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Strengthening High Impact Interventions for an AIDS-free Generation

AIDSFREE ZAMBIA

ELECTRONIC LOGISTICS MANAGEMENT INFORMATION SYSTEM

EVALUATION REPORT

SEPTEMBER 2018

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JSI Research & Training Institute, Inc.
Plot 8658
Kudu Road
PO Box 320087
Lusaka, Zambia
Email: info@aids-free.org
Web: aidsfree.usaid.gov

CONTENTS

ACRONYMS

AIDSFree	Strengthening High Impact Interventions for an AIDS-free Generation
AMC	average monthly consumption
ARV	antiretroviral
CE	Central Edition
CSC	Commodity Security Center
DHO	district health office
eLMIS	electronic Logistics Management Information System
EM	essential medicine
FE	Facility Edition
GHSC-PSM	Global Health Supply Chain Procurement Supply Management
IT	information technology
LMIS	Logistics Management Information System
LMU	logistics management unit
M&E	monitoring and evaluation
MOH	Ministry of Health
MOS	months of stock
MSL	Medical Stores Limited
OJT	on-the-job training
PHO	provincial health office
R&R	report and requisition
SATP	stocked according to plan
SCC	stock control card
SDP	service delivery point
SCMgr	Supply Chain Manager (software)
USAID	United States Agency for International Development
ZMW	kwacha (Zambia currency)

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Deep gratitude is extended to all the respondents who provided valuable information to the field staff amidst competing demands. AIDSFree looks forward to your continued cooperation and partnership in improving the public health supply chain as we strive to attain the UNAIDS 90-90-90 goals to save lives.

Wendy Nicodemus
Country Director
Strengthening High Impact Interventions for an AIDS-free Generation (AIDSFree) Project

EXECUTIVE SUMMARY

This evaluation of the electronic Logistics Management Information System (eLMIS) of Zambia used a formative evaluation method using a mix of quantitative data collected in all 97 health facilities visited and qualitative data collected in selected health facilities, district health offices, and the central medical stores. The evaluation serves as a baseline for AIDSFree Zambia and as a midterm for the eLMIS as a follow-up to the baseline evaluation conducted in 2014.

The purpose of this evaluation was to assess the progress and the effectiveness of the eLMIS intervention from introduction in early 2014 to present. The assessment focused on both editions of the eLMIS being implemented in Zambia: the Central Edition (CE) and the Facility Edition (FE). The focus of the FE was on overall influence of the eLMIS on supply chain performance for the 100 phase I[1] health facilities in which FE has been rolled out for more than one year. The focus of the CE was on the overall influence of the eLMIS on supply chain performance for the more than 2,000 health facilities in the country, including the 100 phase I facilities.

The evaluation specifically focused on the following research questions:

1. To what extent has the eLMIS improved the timeliness, frequency, and accuracy of reporting?
2. To what extent has the eLMIS improved data accessibility, transparency, and quality?
3. Has the availability of eLMIS data led to increased data use or data-driven decision-making?
4. To what extent is the eLMIS usable and acceptable among different users?
5. To what extent has the eLMIS improved supply chain performance?
6. What was the initial investment and ongoing operating costs of the eLMIS solution?
7. What are the financial benefits accrued to the supply chain through the eLMIS?
8. What is the net cost implication of introducing and scaling the eLMIS through 2019?

To answer these questions, descriptive and cross-tabulation tables were created for key quantitative indicators to compare supply chain performance before and after rollout of eLMIS. The qualitative analysis was guided by predefined coding categories based on research questions and the conceptual framework. Based on costs calculated per survey response, summary statistics were calculated and estimates for scale-up benefits determined. It should be noted, however, that this cost-benefit analysis focuses only on

[1] The eLMIS FE is being rolled out in phases, with the first 100 facilities rolled out between 2014 and 2016 considered phase I.

direct attributable costs and benefits of eLMIS implementation. It does not include any direct benefits that cannot be estimated with confidence using the proposed methods (such as reductions in emergency orders, reduced expiries, or other performance improvements), nor does it include benefits to Zambia's wider economy as a result of improved health (due to improved supply chain performance).

The conclusion of the analysis is that eLMIS has improved supply chain performance around the key supply chain indicators of reporting and commodity availability. It was also perceived to be more efficient than Supply Chain Manager (SCMgr) software, and it was projected that eLMIS will generate cost savings in specific areas through improving supply chain processes.

INTRODUCTION

Electronic information systems are increasingly becoming integral tools for data collection, storage, and analysis in strategic management of customer-supplier relationships, with the development of information communication technology, electronic data interchange, and the internet (Gunasekaran 2003). These systems are becoming increasingly common in transport, agriculture, manufacturing, and health as they continue to generate credible evidence of the efficiencies introduced into business processes by enhancing coordination between the customers and suppliers, and create superior inventory management and increase data visibility between levels or organizations (Lin and Huang 2002; Sittig 2012).

In supply chain management, there is a growing demand for increased visibility and availability of data. Electronic information systems provide better visibility into the logistics information system and enable key stakeholders to make required decisions with that data. Research studies have demonstrated eLMIS also improves the quality of logistics data, thus improving supply chain performance and commodity availability at health facilities, which ultimately leads to better patient health outcomes (Rosen et al. 2014; Kablalisa et al. 2016). Recognizing this potential, the Government of Zambia, through its Ministry of Health (MOH), has embarked on a comprehensive program intended to strengthen the supply chain process using a robust electronic information system to capture and manage data. In 2014, the Government began implementing an electronic Logistics Management Information System (eLMIS) to help achieve this goal.

BACKGROUND

Overview of Zambia eLMIS

The Zambia National Commodity Logistics Systems manages commodities for HIV, malaria, reproductive health, and essential medicines (EMs). These commodities are managed through the antiretroviral (ARV), laboratory, the EMs Logistics Improvement Program (EMLIP), and HIV tests logistics systems. The logistics systems are pull systems in which commodities flow from Medical Stores Limited (MSL) to the service delivery points (SDPs) based on ordered quantities. Commodities are prepacked for each facility and flow from the central MSL warehouse to all health facilities, either directly or through the MSL hub or the district health office (DHO). In response, logistics information about these commodities (e.g., consumption/issues, stock on hand, and losses and adjustments) which is used to resupply the SDPs flows from the SDP to MSL. The health centers and health posts send logistics data to the DHOs for approval before they go on to the MSL, while logistics information collected at hospitals moves directly to the MSL.

Prior to the introduction of eLMIS, the logistics management information system (LMIS) was entirely paper-based. SDPs collected logistics data manually, via stock control cards and daily activity registers. Data were sent via report and requisition (R&R) forms and hard copies of these reports were sent to the DHO (health posts and health centers) for approval, or directly to the MSL by the hospitals. Once approved, reports would be sent to the logistics management unit (LMU), where they would be manually entered into Supply Chain Manager (SCMgr) for order processing. Once processed, the orders were forwarded to the central medical stores for order fulfillment and dispatch to the SDPs.

The eLMIS was launched in Zambia in 2014 with the aim of increasing the availability of medicines and commodities and improving health outcomes for HIV-positive patients on antiretroviral therapy by automating the reporting and ordering system in health facilities around the country. The eLMIS was first introduced at the MSL in early 2014 as the CE, replacing the Access-based SCMgr previously used as an order-processing software at the LMU (now referred to as the Commodity Security Center, or CSC). In this edition, paper-based reports sent from health facilities were received by data clerks at the MSL LMU and entered into the web-based eLMIS CE. Based on results from the baseline evaluation of eLMIS, moving to the eLMIS CE improved the visibility and availability of key logistics data (e.g., consumption/issues, stock on hand and losses, and adjustments) to various levels of the health system through the internet.

A second version of the eLMIS, the facility edition (FE), was introduced and piloted in 48 health facilities across Zambia, followed by a rollout to 100 phase I facilities after the evaluation assessment in August 2014. The aim of this version was to automate the facility-level transactions and logistics reporting to achieve and improve timely report submissions, improve data quality and commodity availability, and

improve order processing turnaround time. In August 2014, after an assessment of the eLMIS FE pilot, rollout to more facilities across Zambia commenced. Since 2014, AIDSFree Zambia, with support from the United States Agency for International Development (USAID) has continued the rollout of the eLMIS FE with a target of reaching 600 health facilities by March 2019. As of July 2017, a total of 317 health facilities had the eLMIS FE installed.

In line with the UNAIDS 90-90-90 goals, the implementation of the eLMIS system by the Strengthening High Impact Interventions for an AIDS-free (AIDSFree) Project in Zambia is aimed at introducing operational efficiency, increasing quick report submissions, and improving order process rates within the health supply chain to ensure product availability and improve health outcomes of anti-retroviral therapy patients. This midterm evaluation of the eLMIS is focused on determining the contribution of the system to improved supply chain performance through increased product availability, higher facility reporting rates, and increased availability of health facility workers to attend to clients at health facilities through reduction in time spent completing logistics reports.

OBJECTIVES

Introduction

Now that the eLMIS CE and FE have been rolled out for two years, there is a need to demonstrate how data quality and use, cost savings, and supply chain performance inform the Government and other local stakeholders working on strengthening the supply chain. This midterm evaluation aims to demonstrate the impact of the eLMIS on a range of supply chain and business practice outcomes. The evaluation also aims to show the economic impact, determining whether the implementation of eLMIS has generated any cost savings. Lessons from this evaluation can inform ongoing AIDSFree Project implementation activities to better understand barriers and enablers in eLMIS introduction and rollout. Similar evaluations of the eLMIS have recently been conducted in Rwanda and Tanzania (Rosen et al. 2014; Kablalisa et al. 2016).

This evaluation serves both as a midterm evaluation for the software and baseline evaluation for the AIDSFree Project. A baseline study for the eLMIS CE was conducted by the USAID | DELIVER PROJECT, a predecessor to the AIDSFree Project. The study focused on the functionality and effectiveness of the CE and FE eLMIS in Zambia. It also discovered strengths and weaknesses that were used to improve functionality of the eLMIS CE and FE editions currently in use.

Key Research Questions

The following are the key research questions that this evaluation aims to answer.

1. To what extent has the eLMIS *improved* frequency, timeliness, and accuracy *of reporting*?
2. To what extent has the eLMIS *improved* data accessibility, transparency, and quality?
3. Has the availability of eLMIS data led to *increased data use and/or data-driven decision-making*?
4. To what extent is the eLMIS *FE usable and acceptable* among different users?
5. To what extent has the eLMIS contributed *improved overall supply chain performance*?

