DODOMA	BAHI	0	1		
		MPWAPWA	0	2		
		DODOMA MC	0	3		
	TANGA	TANGA CC	0	0		
		MUHEZA	0	0		
		LUSHOTO	0	0		
	SHINYANGA	SHINYANGA DC	0	4		
		KISHAPU	3	0		
		KAHAMA TC	0	4		

Non-VIMS districts outperformed VIMS districts in terms of avoiding overstock of pentavalent vaccine in the 6 months under review (75% vs. 50% of districts, respectively), though the difference was not statistically significant (p-value = 0.408). VIMS districts outperformed non-VIMS districts in terms of avoiding understock of pentavalent vaccine in the 6 months under review (67% vs. 58% of districts, respectively), though again, the difference was not statistically significant (p-value = 0.414).

Timeliness of district reporting

In each region, we assessed the monthly timeliness of district reporting for a period of 1 year (from February 2016 to January 2017), with "timely" defined as districts reporting to regions by the 15th day of each month. The level of timely reporting varied from between regions (Table 5). The average level of timely reporting in VIMS regions was 88% compared to an 87% average for non-VIMS regions. The difference in level of timely reporting between VIMS and non-VIMS regions was not statistically significant (p-value = 0.717).

Table 5. Monthly timeliness of district reporting over a 1-year period

System	Region	Average time that districts reported in a timely manner over 1 year (%)	Regional average over 1 year
VIMS	Njombe	100%	88%
	Mwanza	96%	
	Arusha	88%	
	Mtwara	67%	
Non-VIMS	Dodoma	100%	87%
	Tanga	96%	
	Shinyanga	82%	
	Mbeya	70%	

Perceptions of VIMS users (user experience)

We interviewed RIVOs, DIVOs, and assistant DIVOs in VIMS and non-VIMS areas to obtain their views on the usability of VIMS compared to the DVDMT/SMT/CCEIT-based data management system. Among the 39 interviewees, 19 (49%) were from VIMS pilot regions/districts and 20 (51%) were from non-VIMS regions. See Table 6 for respondent characteristics.

Table 6. Sociodemographic characteristics of survey respondents

Characteristic	Total N (% or range)	Data management system in use	
		VIMS n (% or range)	Non-VIMS n (% or range)
Region/district	39 (100)	19 (49)	20 (51)
Age categories (years)			
25-35	16 (41)	10 (53)	6 (30)
36-56	23 (59)	9 (47)	14 (70)
Median age (IQR)	37 (29-48)	34 (29-41)	45 (30-51)
Sex			
Male	28 (72)	13 (68)	15 (75)
Female	11 (28)	6 (32)	5 (25)

Characteristic	Total N (% or range)	Data management system in use	
		VIMS n (% or range)	Non-VIMS n (% or range)
Current job position			
RIVO	8 (21)	4 (20)	4 (21)
DIVO	24 (62)	12 (60)	12 (63)
Assistant DIVO	7 (18)	4 (20)	3 (16)
Median years of experience in current position (IQR)	3 (2-7)	2 (1-5)	5.5 (2-11)

Of the 19 respondents from VIMS pilot regions, 17 respondents (90%) received the initial VIMS training[9] and all respondents received some combination of initial, refresher, and/or on-the-job training (Table 7). The majority of respondents (63%) said they were satisfied with the quality of training received, but the same number said they still needed additional training. When asked what topics they wanted additional training on, respondents mentioned stock management, generating reports, voucher preparation, cold chain management, and VIMS registration.

Table 7. VIMS training and perceptions of training (n=19)

Question	n (%)
Received initial training on VIMS	
Yes	17 (90)
No	2 (11)
Type of training received	
Initial only	11 (65)
Refreshers' only	3 (16)
Both initial and refresher's	3 (16)
Satisfaction with VIMS training received	
Unsatisfactory	2 (11)
Somewhat satisfactory	3 (16)
Satisfactory	12 (63)
Need further training	
Yes	12 (63)
No	5 (26)
Desired areas for additional training	
Stock management	6 (32)
Generation of reports	4 (21)
Voucher preparation	3 (16)
Cold chain management	2 (11)
VIMS registration	2 (11)

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[9] The Misungwi DIVO and Mtwara RIVO did not receive initial training but did receive refresher and/or on-the-job training.

Perceived Usefulness of VIMS in Data Management and Decision-Making

We asked respondents in VIMS regions their thoughts on the VIMS' usefulness, functionality, usability, ease of learning, and use in decision-making. We asked respondents to rate the above criteria using a five-point Likert scale, but during data analysis, we collapsed responses into three categories (agree, undecided, disagree) because there were small numbers of responses in the extreme categories.

The majority of respondents reported that VIMS is useful, with 100% agreeing that VIMS is "very reliable," "helps to avoid overstock and understock," and "prevents them from submitting incomplete reports" (Table 8). Respondents also gave VIMS high marks in terms of saving them time, meeting respondents' needs, working as expected, making data quality checks easy, automating calculations, producing stock reports, and protecting data from being changed once approved.