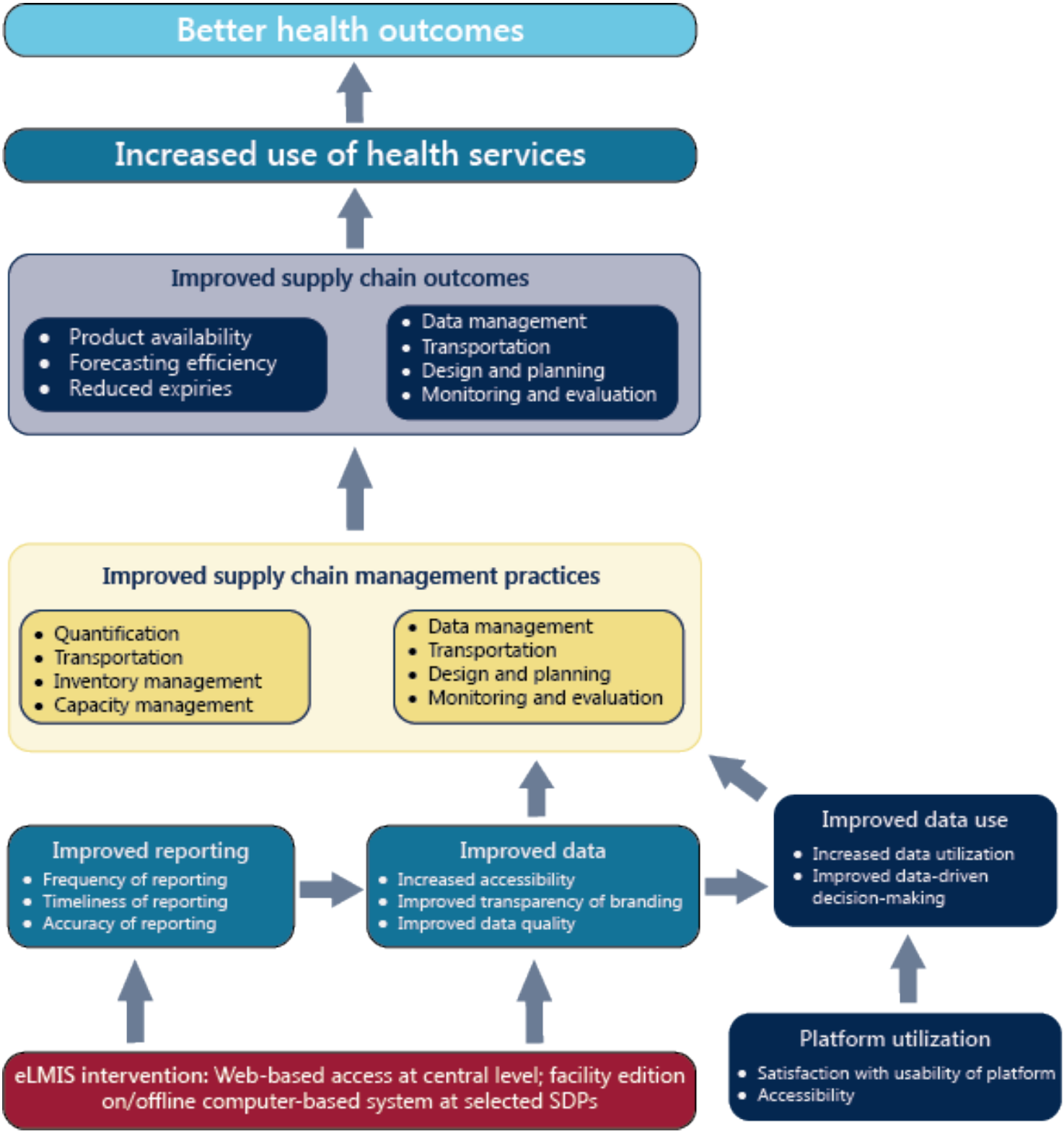
Another aspect of the study was focused on the cost-benefit of eLMIS, with specific focus on the reasonably attributable savings and costs of implementation against operating the eLMIS system, respectively. The cost-benefit evaluation was based on the following research questions:

1. What are the initial investment and ongoing operating costs of the eLMIS solution?
2. What financial benefits accrued to the supply chain through the eLMIS?
3. What is the net cost implication of introducing and scaling the eLMIS through 2019?

CONCEPTUAL FRAMEWORK

Underpinning the evaluation approach is a conceptual framework that describes the pathways through which the eLMIS acts on data production and use and ultimately on supply chain performance, with the ultimate aim of increasing use of health services and improving health outcomes (Figure 1). For the eLMIS intervention, the hypothesized pathway to better supply chain management practices is to improve data capture, reporting, accessibility, transparency, timeliness, and quality. By strengthening data capture and reporting and improving real-time data accessibility and quality, the eLMIS affects a range of supply chain management practices. These improvements lead to better supply chain outcomes, in turn leading to improved medicine availability, then leading to increased uptake of health services and ultimately improved health outcomes. Additionally, the conceptual framework illustrates the relationship between improved aspects of data transparency and quality and increased data use. It is assumed that if better data are available, data use for decision-making will increase. This pathway also leads to better supply chain practices and outcomes (see Figure 1).

Figure 1. eLMIS Path to Improved Supply Chain Management



METHODOLOGY

Survey Methods

A mixed methods approach was used with quantitative and qualitative key informant interview questionnaires administered at the different levels of the system. Quantitative interviews for both the laboratory and pharmacy departments were conducted at the health facilities. A few selected sites also completed a key informant qualitative interview. At the district level, only the key informant qualitative interviews were administered, as the system is not designed to store any health commodities at this level. For comparison of SCMgr and eLMIS performance, secondary data were extracted from both systems for analysis. Based on the study objectives, data extracted for the comparison of SCMgr and eLMIS were focused on supply chain performance of all 2,000+ health facilities, whereas data collected from quantitative and qualitative interviews (in selected health facilities) were focused only on the performance of the 100 phase I sites with eLMIS FE.

For the cost-benefit analysis, a questionnaire was developed to be administered to staff responsible for LMIS activities that would be affected by the transition to the eLMIS—completing and submitting reports, and (in the case of DHOs and MSL) processing submitted reports. This questionnaire asked respondents for the following information:

- Position and civil service grade
- Amount of time spent per reporting period on completing LMIS reports before and after the introduction of the eLMIS to their facility
- Amount of time any other staff normally spent on completing LMIS reports under the paper-based and electronic reporting systems
- The civil service grades of any of those staff

Separate questionnaires were developed for respondents from SDPs such as health centers, clinics, and hospitals; DHOs; and MSL. Each questionnaire largely focused on the above questions, with phrasing and structuring tailored for each respondent type.

Additionally, many implementation costs were incurred by the AIDSFree Project or its predecessor and were documented from project financial records to the extent possible. These costs include one-time development expenses, system maintenance, user training, and system hardware.

STUDY SAMPLE

The study sample was segmented based on the two main sections of the study, each looking at the extent to which the CE and FE eLMIS editions improved the performance of the supply chain in health facilities in Zambia. In the first section, secondary data were collected to analyze the overall improvement in supply chain performance for the more than 2,000 health facilities since the implementation of the eLMIS (this number included all health facilities in the country.)

In the second section, a mix of primary and secondary data was collected to compare performance in supply chain management and practices in only the first 100 health facilities (phase I) that used the facility edition. This comparison focused on the pre- and post-implementation periods (selected period during which the Access-based SCMgr software was used and following the rollout of eLMIS FE, respectively). In addition to the 100 health facilities, 52 districts and the central MSL were also included in the sample. A subset of 54 DHOs, hospitals, and health centers participated in the costing survey.

The 100 health facilities are shown in Table 1 by level and location (the full list of facilities visited is in Appendix 1). Secondary data were extracted for selected reporting and supply chain performance indicators from SCMgr and the eLMIS, while quantitative, qualitative, and costing interview questionnaires were used to collect data from the health facility, district, and central warehouse field visits where applicable.

Table 1. Facility Selection by Level and Location

Facility Province	Facility Level				
	Level 3	Level 2	Level 1	Health Center	TOTAL
Central	0	1	5	5	**11**
Copperbelt	1	3	8	9	**21**
Eastern	0	1	6	1	**8**
Luapula	0	2	2	1	**5**
Lusaka	1	2	6	14	**23**
Muchinga	0	0	1	0	**2**
Northern	0	1	1	3	**5**
North Western	0	2	0	1	**3**
Southern	1	4	4	4	**13**
Western	0	0	7	0	**7**
TOTAL	**3**	**16**	**40**	**38**	**97**

DATA COLLECTION

The field data collection process of the evaluation was conducted over a period of four weeks. The data collection was scheduled in two rounds of one and three weeks. Five teams conducted the collections in all 10 provinces. The collection and management of data were separated into quantitative and qualitative data components.

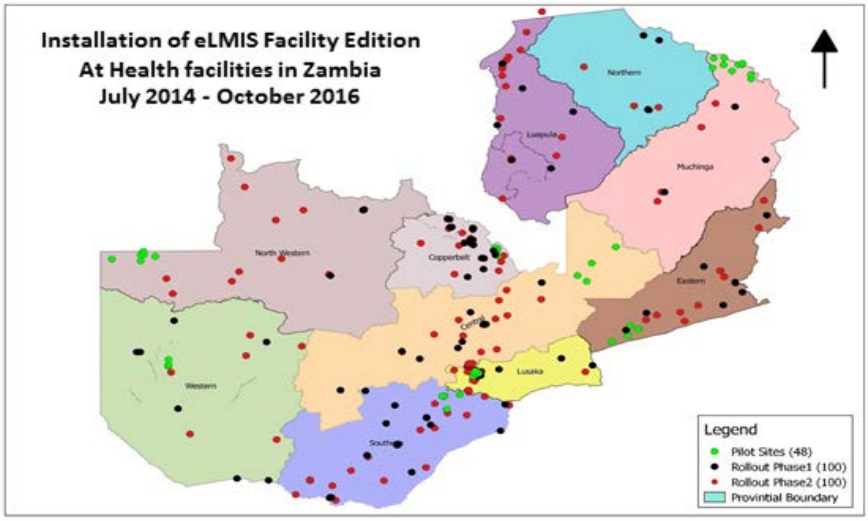
Field Visits

The first week of data collection was April 23–29, 2017. The second round of data collection took place May 7–27, 2017. For the central warehouse, the qualitative interview was conducted in June 2017. All quantitative interviews were collected using mobile devices and submitted to a web-based monitoring and evaluation data collection application called Magpi. For the qualitative and costing interviews, verbatim interviews were recorded using two data collectors, one administering the interview while the other recorded. These two roles alternated between MOH representatives and AIDSFree staff.

Team Composition and Coverage

Each data collection team was led by a technical lead from AIDSFree, a MOH representative from the headquarters or province, and a representative from the district. Each technical team was supported by an AIDSFree administrative assistant. For both round 1 and 2 of the data collection, five teams were in the field in various provinces and districts. Figure 2 shows the geographic coverage of the rollout in phase I sites (black dots) that were visited for data collection, by province. Each team also visited the district level for courtesy calls or a qualitative interview, where applicable. A total of 53 districts were visited.

Figure 2. eLMIS FE Installation in Zambian Health Facilities, July 2014–October 2016



DATA MANAGEMENT AND ANALYSIS

Quantitative Data

Key indicator data were downloaded from the systems (SCMgr and eLMIS) and entered into Excel for the periods March 2012 to February 2013 for SCMgr, and March 2016 to February 2017 for eLMIS. The full list of indicator products can be found in Appendix 2. Quantitative indicators that were not available through the eLMIS were collected through the administered facility and district level questionnaires. The data was collected using Magpi, a mobile data platform, using mobile devices. All data collected were stored online using the Magpi server. A secondary data repository was created to store data electronically on the AIDSFree servers. Access to these data was limited to research team members from the Boston and Lusaka offices. A total of 186 interviews were completed and uploaded into the Magpi server.

Qualitative and Costing Data

Interviews were conducted at health facilities, DHOs, and the central medical stores. Each data collection team had one facilitator and one transcriber, roles that alternated between MOH and AIDSFree staff. The facilitator recorded key points, which were reconciled with the notes collected by the transcriber at the end of each field day. This was done to ensure accuracy and completeness of the transcripts and to share understanding of the respondents' views and experiences. Following reconciliation of the notes, each two-person data collection team compiled a comprehensive and final transcript of the interview and saved an electronic copy. The completed interviews did not include any personal identification data.

Analysis

To compare supply performance during the tenure of SCMgr against that of eLMIS, descriptive statistics and cross-tabulation tables were created for the key quantitative indicators. All indicators and the indicator definition are listed in Appendix 3. The data were downloaded from the server systems and exported to Excel spreadsheets for analysis. Indicator topics included reporting frequency, quality, and data use to establish the general picture of supply chain performance over the two time periods.

All qualitative transcripts were reviewed by two members of the research team for thematic analysis. Themes were derived from the questions that the qualitative data were intended to answer. An initial set of predefined coding categories, based on the research questions and the conceptual framework, were used to guide analysis of the transcripts. Additional codes were drawn directly and inductively throughout the data analysis process. References were categorized into codes, and the study team analyzed the findings to provide an explanation of the detail, variation, meaning, and nuance. For the

cost-benefit component, costing surveys were transcribed into a spreadsheet. The responses were then reviewed for completeness and correctness, and the interviewer provided clarification for any response that was incomplete or unclear. Several edits were made to the transcribed dataset for analysis, including the following:

- Correction of facility codes
- Harmonization of reported civil service codes with current system: some respondents gave responses as "Division 1, Division 2, etc.," which were translated to the current A, B, C, D, F, etc.
- Translation of time spent into work hours: in some cases, respondents gave their required report completion time in days, which were mistakenly written down as "24 hours" for one day when it should be captured as eight work hours.

Three DHO responses also were removed from the dataset for the purpose of analysis because at the time of the survey they used both the paper LMIS and eLMIS.

Following data cleaning, reported time spent on LMIS activities was valued using the 2013 civil servant union collective bargaining agreement. Value per work-hour was calculated in Zambia kwacha (ZMW) and compared to reported hours spent to estimate a monetary cost for individual responses. For each individual response, a total savings per reporting period was calculated by comparing the cost under the paper LMIS to the cost under eLMIS reporting.

Based on the costs calculated per survey responses, summary statistics were calculated and estimates for scale-up benefits determined.

Additionally, the cost-benefit analysis included costs provided by AIDSFree Project accounting. These implementation and operating costs were captured by a project accounting system for accounting, project management, and budgeting purposes, and they have sufficient granularity to the eLMIS implementation project to include certain costs within this cost-benefit analysis. Cost line-items estimated this way are listed in Table 2.

Table 2. Implementation and Operating Cost Line Items

Line Item	Notes
One-time eLMIS development costs	Original project also supported Tanzania; these costs are attributed to Zambia specifically.
eLMIS user training and ongoing support costs	It was not possible to disaggregate these two costs, so they are included together
eLMIS hardware provision	Includes shipping and distribution
Printing of paper forms	It was not possible to obtain enough context to figures, so they are not included in analysis.

FINDINGS

This section presents the results from the data analysis of the eLMIS evaluation. The results are presented by domain with general frequencies and descriptive statistics for all background variables, followed by cross-tabulations of selected variables. All the tabulation of results in this report have been accompanied by a narrative discussion, or a guide, for interpreting the results. It is important to note that these results are based on the data obtained from 186 health facility questionnaires administered in the 52 target districts to the 100 target health facilities.

Respondent Distribution

Table 3 shows the distribution of health facilities in provinces and respondents by department (pharmacy or laboratory). The results show an equal representation of pharmacy and laboratory respondents, with pharmacy accounting for 52 percent. Within the provinces, the distribution is (more or less) equal between the pharmacy and laboratory. The result is consistent with the study's aim of equal representation of the two departments. The slightly higher number of pharmacy respondents is also consistent with the national population of health facilities having more pharmacy than laboratory departments. Three facilities were not visited because two of the facilities had just moved to new locations while the third University Teaching Hospital (UTH) had stopped using the system for some time prior to the evaluation data collection period. The data on eLMIS FE presented in this report are from the 97 sites that were visited.

Table 3. Provincial Respondent Distribution

Province	No. of Health Facilities	Pharmacy		Laboratory		Total Respondents
		No.	%	No.	%	
Central	**11**	11	58	8	42	**19**
Copperbelt	**23**	21	50	21	50	**42**
Eastern	**8**	8	47	9	53	**17**
Luapula	**5**	5	50	5	50	**10**
Lusaka	**22**	23	53	20	47	**43**
Muchinga	**3**	1	33	2	67	**3**
Northern	**5**	5	56	4	44	**9**
Northwestern	**3**	3	75	1	25	**4**
Southern	**13**	13	50	13	50	**26**
Western	**7**	7	54	6	46	**13**
TOTAL	**100**	**97**	**52**	**89**	**48**	**186**

Table 4 shows the distribution of respondents by health facility level. Of the respondents in this study, 40 percent were from Level 1 health facilities, followed by 39 percent from health centers and 18 percent from Level 2 and 3 percent from Level 3 health facilities.

Table 4. Facility-Level Respondent Distribution

Facility Level	No. of Facilities	Pharmacy		Laboratory		Total	
		No.	%	No.	%	No.	%
Health Center	**41**	**38**	53	34	47	72	**39**
Level 1 Hospital	**39**	**40**	54	34	46	74	**40**
Level 2 Hospital	**18**	**16**	47	18	53	34	**18**
Level 3 Hospital	**2**	**3**	50	3	50	6	**3**
TOTAL	**100**	**97**	**52**	**89**	**48**	**186**	**100**

FINDINGS OF KEY RESEARCH QUESTIONS

Research Question 1: To what extent has the eLMIS improved reporting frequency, timeliness, and accuracy?

The evaluation measured three data reporting indicators: reporting rates, timeliness of reporting, and accuracy of reports.

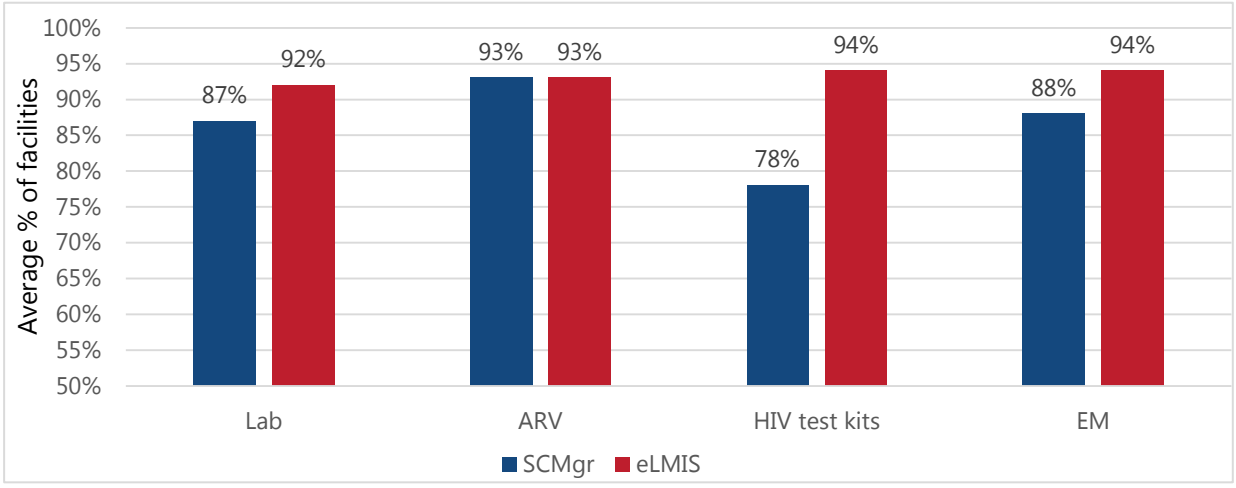
Reporting rates: Comparing the trend of reporting rates under SCMgr with the eLMIS implementation periods showed that there was more consistency in the reporting rates in the eLMIS implementation period compared to the SCMgr period. Further analysis focusing on 100 eLMIS FE facilities showed that average reporting rates for a period of 12 months was above 90 percent for all program areas.

Timeliness of reporting: Data on how promptly reports were submitted to MSL could not be extracted from SCMgr, which did not show time stamps on when a report was submitted, because MSL was receiving hard copy and thus showed only the time a report was entered in the system. A comparison of the timeliness of report submission of CE and FE found that FE was submitting reports in a more timely manner than CE.

Report accuracy: eLMIS was found to produce more accurate reports than SCMgr. This is because FE and CE pre-generate beginning balances based on the previous month's closing balance and flag discrepancies in entries. (A report was considered to be accurate if the closing balance for the previous month matched the beginning balance for the reporting month.)

Figure 3 shows a comparison of average annual reporting rates for all facilities reporting for the four program areas: ARVs, EMs, HIV test kits, and laboratory. Figure 5 shows that toward the end of the analysis period, the EM reporting rates continued to improve.

Figure 3. Average Annual Reporting Rates for SCMgr and eLMIS by Commodity Area



Additionally, Figures 4 and 5 show the monthly reporting rate trends over time between SCMgr (Figure 4) and eLMIS (Figure 5) for their respective reporting periods (SCMgr: March, 2012 to February 2013, eLMIS: March 2016 to February 2017). The trend is toward more consistent reporting rates in eLMIS, especially by February 2017. The average deviation when using SCMgr was 0.06 versus 0.03 when using eLMIS.