Table 8. Qualitative assessment of VIMS in data management function

	Question	RESPONSE		
		Agree	**Undecided**	**Disagree**
		n (%)	**n (%)**	**n (%)**
I.	**USEFULNESS**			
(a)	It saves me time when I use it.	16 (84)	0	3 (16)
(b)	It meets my needs.	17 (90)	0	2 (11)
(c)	It does everything I would expect it to do.	14 (74)	2 (11)	3 (16)
(d)	The system is very reliable.	19 (100)	0	0
(e)	It makes it easy to conduct data quality checks.	17 (90)	0	2 (11)
(f)	It allows auto filled fields based on previous information.	16 (84)	2 (11)	1 (5)
(g)	It allows auto calculations.	18 (95)	0	1 (5)
(h)	It takes less time to enter information.	17 (90)	0	2 (11)
(i)	It links to better performing supply chain.	16 (84)	0	3 (16)
(j)	It helps to avoid overstock and under stock.	19 (100)	0	0
(k)	It helps in production of stock reports.	18 (95)	0	1 (5)
(l)	Data are protected after approval and cannot be edited.	16 (84)	1 (5)	2 (11)
(m)	It prevents submission of incomplete reports.	19 (100)	0	0
2	**VIMS FUNCTIONALITY**			
(a)	VIMS is not very stable and crashes multiple times.	1 (5)	4 (21)	14 (74)
(b)	It was easier to navigate through the previous systems to find information.	12 (63)	2 (11)	5 (26)
(c)	I prefer using the previous system of data management for immunization.	6 (32)	1 (5)	12 (63)
(d)	It allows me to use data offline.	2 (11)	4 (21)	13 (68)
(e)	I don't notice any inconsistencies as I use it.	11 (58)	0	8 (42)

	Question	RESPONSE		
		Agree	Undecided	Disagree
		n (%)	n (%)	n (%)
3	**EASE OF LEARNING**			
(f)	I learned to use it quickly.	15 (79)	0	4 (21)
(g)	I easily remember how to use it.	16 (84)	1 (5)	2 (11)
(h)	The technical manuals are very clear.	17 (90)	1 (5)	1 (5)
(i)	Adequate support has been provided in using VIMS.	14 (74)	0	5(26)
4	**USABILITY**			
(a)	I think that I would like to use this system frequently.	18 (95)	0	1 (5)
(b)	I found the system unnecessarily complex.	6 (32)	2 (11)	11 (58)
(c)	I think that I would need the support of a technical person to be able to use this system.	11 (58)	1 (5)	7 (37)
(d)	I found the various functions in this system were well integrated.	16 (84)	0	3 (16)
(e)	I would imagine that most people would learn to use this system very quickly.	15 (79)	2 (11)	2 (11)
(f)	I found the system very cumbersome to use compared to the previous system.	7 (37)	1 (5)	11 (58)
(g)	I felt very confident using the system.	18 (95)	0	1 (5)
(h)	I have difficulties using it because of poor internet connection.	12 (63)	1 (5)	6 (32)
(i)	It uses standard terminology throughout the system.	19 (100)	0	0
(j)	Error messages on the screen are confusing and not clear.	5 (26)	0	14 (74)
(k)	The system speed is too slow.	3 (16)	2 (11)	14 (74)
(l)	The system is very reliable.	19 (100)	0	0
(m)	It is user friendly.	17 (89)	1 (5)	1 (5)
(n)	I can use it without written instructions.	17 (89)	1 (5)	1 (5)
(o)	It is easy to correct mistakes in the system.	17 (89)	1 (5)	1 (5)
(p)	I am satisfied with it.	18 (95)	0	1 (5)
5	**VIMS USE IN DECISION-MAKING**			
(a)	The system allows generating automatic reports from the data entered.	18 (95)	1 (5)	0

	Question	RESPONSE		
		Agree	Undecided	Disagree
		n (%)	n (%)	n (%)
(b)	It is easy to generate reports that show various geographical areas.	13 (68)	4 (21)	2 (11)
(c)	It is easy to generate reports that show trends over time.	15 (79)	2 (11)	2 (11)
(d)	It is easy to generate reports that compare multiple facilities.	16 (84)	1 (5)	2 (11)
(e)	The dashboards are not very helpful in making decisions.	1 (5)	1 (5)	17 (90)
(f)	It allows better reports that help in identifying gaps.	17 (90)	1 (5)	1 (5)
(g)	The reports generated by VIMS saves me a lot of time.	15 (79)	1 (5)	3 (16)

Respondents had mixed feelings about VIMS' functionality, with VIMS stability, availability in the absence of an Internet connection, and ease of navigation being concerns. Five percent of respondents thought that VIMS is "not very stable and crashes multiple times," and 21% were undecided on whether VIMS is stable or not. Sixty-eight percent of respondents noted that VIMS does not "allow me to use data offline" (when there is no Internet connection).[10] Sixty-three percent of respondents said that "it was easier to navigate through the previous systems to find information," and 42% said they "noticed inconsistencies" when they used VIMS. Despite these opinions, 63% of respondents said they prefer using VIMS over the previous system. In terms of ease of learning VIMS, 79% of respondents said they learned to use VIMS quickly, 90% said that VIMS manuals are clear, 84% said they could easily remember how to use VIMS, and 74% said they had adequate support in using VIMS.

Regarding VIMS usability, perceptions were generally positive, but there were concerns about VIMS being "unnecessarily complex" (32%), "cumbersome relative to the old system" (37%), and having "confusing" error messages (26%). Nearly two-thirds of respondents (63%) said they had difficulties using VIMS because of poor Internet connections and perhaps related, 16% said that VIMS's speed was "too slow." For example, some respondents mentioned that, due to Internet connectivity challenges, it sometimes took a long time for VIMS to become updated with newly entered data. Despite these concerns, 95% of respondents reported feeling "very confident" using VIMS, 89% said that VIMS was "user-friendly," 95% said they would "like to use VIMS frequently," and 95% said they were "satisfied" with VIMS.

Finally, in terms of using VIMS for decision-making, 95% of respondents agreed that VIMS generates automatic reports based on data entered, the majority said that it was easy to generate various reports (68-84% depending on the type of report), 90% said that dashboards are helpful in making decisions, 90% said that VIMS produces reports that help in identifying gaps, and 79% said that reports generated by VIMS saved them time.

Experience of DVDMT, SMT, and CCEIT users in non-VIMS districts

We surveyed RIVOs, DIVOs, and assistant DIVOs in non-VIMS areas about their experience using DVDMT, SMT, and CCEIT tools. We used a checklist to assess the consistency of data from facilities to the

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[10] Note: Offline mode was incorporated into VIMS around June 2017, but it has not been advocated for use, so many DIVOs/RIVOs may not be aware of this feature. Offline mode can be used only for entry of immunization monthly reports from health facilities. For other functions like viewing and/or creating reports, submitting requisitions, issuing vaccines, receiving vaccines, etc., Internet connectivity is needed.

district level. In some districts, the forms for recording data from health facilities were not available; therefore, it was difficult to compare what was received and what was entered into the system.

Qualitative findings indicated that although most DIVOs in non-VIMS districts appeared to be knowledgeable and comfortable with the DVDMT/SMT systems, some said because they had not received adequate training on one or the other tool, they had trouble using them. Some respondents suggested moving toward web-based systems and merging the SMT and DVDMT into one web-based system. Other feedback included:

- The DVDMT is not easy to navigate.
- The DVDMT only allows annual calculation of vaccine stocks and cannot automatically provide monthly estimates.
- The DVDMT allows higher-level users to edit the data they receive from lower levels without discussing it with lower-level staff. For example, a RIVO can edit data sent to the national level without informing the DIVO, which can lead to unexplained discrepancies between district-, regional-, and national-level data. This was observed in Mtwara and Dodoma regions.
- The DVDMT is susceptible to viruses, with some 2016 data having been corrupted.
- Some data fields in the DVDMT and SMT overlap, which leads to additional, redundant work in completing both tools. Some DIVOs recommended that the SMT and DVDMT tools be combined.
- A skills gap exists, with some DIVOs and assistant DIVOs needing additional training on using the DVDMT and SMT.
- The CCEIT does not easily provide real-time information concerning temperature settings because the tool is designed to only record minimum and maximum temperature information. Thus, it is difficult to establish a more accurate, real-time record of temperature.
- Unreliable Internet connectivity makes using web-based tools (SMT, CCEIT) difficult.

Discussion

VIMS did not have any statistically significant effect on improving IVD program data reporting accuracy, consistency, or timeliness relative to the current DVDMT/SMT/CCEIT-based system. Nor was VIMS found to significantly improve district performance in vaccine stock management compared to use of the DVDMT/SMT/CCEIT tools.[11] Possible factors that may have hampered VIMS' effectiveness include:

- In VIMS pilot areas, staff were required to enter IVD data into both VIMS and the DVDMT/SMT/CCEIT tools (i.e., they were not released from their responsibility of completing the DVDMT, SMT, and CCEIT tools during the VIMS pilot). Staff were required to duplicate their data entry work, and this may have negatively affected their performance (accuracy, motivation, etc.), which in turn may have obscured impact of the VIMS intervention.

- In three pilot districts (Masasi DC, Mtwara DC, and Nanyumbu DC in Mtwara region), a shortage of VIMS paper report forms caused some health facilities to make their own forms. Self-made forms lacked items indicated in standard VIMS forms that then led to reporting of incomplete immunization coverage data.

- Unreliable Internet connectivity in some areas of the country may have hampered optimal use of VIMS. In 2016, the Internet was estimated to only have covered 13-15%[12] of the Tanzanian population.

- Outdated computer hardware at district, regional, or national levels may have been unable to run or display VIMS properly.

- The study's small sample size (e.g., number of districts sampled, number of indicators selected for inclusion, period under review for each indicator) may have limited our ability to detect effects related to VIMS introduction.

Despite a lack of evidence that VIMS usage resulted in data quality improvements, VIMS did integrate the IVD's existing multiple tools into one, harmonized data collection, analysis, and visualization platform. VIMS was well regarded by users for easing the burden of data collection and management. With this, VIMS brought fragmented immunization data management systems into one platform. Users said VIMS:

- Is easy to use;
- Streamlines multiple functions;
- Allows auto-calculations and can generate real-time reports;
- Prevents submission of incomplete reports;
- Makes it easy to detect reporting errors;
- Is accessible anywhere with an Internet connection;
- Has the potential to make stock status management easier; and
- Provides dashboard displays of statistics and trends that are helpful in decision-making.