Of the 100 facilities using the FE, reporting rates were also very high. Figure 6 shows the consistently high reporting rates for the facilities using eLMIS FE in 2016–17. These are consistent with the eLMIS CE reporting rates, even slightly higher, especially for EMs, which averaged 91 percent for the year versus 88 percent in the CE. This shows that sites using the FE had a higher reporting rate for this program area.

Figure 4. Monthly Reporting Rates by Program (SCMgr), 2012–13

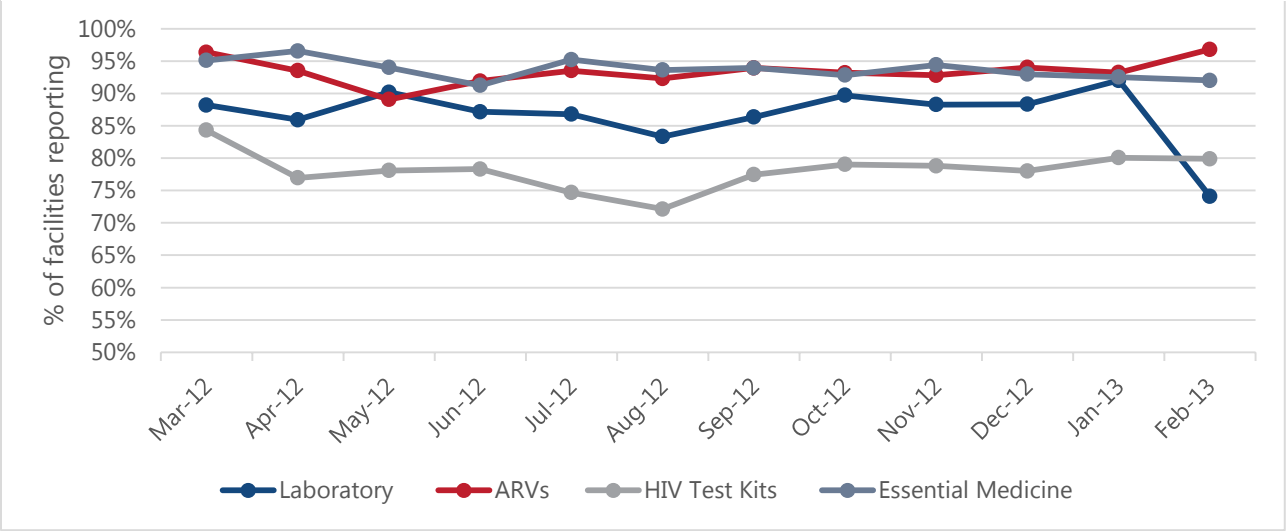


Figure 5. Monthly Reporting Rates by Program (eLMIS), 2016–17

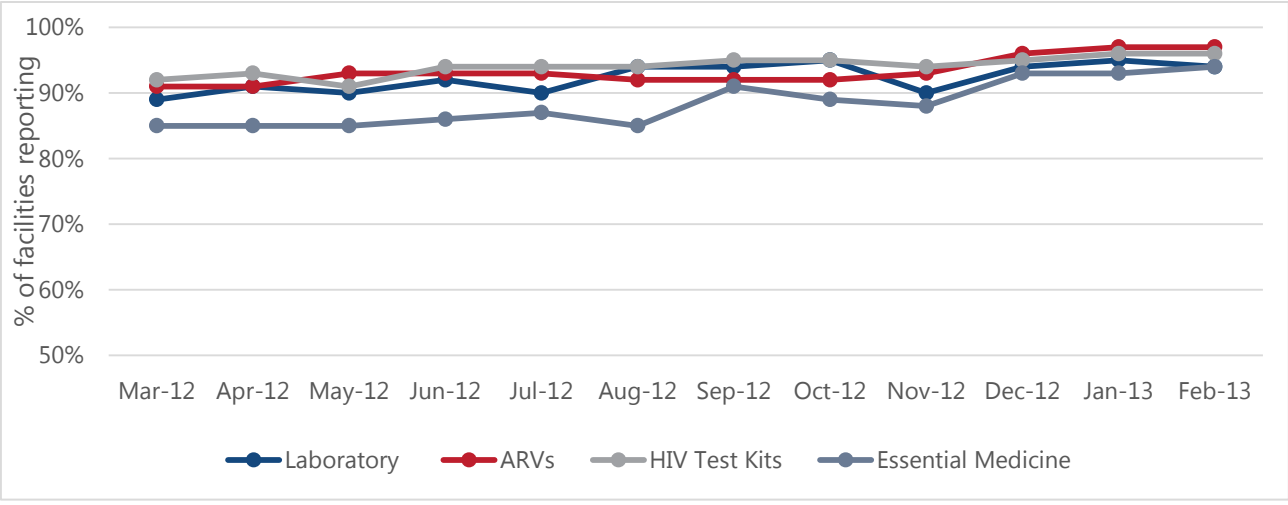


Figure 6. Average Monthly Reporting Rates by Program for Sites Using eLMIS FE (Phase I Facilities)

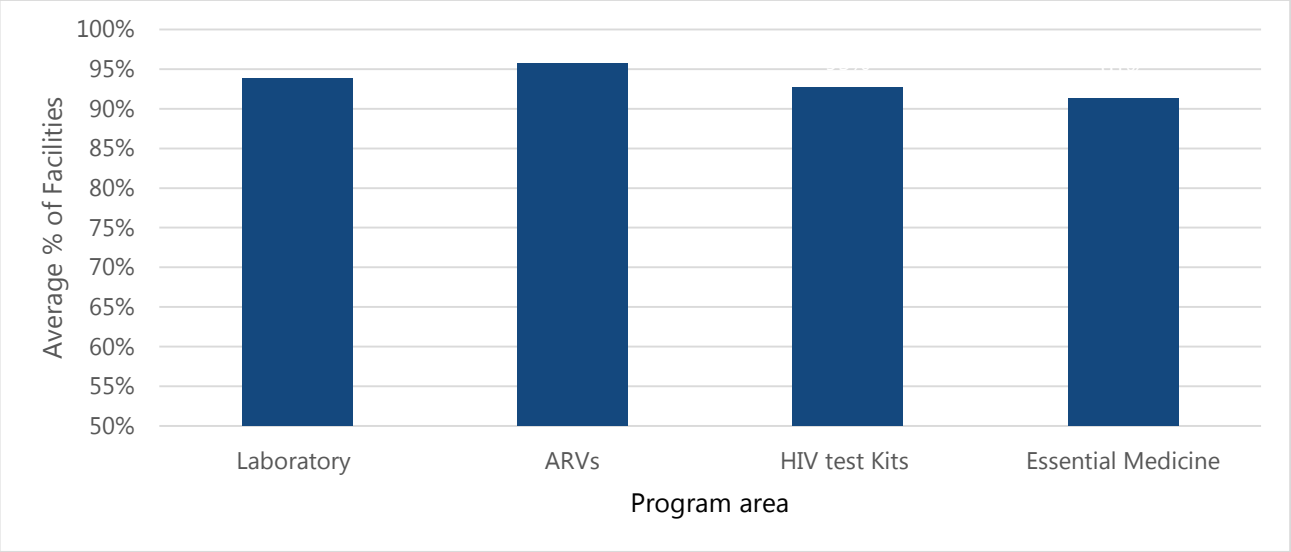


Figure 7. Average Annual On-Time Reporting Rates by Commodity Area (CE and FE)

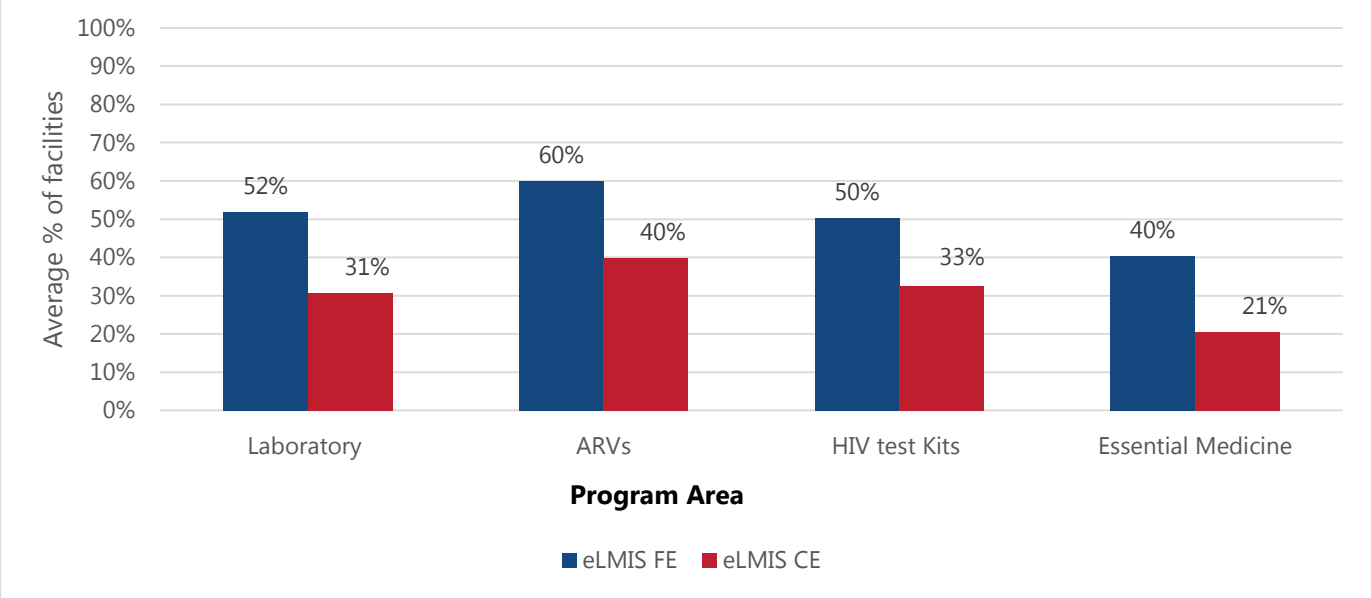


Figure 7 shows the percentage of all facilities that report on time by commodity area over their respective 12-month periods, as well as percentage of facilities with FE that report on time during the same period. On-time reporting is defined as report sent to or entered into the eLMIS CE by the 10th of the month following the reporting period. There is an obvious increase in on-time reporting when using the FE verses the CE, but the averages for both are still considered low, which will be analyzed in the discussion section of this report. Upon further analysis, 5.4 percent of the sites with FE reported with the CE and not the FE during this period.