One such user, Mr. Kidayi Kiteleja, the Mwanza region RIVO, said about VIMS:
 "VIMS is the best system for immunization data management compared to DVDMT, CCEIT, web SMT, and manual paperwork I've used since 1995 when I was appointed for the first time as District Cold Chain Officer (now DIVO). Compared to the former systems, VIMS has helped me to trace the monthly distribution of vaccines and supplies, which is not existing in other systems. Through VIMS, monitoring of IVD activities is simple compared to other systems as all activities have been merged to one system. The

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[11] It should be noted that poor population estimates (population denominators) also makes proper stock management difficult. This challenge would apply to all districts, VIMS and non-VIMS.
[12] According to Internet World Stats (http://www.internetworldstats.com/af/tz.htm; accessed November 2017) and the CIA World Factbook (https://www.cia.gov/library/publications/the-world-factbook/geos/tz.html; accessed November 2017).

Assessing the Effectiveness of a Web-Based Vaccine Information Management System on
Immunization-Related Data Functions

requisition of IVD supplies including vaccines into VIMS is simple with quick alerts in my email from districts. Email alert are good to make sure supplies are delivered at the right time within the shortest time period. VIMS has also helped to make sure data are consistent all the time as (previously) some districts were able to change data at any time. Once data has been approved in VIMS, it cannot be changed and hence remains as it is forever. So, VIMS is a very good system for data management including reporting, analysis, and storage of data."

Further investments in VIMS refinement and training/mentoring support for VIMS users is needed to see additional beneficial effects observed in other countries that have implemented electronic vaccine LMISs such as Ethiopia and Pakistan.[13] It is also worth noting the importance of behavior change when introducing and adopting a new system, and the short timeline of this study may not have allowed for that aspect.

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[13] USAID, DELIVER PROJECT. 2015. eLMIS Selection Guide, Electronically Managing Your Supply Chain Information. (http://www.jsi.com/JSIInternet/Inc/Common/_download_pub.cfm?id=16187&lid=3)

Conclusions and Recommendations

In 2018, investment in VIMS will continue, with MCSP supporting national VIMS rollout. VIMS has already been incorporated as an indicator in the Tanzania 2016-2020 cMYP, and 100% of districts were expected to be using it by 2017 and 100% of councils having "improved quality of (their) routine immunization data to 95% at all levels by 2020." Given this, the following recommendations can be made for improving the VIMS tool and VIMS implementation to maximize the benefit of future investments.

- Refine the VIMS tool as needed to address technical issues identified by users in this study. Areas needing attention include simplifying certain processes, functions, or displays and making error messages more clear and user-friendly.

- Provide follow-up training and frequent on-the-job training to VIMS users (including health facility workers, the sources of data entered into VIMS) at all levels and focus on competency-based training to build skills. In addition, prioritize inclusion of VIMS-related items in supportive supervision visits (and in supportive supervision checklists) at sub-national levels. This is in recognition that effective use of VIMS (or any information technology solution) is not solely a "tools" or "technology" issue but also a "systems" issue where stakeholders must be continuously supported in their technology use.[14,15,16]

- Increase the provision of feedback on IVD program performance from the national to sub-national levels (and vice versa), so that users can be engaged in a discussion about data, data use in decision-making, and continuous performance monitoring and improvement. As noted in the cMYP, feedback is currently limited and activities like annual IVD evaluation meetings have not taken place. If resumed, review meetings would facilitate stakeholders at all levels in discussing VIMS (and other) data.

- Update VIMS as needed to accommodate new vaccines. According to the cMYP, Tanzania will introduce seven new vaccines (inactivated polio, bivalent oral polio , hepatitis B birth dose, yellow fever, human papillomavirus, meningitis A, malaria) by December 2020. Continuous updating of VIMS to include new vaccines will ensure that it stays relevant and useful to IVD stakeholders.

- Advocate for/mobilizing additional resources to further integrate VIMS with the HMIS/DHIS2, such that these data management systems are streamlined and linked.

- Continue to integrate VIMS with the Electronic Immunization Registry (EIR) in collaboration with the MOHCDGEC and PATH-led Better Immunization Data Initiative (BID). In Arusha and Tanga regions, health facility staff at the service-delivery level currently use the EIR to digitize IVD program data (going from a paper-based to an electronic system). Health workers use tablets to tally and enter immunization data, stock data, and cold chain equipment status. VIMS and EIR have already been integrated in Arusha region in response to the government's "vision of a single system that provides end-to-end visibility for immunization."[17] By the end of 2018, EIR is expected to be rolled out in Kilimanjaro region and three other regions, and continued VIMS/EIR integration is recommended.

- Conduct further VIMS-related implementation research studies to assess whether using VIMS saves time relative to using the DVDMT, SMT, and CCEIT tools and to determine the impact VIMS usage has on stakeholders' data use and decision-making. Study findings could then be used to further strengthen the VIMS system.

- Continue to document VIMS scale-up to inform future Tanzanian implementation (including comparing differences in use of data for decision-making in VIMS districts relative to non-VIMS districts) as well as potential VIMS adoption and adaptation in other countries.

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[14] Mavimbe J, Braa J, Bjune G. 2005. Assessing immunization data quality from routine reports in Mozambique. *BMC Public Health* (5):108.

[15] Yadav P. 2015. Health Product Supply Chains in Developing Countries: Diagnosis of the Root Causes of Underperformance and an Agenda for Reform. *Health Systems & Reform* 1:142-154.