Research Question 2: To what extent has the eLMIS improved data accessibility, transparency, and quality?

Data Accessibility

Respondents stated that use of eLMIS has improved data accessibility in two ways: Data are more easily available because they can be seen close to real time, and are more easily accessible because they are in one place. In addition, they reported that the data are more easily accessible because they are not lost or ruined by accident. However, some respondents from the central warehouse reported that not having real-time data is a limitation. The respondents said they could view complete data only for the previous month. This requires respondents to call the facilities to monitor how they are stocked. Even so, the eLMIS facilitates monitoring, even if data reports are delayed by a month.

> *"We pray one day it becomes real time, because right now to know how facilities are stocked, I have to call. And there is limited transport I can't go around. So if eLMIS was live, at least in the eight facilities that we have which are high-volume, it would be easy to monitor."* —Pharmacy Technologist

> *"Before eLMIS, it was difficult to identify problematic facilities or check the product status for facilities. But now all the information is available in the system. With transport challenges, you don't need to always go to facilities to check on issues. You can log into the system and be able to check on performance of facilities off-site."* —Pharmacy Technologist

Data Transparency

Respondents reported an increase in accountability because users are prompted to account for transactions because of the system has built-in controls, such as prompting for physical counts before the R&R is generated and providing reasons for any adjustment. Facilities now have more ownership of the data because they cannot easily falsify numbers. With the previous system, it was reported that users would falsify data numbers in reports. This data manipulation skewed numbers and results and could have contributed to inaccurate numbers being used for decision-making. Poor decisions made on poor quality data led to stockouts and other consequences. The electronic system has built-in calculations, making it more difficult to falsify numbers.

Data Quality

With the paper-based system, many respondents mentioned that paper records were too bulky and would easily tear off, running the risk of losing papers or having them ruined by the elements like rain, wear and tear from transport, etc. It was also difficult to do calculations and run analyses manually. This took time and delayed decision-making. With the initiation of the eLMIS FE, facilities are seeing improvements in the quality of data and system performance.

"It's very fast whenever I am dispensing ARVs. It makes me proud that I am dispensing the right drugs and right quantities." —Classified Daily Employee

"With eLMIS, the system is able to calculate accurately AMCs (average monthly consumption), check for incorrect figures, and improve data quality. Cooking of figures and order quantities used to be the order of the day." —Pharmacy Technologist

One respondent reported that the eLMIS enables him to compare numbers in the system to numbers in the hard-copy stock control card. This keeps him alert in his job and "no lazing any more" to ensure that the cards match what is entered in the system.

During the facility surveys, data were captured on how timely facilities update transactions in eLMIS FE. Table 5 shows the percentage of facilities with physical count conducted on day of visit, matching the balance on the electronic stock control card (SCC) on day of visit in eLMIS FE. A total of 15 indicator products were used for the assessment. On average, in 63 percent of the facilities visited, the physical count matched the SCC balance on eLMIS FE. Facilities first record the transaction on a hard copy SCC before entering it in eLMIS. It was found that entry in eLMIS occurred a few days after the transaction was conducted.

Table 5. Timeliness of Updating eLMIS Transactions

Product Category	Indicator Product Name	No. of Facilities	No. Updated on Time	% Updated on Time
ARV	Tenofovir 300 mg/Lamivudine 300 mg/Efavirenz 600 mg (TLE)	94	57	60.6
ARV	Abacavir 30 mg/Lamivudine 60 mg (ABC/3TC)	93	59	63.4
ARV	Lopinavir 80 mg/Ritonavir 20 mg (LPV/r)	88	56	63.6
EM- Antibiotic	Cotrimoxazole tablets 480 mg	93	55	59.1
Malaria	Artemether 120 mg/Lumefantrine 20 mg (ALs) 1*6 tabs	90	55	61.1
Malaria	Malaria rapid diagnostic test (RDT)	60	38	63.3
Reproductive Health	Depo-Provera	68	39	57.4
Reproductive Health	Ethinyloestradiol/Levonorgestrel 130 mg/150 mcg	71	44	62.0
Reproductive Health	Male condoms	77	43	55.8
Laboratory	BD Facs Count CD4% reagent	71	43	60.6
HIV Tests	Determine HIV test kits	83	49	59.0

Table 5, cont. Timeliness of Updating eLMIS Transactions

Product Category	Indicator Product Name	No. of Facilities	No. Updated on Time	% Updated on Time
Laboratory	EDTA Vacutainer (4 ml)	78	47	60.3
Laboratory	Rapid test kit for syphilis (RPR)	76	45	59.2
Laboratory	DBS Bundles for 50 tests	74	52	70.3
Laboratory	ABX Minoton (Minidil)	55	46	83.6

Some users of the central-level system did mention challenges with clean data, especially from those facilities still using the paper-based system.

> *"You know maybe this facility has been reporting 10, 12, 30 and suddenly you find a 10,000 (packs of commodities)—you stop there and say aha! where is this 10,000 coming from? And you ask a few questions, then maybe you find out that it's a misunderstanding of the pack size as an example… The pack sizes… we look at this because it is a result of many errors. Here is a product that has 50 and someone is ordering 50 and you know it contains 50 tests and the order is saying "one," and this is a hospital and you well know this is a hospital [so] you know that surely a hospital can't use one box for this so that's when you make a call only to hear them say they needed 50 [boxes] of 50 [tests each]."* —MSL Data Specialist

This comment refers to issues with users' understanding of product pack size as seen in data from Levy Mwanawasa General Hospital in Table 6. Some staff are confused about data regarding pack size, which can skew the consumption data. Consumption on AL 1x6, AL 2x6, and AL 3x6 was in the single digits in August–December 2016. Then, in May 2017, it rose to the hundreds. eLMIS does not currently have a feature that flags anomalies such as this to address potential problems in data quality.

Table 6. One-Year Consumption Patterns of Artemisinin-based Combination Therapy at Levy Mwanawasa General Hospital

Product	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17
AL 1x6	0	0	0	0	0	NR	0	0	NR	540	6	3
AL 2x6	0	0	0	0	0	NR	0	0	NR	210	0	0
AL 3x6	3	0	2	0	3	NR	0	0	NR	210	0	0
AL 4x6	0	0	0	0	0	NR	0	0	NR	150	8	8

Research Question 3: Has the availability of eLMIS data led to increased data use and/or data-driven decision-making?

> *"I know which drugs are stocked out and am able to make a decision, for example, to borrow from another facility or do an emergency order. For overstocks, I will be able to inform the district for*

possible redistribution to other facilities, thus avoiding wastage and expiries."
—Pharmacy Technologist

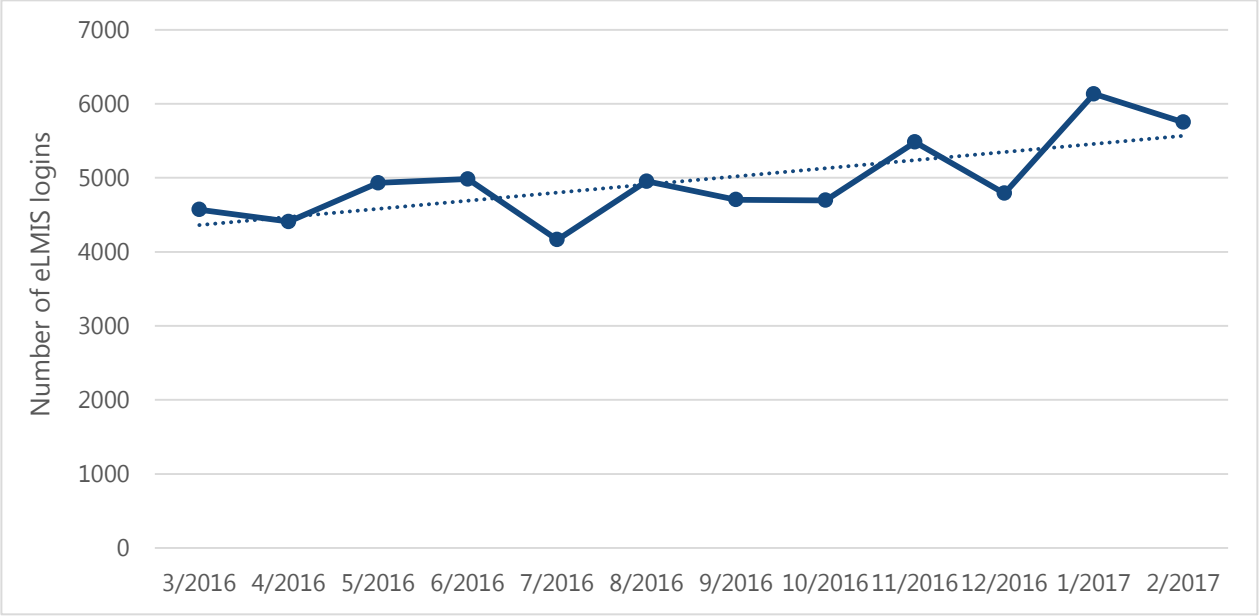
"From the stock status, I know what and how much to issue to the other departments. Also if there are low stocks, I would know how to ration some of these products." —Laboratory Technologist

"The system makes work easy for me, and I can make an informed decision at the end of the day."
—Pharmacist

"For example, this morning we were planning with some partners. We were able to do it within three minutes. They were asking, 'How has been the consumption in this clinic in the past three months?' It was easy; in the old days you had to first scratch your head and ask which box file? So, accessibility is very easy." —Pharmacy Technologist

In addition, in eLMIS user sessions can be tracked, meaning how often different users log into the system. Figure 8 depicts the growing user base of eLMIS since inception in 2015. Interestingly, the user description shows that many of the new users are district and provincial supervisors.

Figure 8. Number of User Sessions Over Time, March 2016–February 2017



Research Question 4: To what extent is the eLMIS FE usable and acceptable among different users?

Although there were several challenges, outlined below, the consensus from interviewed users was that eLMIS FE is acceptable and usable. Table 7 shows the level of satisfaction of the eLMIS FE users.

Table 7. eLMIS FE User Satisfaction

Is the eLMIS equipment suitable for its intended work?		
Response	**Number of Users**	**% of Responses**
No	12	6%
Yes	174	94%
Grand Total	186	100%

"What is good about eLMIS is that it shows what you feed in there. If, let's say, you happen not to dispense the drugs through the system, then there is nothing that you are going to dispense to the patients since the system has nothing. So, it makes you do the work you were omitting in the first place. I don't have a specific module I prefer; I enjoy working with it as a whole. I use the issuing, dispensing, and physical counts. I specifically like the receive, issue, and R&R [referring to reports] because they are straightforward. Again, say for the R&R, the figures will just come automatically because you have been using the system during the month." —Nursing Officer

Satisfaction with the system does not mean it works all the time, though. To verify if the system was functional on the day of the visit, the data collectors checked that eLMIS computer hardware and software were working as intended, allowing users to enter transactions and generate reports. Table 8 shows verified responses to the functionality of the eLMIS software and hardware. Of the total number of respondents (n=186), 90.3 percent had fully functional eLMIS FE software, 3.2 percent had no data (eLMIS software was not verifiable on the day of visit). Despite having made appointments with the facilities, the evaluation team was unable to verify software and hardware functionality because the equipment could not be accessed. In most cases, this was because the offices were locked; 6.5 percent were not able to use eLMIS on the day of visit. Of those facilities unable to use the system, seven were due to computer hardware challenges, mainly the network, while the remaining six were due to eLMIS software challenges. However, 94.1 percent had functional hardware on the day of the visit.

Table 8. Respondent Observations on eLMIS FE System Functionality (n=186)

Response	% with Functional Software (n=186)	% with Functional Hardware (n=186)
Not verified	3.2%	3.2%
No	6.5%	2.7%
Yes	90.3%	94.1%
Total	**100%**	**100%**

To confirm that there are staff trained at the facilities implementing the system, the data collectors inquired during the facility survey about the number of staff trained. All 186 respondents (97 pharmacy and 89 laboratory) reported having at least one trained staff member working in stock management in their department. The training was administered formally in a classroom setting or through on-the-job training by MOH facility staff or AIDSFree staff.

Even given the overall satisfaction, some respondents mentioned frustration with the speed of the program, stating it is sometimes hard to meet deadlines when the system is running slowly. Environmental factors sometimes interfered with system functioning; the most frequently cited were power outages which shut down the system. Additionally, poor reception caused systems to be slow when the internet was needed (at the district level or when facilities are submitting reports).

> *"What I don't like is the slow network. When that happens, it means more work. You have to enter the data afterward instead of doing it as you are dispensing."* —Pharmacy Technologist

Respondents who were satisfied with their experience with eLMIS also advocated for eLMIS adoption across all facilities, stating there is an increase in workload at the district level when entering data for facilities that are currently not using the eLMIS FE.

> *"We shall have less work at the district if all the facilities will have the facility edition; currently we are entering all the reports at the district with less manpower. For the central edition you only work online, making work difficult when you have no bundles."* —Pharmacy Technologist

> *"Less time-consuming—for facilities with facility edition and more time on central edition because you have to enter reports for the facilities."* —Pharmacy Technologist

A surprising finding was the effect the electronic system had on supervision.

> *"Previously (before eLMIS), supervision was difficult as data were not readily available to reference. But with the automated system in place, it is easy to supervise the testing sites. Like transaction data: I use the system to check how much was issued to testing sites and how much was used according to data in the system. And then I go to physically check what is remaining at the testing sites."* —Biomedical Technologist

Respondents also discussed limitations of the system in terms of supply chain performance. Some reported that a few products were not in the system or else the user could not add new products in the system, although the products had been dispensed to patients. This is problematic because if a product is missing in the system and it's not ordered in the paper form, it is then not available to the patient. Respondents also mentioned that there are mismatched product codes in the eLMIS and the paper-based system. Another limitation is that, although the staff can monitor how many products have expired, they would like the system to have a function enabling them to minimize the number of expired products, such as an alert function that would let them know if a product is nearing expiration.

> *"With the old system we could capture all the products. But with this system, most of the products are not there, I have some stock control cards which are for products that are not found in the system."* —Laboratory Technologist

Several respondents mentioned the need to integrate or merge SmartCare and eLMIS. They currently use both systems, and the double reporting adds to their workload.

> *"Also, as I am alone and using SmartCare in the ART dispensary, it becomes difficult for me to enter dispensed data both in eLMIS and SmartCare. The two should be integrated I think; to make our work easier."* —Pharmacy Technologist

The goal of the eLMIS FE is to send data electronically from the eLMIS FE to the eLMIS CE, with no paper slowing down data transmission. Table 9 shows the method used by respondent departments to submit the last regular R&R to MSL. They were verified with eLMIS FE at the facility to ensure that there were no discrepancies between the verbal response and data on eLMIS FE. The results show that 150 out of 186, or 81 percent, of responders confirmed submitting their last R&R using eLMIS FE. Also, 5.4 percent of the respondents were using eLMIS FE, but they printed a copy of the report from FE and sent this to the DHO. The most common reason given for this was lack of internet access. Therefore, 86 percent of respondents were using the eLMIS FE to generate their reports. The most common reason for not using FE among the other 14 percent of respondents was that the facilities preferred using CE.

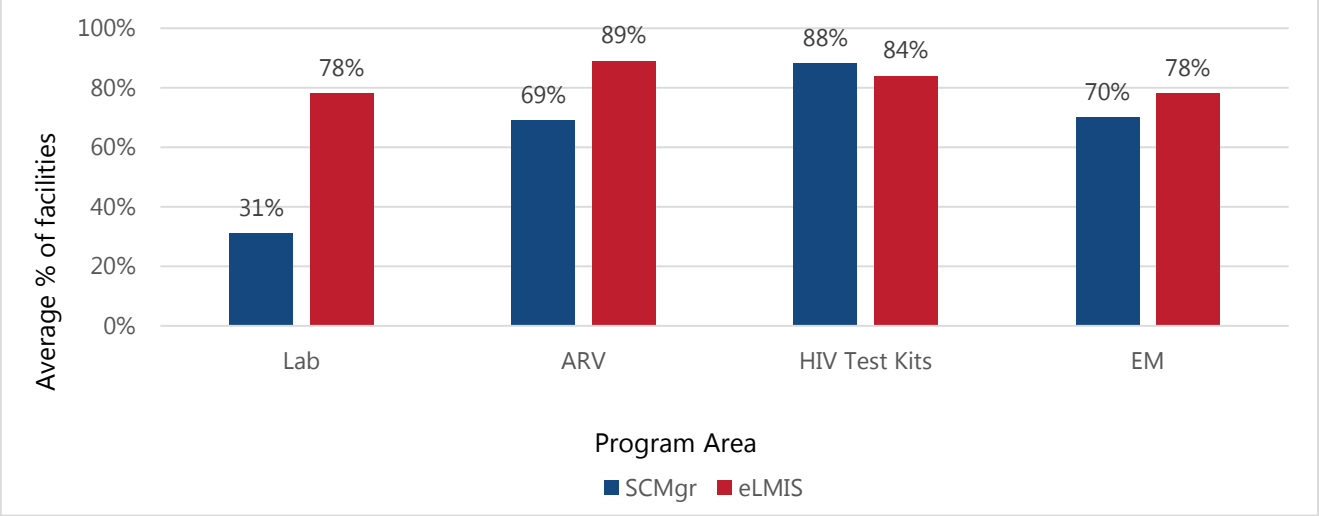
Table 9. Mode of Last R&R Transmission

Mode of R&R Transmission	Laboratory (n=89)	Pharmacy (n=97)	Total (n=186)
	%	%	%
No data	4.5	2.1	3.2
By eLMIS FE	79.8	81.4	80.6
Did not report	0.0	2.1	1.1
Printed copy sent to DHO	6.7	4.1	5.4
Handwritten copy sent to DHO	9.0	10.3	9.7

Research Question 5: To what extent has the eLMIS contributed to improved supply chain performance?

Although it is difficult to attribute all supply chain improvements, or challenges, to the implementation of the system, this evaluation strives to show the difference in supply chain outcomes and performance before and after the implementation of eLMIS. Key supply chain indicators include stock availability, stock status (stocked according to plan), rate of expiries, emergency order rates, and improvement in order fill rates. These indicators are explored with regard to the impact of the CE and the FE on the supply chain at the 100 selected health facilities. Figure 9 shows a comparison of average percentage of product availability for a period of 12 months of eLMIS CE and SCMgr implementation.

Figure 9. Average Percentage of Product Availability between Mar. 2013–Feb. 2014 under SCMgr, and Mar. 2016–Feb. 2017 under eLMIS and Mar. 2013–Feb. 2014



As depicted in Figure 9, product availability has improved for all programs during the time of eLMIS implementation except HIV test kits. The reason for the apparent lack of improvement in stock status of HIV test kits during the selected 12 months of eLMIS may be associated with the national stockout of HIV test kits.

Figures 10 and 11 show the trend of product availability for SCMgr and eLMIS implementation periods, respectively. The trend in eLMIS is toward more consistent product availability in all program areas compared to SCMgr. The average deviation is 0.05 for eLMIS, whereas for SCMgr it is 0.17.