[16] MEASURE Evaluation. 2017. Easing the Data Collection Burden on Healthcare Providers by Strengthening Health Information Systems. (https://www.measureevaluation.org/resources/publications/tr-17-211_en)

[17] Brownlow K, Ryman T. 2017. Tanzania realizes vision for an integrated immunization system. Better Immunization Data Initiative blog post. Available at: http://bidinitiative.org/blog/tanzania-realizes-vision-for-an-integrated-immunization-system/. Accessed December 2017.

Annex 1A: Interview Guide for DIVOs, RIVOs, and Other Health Care Workers Engaged on Immunization-Related Services and Data Management in VIMS Pilot Districts

ASSESSING THE EFFECTIVENESS OF A WEB-BASED VACCINE INFORMATION MANAGEMENT SYSTEM (VIMS) ON IMMUNIZATION RELATED DATA FUNCTIONS

INTERVIEWER: Read the consent form before proceeding

Questionnaire Identification Number |_____|

Part A: Basic Participant Information

1. Region:	2. District:
3. Age:	4. Sex:
5. Job Title:	6. Number of years working in this post:
7. Research name:	8. Date of interview:

Part B: Training

No.	Questions and filters	Coding categories	Codes	Skip to
1	Have you been trained on VIMS?	Yes	1	If 1- continue
		No	2	If 2- go to Q7
2	If yes which type of training did you receive?	Refreshers' training only	1	
		Fresher and refreshers training	2	

No.	Questions and filters	Coding categories			Codes	Skip to
	(Multiple response)	Both fresher's and refreshers training			3	
3	When did you receive the trainings?		**Fresh**	**Refresh**		
		Month				
		Year				
4	How would you rate the trainings you received?	Unsatisfactory			1	
		Somehow satisfactory			2	
		Satisfactory			3	
5	Do you think you need any additional training on VIMS?	Yes			1	Continue
		No			2	Go to PART C
6	In which specific areas under VIMS would you like to be trained on? (mention) *(Mark all points mentioned by a respondent.)*					
7	How long have you worked on this system?	1 week to less than 1 month				
		1 month to less than 6 months				
		6 months to less than 1 year				

PART C: PERCEIVED USEFULNESS OF VIMS IN DATA MANAGEMENT FUNCTIONS

(In each of the statements given, based on your experience of using the VIMS, we would like you to rate your agreement with the statements from strongly disagree to strongly agree). Please insert a mark/tick in appropriate box against each of the statements below.

	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
USEFULNESS OF VMIS					
1. It saves me time when I use it.					
2. It meets my needs.					
3. It does everything I would expect it to do.					
4. I can easily predict vaccine stock-outs					
5. Makes it easy to conduct data quality checks					
6. Allows auto filled fields based on previous information					
7. Allows auto calculations					
8. It takes less time to enter information					
9. It links to better performing supply chain					
10. It helps to avoid overstock and under stock					
11. Helps in production of stock reports					
12. Data is protected after approval and cannot be edited					
13. It prevents submission of incomplete reports					
SYSTEM FUNCTIONALITY					
14. VIMS is not very stable and crashes multiple times					
15. It was easier to navigate through the previous systems to find information					

	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
16. I prefer using the previous system of data management for immunization					
17. VIMS allows me to use data offline					
18. I don't notice any data inconsistencies as I use it.					
EASE OF LEARNING					
19. I learned to use it quickly.					
20. I easily remember how to use it.					
21. The technical manuals are very clear					
22. Adequate support has been provided in using VIMS					
USABILITY OF VIMS					
23. I think that I would like to use this system frequently					
24. I found the system unnecessarily complex					
25. I think that I would need the support of a technical person to be able to use this system					
26. I found the various functions in this system were well integrated					
27. I would imagine that most people would learn to use this system very quickly					
28. I found the system very cumbersome to use compared to the previous system					
29. I felt very confident using the system					
30. I have difficulties of using it because of poor internet connection					
31. VIMS uses standard terminology throughout the system					

	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
32. Error messages on the screen are confusing and not clear					
33. The system speed is too slow					
34. The system is very reliable					
35. It is user friendly.					
36. I can use it without written instructions.					
37. It is easy to correct mistakes in the system					
38. I am satisfied with it.					
ANALYSIS AND REPORTING					
39. The system allows generating automatic reports from the data entered					
40. It is easy to generate report that show – various geographical areas					
41. It is easy to generate report that show – trend overt time					
42. It is easy to generate report that show data for multiple facilities.					
43. The dashboards are not very helpful in making decisions					
44. VIMS allows better reports that help in identifying gaps					
45. The reports generated by VIMS saves me a lot of time					

Part D: Access and System Usability

Ask the staff member being interviewed to access the VIMS system and observe the following:

1.	The staff member is able to easily locate the VIMS portal	1...Yes 2. ....No
2.	The staff member is able to easily log-in and log-out of VIMS	1...Yes 2. ....No
3.	The staff member is able to explain the data entry page	1...Yes 2. ....No
4.	The staff member is able to generate one report of health facilities by time period	1...Yes 2. ....No

Part E: Perceived Challenges in Using VIMS for Data Management

Questions and filters	Coding categories	Codes	Skip to
1. Did you encounter any challenges while using VIMS?	Yes	1	Continue
	No	2	Go to qn 3
2. Can you explain/mention the challenges you ever faced?	1.. 2. .... 3.. 4.. 5..		
3. What steps/actions did you try to follow to avail the challenges?	1.. 2. .... 3.. 4.. 5..		
4. How best can you describe VIMS in relation to immunization data quality compared to the previous system (excel based)?	....		
5. Any suggestions on how to improve VIMS?	....		