Figure 10. Product Availability during SCMgr Implementation

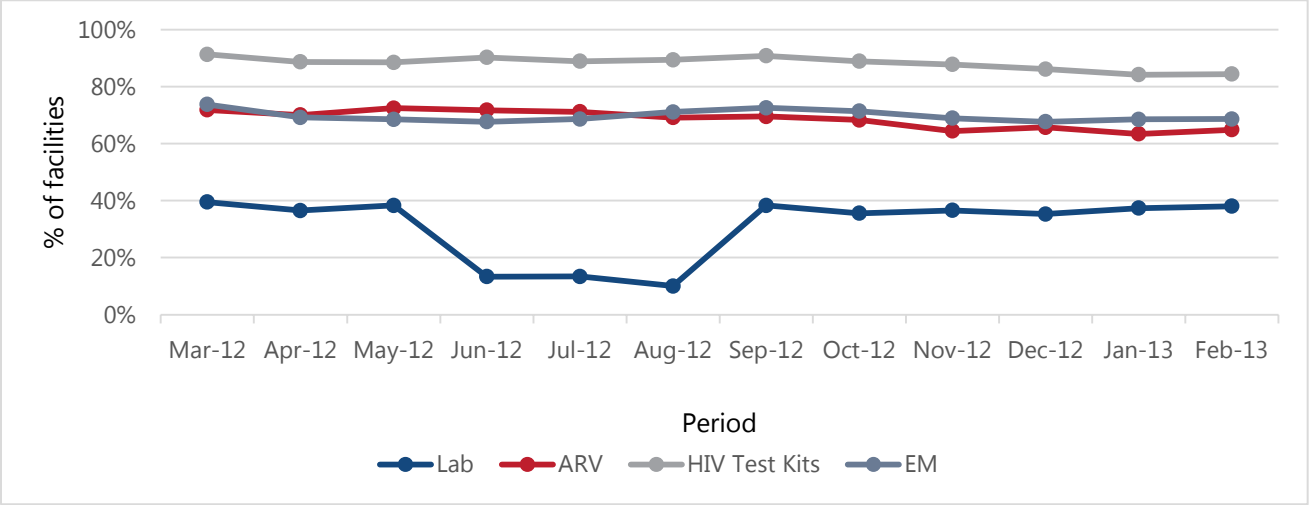
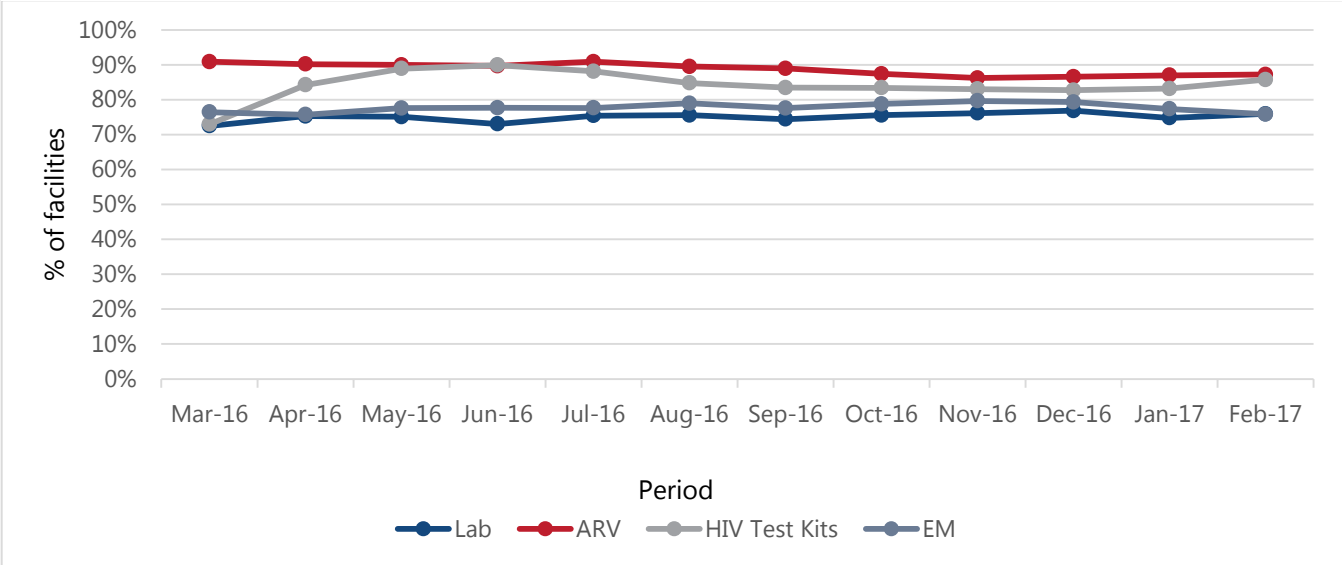


Figure 11. Product Availability during eLMIS Implementation



Beyond stock availability, it is important to look at stock status. Months of stock (MOS) shows the number of months the stock is expected to last, according to the country's logistics system. Table 10 shows the maximum MOS for each product and facility level.

Table 10. Maximum MOS for Products in Each Supply Chain Program by Facility Level

Facility Level	ARVs	HIV Test Kits	Laboratory	Essential Medicines
Level 3	3.0	3.0	3.0	3.0
Level 2	3.0	3.0	3.0	3.0
Level 1	3.0	3.0	3.0	3.0
Health Center	3.0	3.0	3.0	4.0

The emergency order point (EOP) for all products is 0.5 MOS. The goal is for all stock levels in facilities to remain between the maximum MOS and the emergency order point, which represents SATP, or "stocked according to plan." Figures 12 to 14 show the stock status analysis for each commodity area, comparing eLMIS CE and SCMgr, as well as the eLMIS FE sites. The average SATP (not shown) for SCMgr and CE are both 39 percent, while FE is 46 percent. There seems to be no difference between average SATP for CE and SCMgr because the facilities being compared for the EM program area are not the same. There are more facilities under eLMIS than SCMgr because there was a scale-up for the EM program during the eLMIS review period. The scale-up affected stock status, as new products were being introduced to facilities. As for FE, the average percentage of products SATP was 46 percent, representing a 7 percent difference from CE.

Figure 12. Stock Status by Program Area in SCMgr for All Facilities

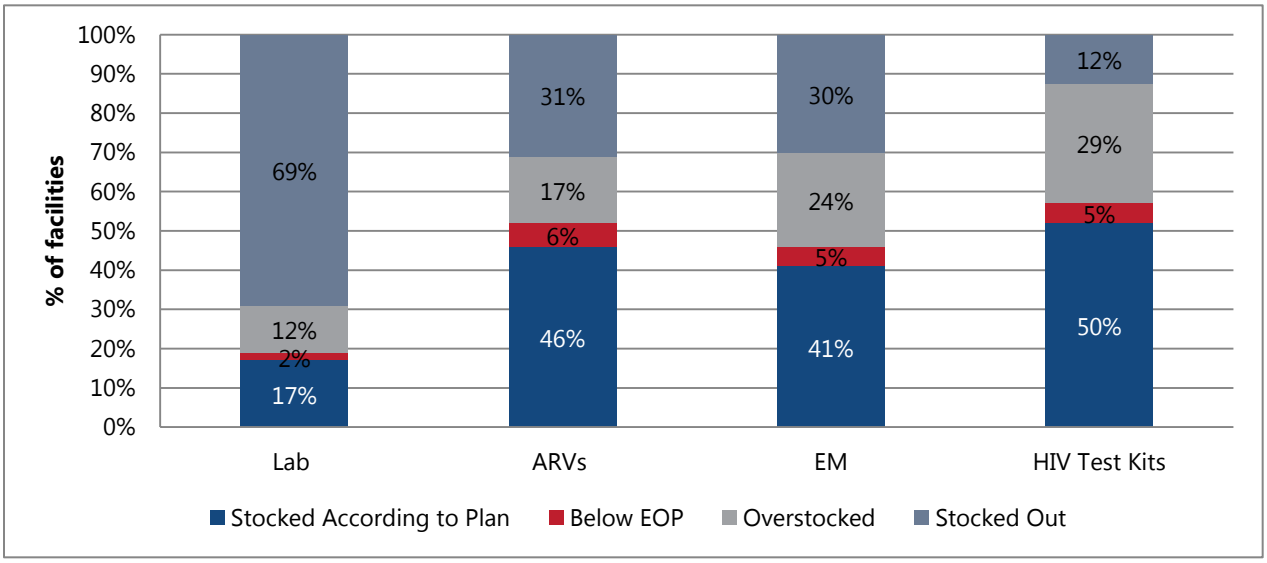


Figure 13. Stock Status by Program Area in eLMIS CE for All Facilities

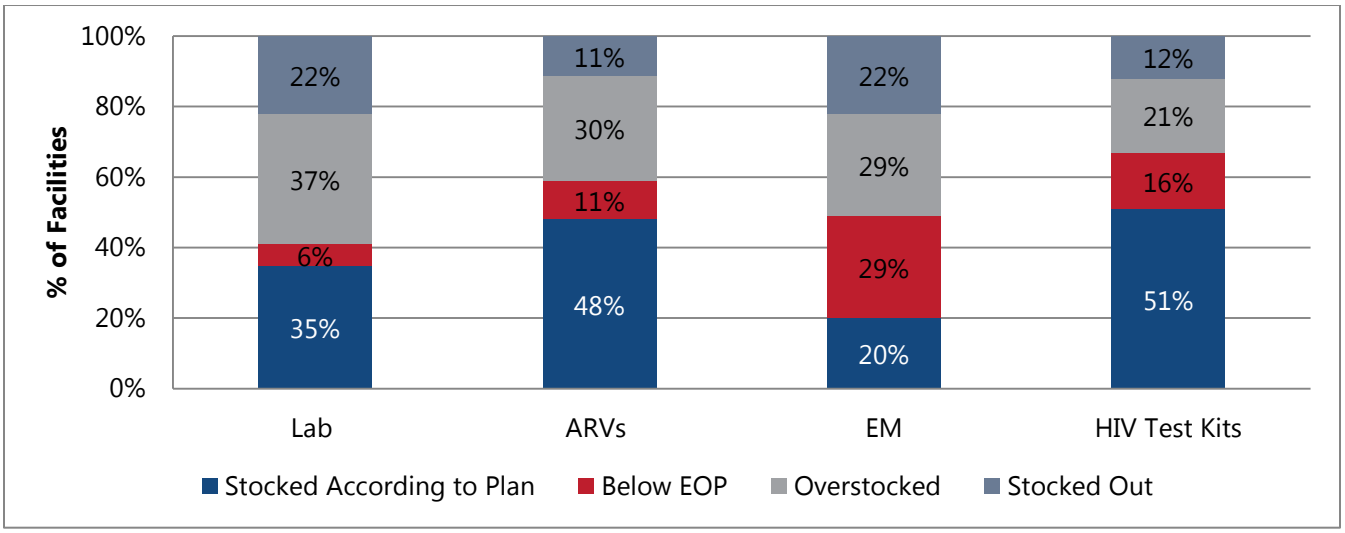
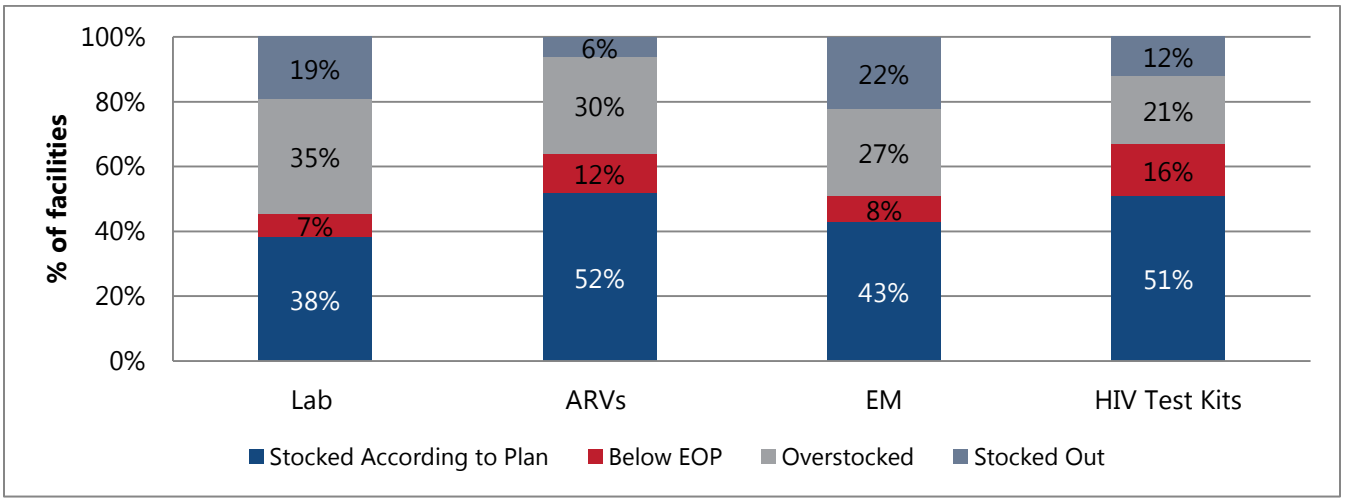


Figure 14. Stock Status by Program Area in eLMIS FE for All Facilities



As can be seen in the stock status analysis in Figure 14, product availability has improved and more facilities are stocked according to plan.