THANK YOU FOR YOUR TIME AND COOPERATION

Annex 1B: Interview Guide for DIVOs, RIVOs, and Other Health Care Workers Engaged in Immunization-Related Services and Data Management in Non-VIMS Districts

ASSESSING THE EFFECTIVENESS OF A WEB-BASED VACCINE INFORMATION MANAGEMENT SYSTEM (VIMS) ON IMMUNIZATION RELATED DATA FUNCTIONS

INTERVIEWER: Read the consent form before proceeding

Questionnaire Identification Number |_____|

Part A: Basic Participant Information

1. Region:	2. District:
3. Age:	4. Sex:
5. Job Title:	6. Number of years working in this post :
7. Research assistant name:	8. Date of interview:

Part B: Perceived Challenges In Using District Vaccine Data Management Tool (DVDMT), Stock Management Tool (SMT) and Cold Chain Inventory Tool (CCIT) for Immunization Data Management

Qn #.	Questions and filters	Coding categories	Codes	Skip to
1	Do you encounter any challenges while using the DVDMT for immunization data management?	Yes	1	Continue
		No	2	Go to qn 3

Qn #.	Questions and filters	Coding categories		Codes	Skip to
2	Can you explain/mention the challenges you ever faced?	1…………………………………………………… 2. ………………………………………………….. 3…………………………………………………… 4…………………………………………………… 5………………………………………………….. 6…………………………………………………… 7……………………………………………………			
3	Do you encounter any challenges while using the SMT/ CCIT for immunization data management?	Yes	1		continue
		No	2		Go to qn 6
4	Can you explain/mention the challenges you ever faced?	1…………………………………………………… 2. ………………………………………………….. 3…………………………………………………… 4…………………………………………………… 5…………………………………………………… 6. ……………………………………………… 7…………………………………………………..			
5	What steps/actions did you try to follow to avail the challenges faced for both the DVDMT/SMT/CCIT?	1…………………………………………………… 2. ………………………………………………….. 3…………………………………………………… 4…………………………………………………… 5……………………………………………………			
6	How best can you describe the system you are using in relation to immunization data quality? (probe on data quality parameters such as timeliness, completeness, accuracy etc.)	……………………………………………………… ……………………………………………………… ……………………………………………………… ……………………………………………………… ………………………………………………………			
7	Any suggestions on how to improve the DVDMT for data management?	……………………………………………………… . …………………………………………………… ……………………………………………………… ……………………………………………………… ………………………………………………………			
8	Any suggestions on how to improve the SMT/CCIT for data management?	……………………………………………………… . …………………………………………………… ……………………………………………………… ……………………………………………………… ………………………………………………………			

Assessing the Effectiveness of a Web-Based Vaccine Information Management System on Immunization-Related Data Functions

How would you rate the immunization data system you are currently using i.e., District Vaccine Data Management tool (DVDMT), Stock management tool (SMT) and Cold chain inventory tool (CCIT) in terms of usefulness, easy to learn etc.?

		Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
USEFULNESS OF DVDMT/SMT/CCIT						
1.	The DVDMT saves me time when I use it.					
2.	The SMT/CCIT saves me time when I use it.					
3.	It meets my needs.					
4.	It does everything I would expect it to do.					
5.	Makes it easy to conduct data quality checks					
6.	Allows auto filled fields based on previous information					
7.	It takes less time to enter information					
8.	It links to better performing supply chain					
9.	Helps in production of stock reports					
10.	Data is protected after approval and cannot be edited					
11.	It prevents submission of incomplete reports					
SYSTEM FUNCTIONALITY						
12.	DVDMT/SMT/CCIT is not very stable and crashes multiple times					
13.	It is easier to navigate through the forms to find information					
14.	The DVDMT allows me to use data offline					
15.	I don't notice any inconsistencies as I use it.					

		Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
EASE OF LEARNING						
16.	I learned to use it quickly.					
17.	I easily remember how to use it.					
18.	The user guide are very clear					
19.	Adequate support has been provided in using DVDMT					
USABILITY OF DVDMT/SMT/CCIT						
20.	I think that I would like to use this system frequently					
21.	I found the DVDMT unnecessarily complex					
22.	I think that I would need the support of a technical person to be able to use the DVDMT					
23.	I found the DVDMT and the SMT/CCIT well integrated					
24.	I found the DVDMT very cumbersome to use compared to the previous system					
25.	I felt very confident using the DVDMT					
26.	DVDMT/SMT/CCIT uses standard terminology throughout the system					
27.	It is easier to enter data in the DVDMT/SMT/CCIT hence speed up the reporting process.					
28.	The DVDMT is very reliable					
29.	DVDMT is user friendly.					
30.	I can use it without written instructions.					
31.	It is easy to correct mistakes in the DVDMT/SMT/CCIT					
32.	I am satisfied with the DVDMT/SMT/CCIT					

		Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
ANALYSIS AND REPORTING						
33.	The DVDMT/SMT/CCIT allows generation of reports from the data entered					
34.	It is easy to generate report that show – various geographical areas					
35.	It is easy to generate report that show – trend over time					
36.	It is easy to generate report that show variation– between multiple facilities.					
37.	With the DVDMT calculations are made easy					
38.	I can easily predict vaccine stock-outs using the DVDMT/SMT					
39.	They help avoid overstock and understock					
40.	The DVDMT/SMT/CCIT allows better reports that help in identifying gaps					
41.	The reports generated by DVDMT/SMT/CCIT saves me a lot of time					

THANK YOU FOR YOUR TIME AND COOPERATION

Annex 2: Data verification checklists for non-VIMS and VIMS facilities

Data Verification Checklist-1

A. Basic Profile

1. REGION ....

2. DISTRICT ....

3. Do they use vims for data management? YES NO

B. Vaccine Stock Management-District Level

(Assess from the District stock ledger report and fill appropriately the stock at hand of **PENTAVALENT VACCINES** in that particular month)

Under One Year Annual Target (Surviving Infants)

2016	2017

Monthly target stock (In Doses) as per children under one year	Stock at hand at the end of this particular month of 2016/2017					
	November 2016	December 2016	January 2017	February 2017	March 2017	April 2017

C. Data Verification from the District Immunization and Vaccine Officer (DIVO)

1. In the past six months can you recall how many episodes of understock of any vaccine or ad syringe experienced? (Circle accordingly)

   a. Never

   b. Between 2-3

   c. More than 3

   d. Mention if he/she recalls exactly number of episodes ....

2. In the past six months can you recall how many episodes of overstock of any vaccine experienced? (Circle accordingly)

   a. Never

   b. Between 2-3

   c. More than 3

   d. Mention if he/she recalls exactly number of episodes ....

Assessing the Effectiveness of a Web-Based Vaccine Information Management System on Immunization-Related Data Functions

Data Verification Checklist-2

(Note: This tool is to be used ONLY at the regional level)

1. REGION ....
2. How many districts are supposed to report immunization data in this region? ....
3. Assess from the REGIONAL monthly DVDMT data for indicators

Number recorded for this particular month of 2016/2017 (regional data)

Indicator	*Number of districts reported data on time (i.e. Before or on15ᵗʰ of next month)*	Number of districts which submitted immunization reports on that particular month
February 2016		
March 2016		
April 2016		
May 2016		
June 2016		
July 2016		
August 2016		
September 2016		
October 2016		
November 2016		
December 2016		
January 2017		

Data Verification Checklist-3

(Use a separate checklist for each district)

A. Basic Profile

1. REGION ....
2. DISTRICT ....

B. Data Quality Assessment

1. How many health facilities are supposed to report immunization data in this district? ....

Assess from the Health facility monthly reports (PAPER REPORTS) at District for these indicators and record them accordingly

Indicator 1: Number of children vaccinated for Penta 1 from each facility

Number recorded for this particular month of 2016/2017 (District data)												
Name of the health facility	February 2016	March 2016	April 2016	May 2016	June 2016	July 2016	August 2016	Sept 2016	October 2016	Nov 2016	Dec 2016	Jan 2017

Number recorded for this particular month of 2016/2017 (District data)												
Name of the health facility	February 2016	March 2016	April 2016	May 2016	June 2016	July 2016	August 2016	Sept 2016	October 2016	Nov 2016	Dec 2016	Jan 2017

Number recorded for this particular month of 2016/2017 (District data)												
Name of the health facility	February 2016	March 2016	April 2016	May 2016	June 2016	July 2016	August 2016	Sept 2016	October 2016	Nov 2016	Dec 2016	Jan 2017

Assessing the Effectiveness of a Web-Based Vaccine Information Management System on Immunization-Related Data Functions

Indicator 2: Number of children vaccinated for Penta 3 from each facility

Number recorded for this particular month of 2016/2017 (District data)												
Name of the health facility	February 2016	March 2016	April 2016	May 2016	June 2016	July 2016	August 2016	Sept 2016	October 2016	Nov 2016	Dec 2016	Jan 2017

Number recorded for this particular month of 2016/2017 (District data)												
Name of the health facility	February 2016	March 2016	April 2016	May 2016	June 2016	July 2016	August 2016	Sept 2016	October 2016	Nov 2016	Dec 2016	Jan 2017

Number recorded for this particular month of 2016/2017 (District data)												
Name of the health facility	February 2016	March 2016	April 2016	May 2016	June 2016	July 2016	August 2016	Sept 2016	October 2016	Nov 2016	Dec 2016	Jan 2017

Data Verification Checklist-4

(Use a separate checklist for each district)

A. Basic Profile

1. REGION ....

2. DISTRICT ....

B. Data Consistency

1. Assess from the REGIONAL DVDMT monthly data for these indicators

Number recorded for this particular month of 2016/2017 (District data)							
Indicator	**Nov 2016**	**Dec 2016**	**January 2017**	**February 2017**	**March 2017**	**July 2016**	**April 2017**
Number of children vaccinated for **Penta 1**							
Number of children vaccinated for **Penta 3**							

2. Assess from the DISTRICT DVDMT monthly data for these indicators

Number recorded for this particular month of 2016/2017 (District data)							
Indicator	**Nov 2016**	**Dec 2016**	**January 2017**	**February 2017**	**March 2017**	**July 2016**	**April 2017**
Number of children vaccinated for **Penta 1**							
Number of children vaccinated for **Penta 3**							

Assessing the Effectiveness of a Web-Based Vaccine Information Management System on Immunization-Related Data Functions

Annex 3A: Informed Consent Form for Users and Non-Users of VIMS (English)

Consent to participate in research

Introduction: Greetings! My name is............................... I am a member of the research team conducting a study to assess the implementation of VIMS, a JSI/USAID supported initiative to improve the performance of immunization and vaccination functions in selected regions of mainland Tanzania.

Purpose of the assessment

We would like to thank you for participating in this interview. The interview is part of this study involving users and non -users of the system (VIMS) and aims at assessing the performance of the systems during the course of its implementation/pre test. The reason for inviting you for the interview is to understand your (as a RIVO, DIVO, health worker or other beneficiaries) perspectives of the of the system, your opinion on the success, challenges, best practices and lessons learned during the course of its implementation. We would like to learn from non-users experiences with regard to their experiences, the challenges and willingness to use the system. In this assessment we will conduct interviews with health workers at different levels (regional, district and other lower facilities) with selected frontline health workers who participated in the implementation or benefited directly or indirectly from the intervention/project as well as those who have not used the system. Finally, we are also interested to document your recommendations for future direction of the program. The interview will take approximately one hour. If you feel that there are related issues that are relevant and important, please feel free to raise them during the interview and provide your opinion. Your responses will be treated with highest degree of confidentiality.

What participation involved

If you agree to participate in this study, you will be requested to answer questions on various issues about the implementation of VIMS in your district/region/facility. Participation is on voluntary basis. You will not receive any payment/gifts or rewards for participation.

Confidentiality

All information we collect on forms will be entered into computer with only the study identification number and that the information will be strictly confidential. The information you give will only be used for purposes of this evaluation

Rights to withdraw and alternatives

Taking part in this evaluation is completely your choice. If you choose not to respond to any question asked, this should be fine. You can stop participating in this interview any time even if you have already given your consent. Refusal to participate or withdraw from the evaluation will not involve any penalties.

Benefits

Your participation in this study will make you aware of your contribution to implementation of program, its challenges and lessons thus contributing to improving job performance, service delivery and eventually contribute to promoting health for yourself and members of community in general. We hope that the information we collect from you will provide lessons and recommendations that will eventually benefit you and others directly and indirectly through influencing programmatic changes geared at improving both curative and preventive services.

Potential Risks

There are no potential risks to your participation.

Who to Contact

If you ever have questions about this evaluation, you should contact the assessment team leader; Mr. Raphael Nshunju. His mobile number is: +255 715304263.

Signature:

Do you agree? (Please check where appropriate)

Participant agrees .... Participant does NOT agree..........................

I .... have read the contents in this form. My questions have been answered. I agree to participate in this evaluation.

Signature of participant .... Signature of researcher/assistant ....

Date of Signed consent ....

Annex 3B: Informed Consent Form for Users and Non-Users of VIMS (Kiswahili)

FOMU YA RIDHAA

Kuridhiakushirikikatikautafitikuhusutathminiyampangowamatumiziyamifumoyakielektronikikatika kutunzataarifazachanjo

Salaam! Mimi naitwa……………………………., nimshauriwakujitegemeaninayefanyakazikwaniabaya USAID/JSI, kutathminiutekelezajiwamradiwa VIMS kwenyebaadhiya mikoa/ wilaya/vituovyakutoleahudumahapa Tanzania

Lengo la utafiti/tathmini

Tungependakukushukurukwakukubalikushirikikwenyeutafitihuu, tungependakuzungumznawewekwaajiliyakupatamaoninauzoefuwakokuhusumfumohuu. Utafiti/tathminihiiinalengakuangaliautendajiwamfumohuuwautoajinaupelekajiwataarifazachanjotanguulipoanz akutekelezwakwamajaribio

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Ushirikiganiunaohitajikakutokakwako

Ukiridhiakushirikikatikatathminihiiutatakiwakujibumaswaliyatakayoulizwakuhusiananamasuaalambalimbalikuh usumpangohuuwa VIMS.Ushirikiwakoniwawahiari, hakutakuwanamalipoyatakayotolewakwakushiriki.

Usiri

Taarifazotetutakazokusanyazitaingizwanakutunzwakwenyetarakilishitukiandikanambayakoyautambulishotu, nataarifahizozitatunzwakwausirimkubwa

Hakiyakujitoakatikatathmini

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Faida

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Hatari/atharizinazowezakutokea

Hakunamadharayoyotekatikakushirikikatikatathminihii.

Mawasiliano

Kama utakuwanaswali au maswalikuhusiananatathminihii, wasiliananaMkuuwatimuyatathmini Mr. Raphael Nshunjukutoka JSI.Nambayakeyasimuyamkononini +255 0715304263

Sahihi:

Je, unakubalikushiriki? (Weka alamapanapostahili)

Mshiriki ANAKUBALI...................................Mshiriki HAKUBALI..........................

Mimi..nimesomayaliyomokatikahatihii.Maswaliyanguyoteyamejibiwavizuri.Nakuba likushirikikatikatathminihii.

SahihiyaMshiriki..

Sahihiya mtathimini/msaidizi..

Tarehe..