Figure 15 shows the trend in emergency orders after eLMIS implementation. The figure shows an increase in emergency orders, especially after January 2017. This can be attributed to the introduction of the supply of products by MSL every two months.

Figure 15. eLMIS CE Total Emergency Orders by Month for All Program Areas

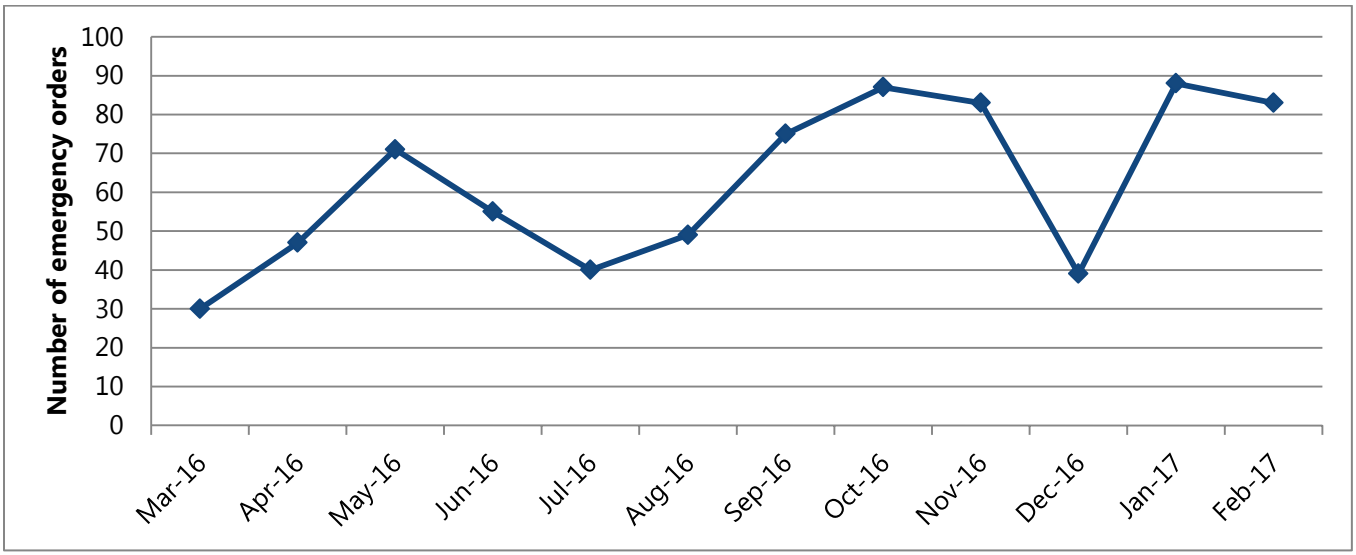
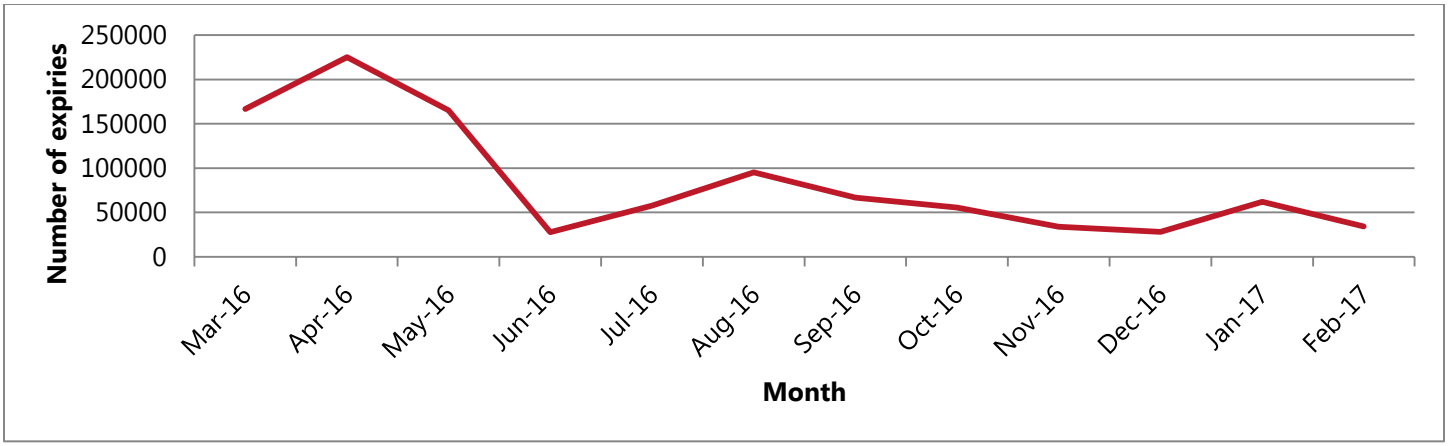


Figure 16 shows the trend of expiries captured post eLMIS implementation, which shows that the number of expiries has been steadily decreasing over time. This could be attributed to an increased number of supply chain supervisors having visibility of facility stock on eLMIS, which helps them make informed decisions.

Critical analysis of the eLMIS data shows that the introduction of eLMIS has enhanced the way expiries are captured in the system. Before eLMIS, expiries were only captured under comments on the reports, which depended on the data entry clerk making such comment in the system. In most cases, this was not done. eLMIS specifies predefined adjustment types[2] from which staff are expected to choose.

[2] Adjustment types include expiries, damaged, found, lost, cross-program transfer, purchased, stolen, transfers and returns.

Figure 16. Trend of Expiries in the Post-eLMIS Period



Research Question 6: What are the initial investment and ongoing operating costs of the eLMIS solution?

Like any major system change, the introduction of the eLMIS in Zambia required an initial up-front investment followed by ongoing support. The direct costs of eLMIS introduction were largely passed through to AIDSFree and its predecessor in Ethiopia, the USAID | DELIVER PROJECT, meaning that to an extent they are captured in project accounting systems.

Introduction of the eLMIS first required development of a new system. Starting in 2012, a joint development project was initiated to support development of a similar system for Tanzania simultaneously with Zambia's eLMIS, meaning that development costs were shared between the two countries.

Once the system was developed, users received training and the required hardware was installed to make the system operational.

The costs of these implementation activities through May 2017 were captured from project accounting, as shown in Table 11.

Table 11. eLMIS Implementation Costs, 2014 through May 2017 (US$)

Costs	Total (US$)
One-time eLMIS development costs (attributed to Zambia)	921,556
eLMIS user training and ongoing support	1,796,958
eLMIS hardware	1,767,760
Total costs	4,486,274

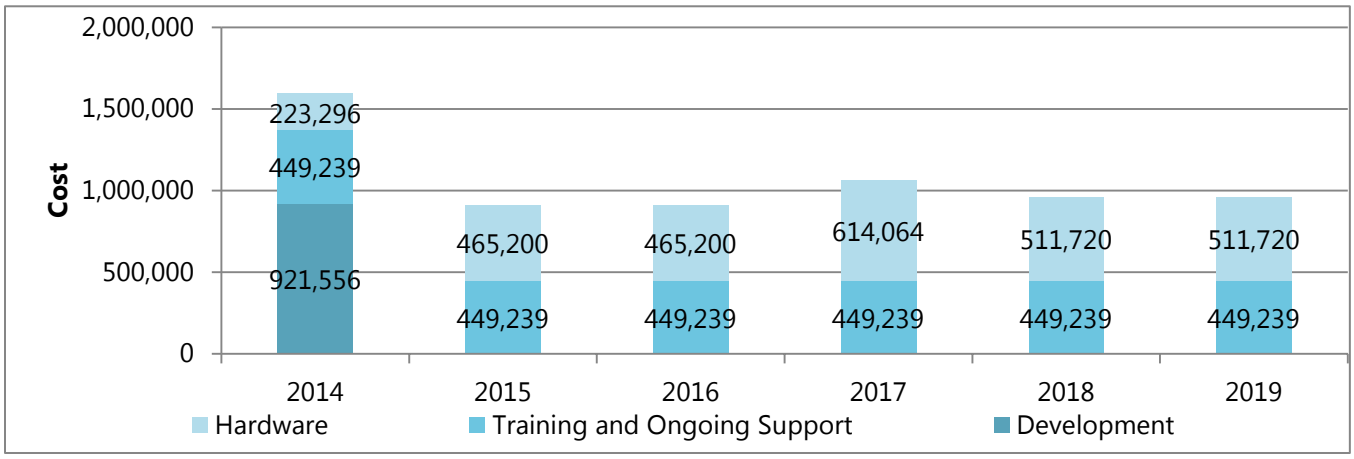
Because the eLMIS was developed "in-house" for Zambia, there is no routine license cost for the system. Ongoing support costs (such as system maintenance and server management) are captured in a single accounting line item along with training costs. As of May 2017, the eLMIS covered approximately 380

facilities, meaning that hardware costs can be expected to continue accruing at an average rate of US$4,652 per facility. Given a scale-up schedule of adding about 100 facilities per year to the eLMIS, the training and ongoing support costs are expected to continue at the same annual rate as shown in Table 11.

Printing of paper LMIS forms was captured as US$15,442, but the number of forms printed for this cost could not be determined. Given the relatively small size of this expense compared to other implementation costs, it is not included in the analysis.

In total, implementation and ongoing support costs for the eLMIS can be projected, as shown in Figure 17.

Figure 17. eLMIS Implementation and Ongoing Support Costs 2014–2019 (Historical and Projected) (US$)



Research Question 7: What are the financial benefits accrued to the supply chain through the eLMIS?

In terms of financial benefits to the supply chain, the evaluation focused on the value of the labor effort potentially saved by the switch from a paper-based LMIS to the eLMIS. Stated as a hypothesis, this assessment assumed that the introduction of eLMIS to a health facility or DHO would reduce the labor effort required to complete LMIS reporting each month and would therefore reduce the cost associated with that labor effort.

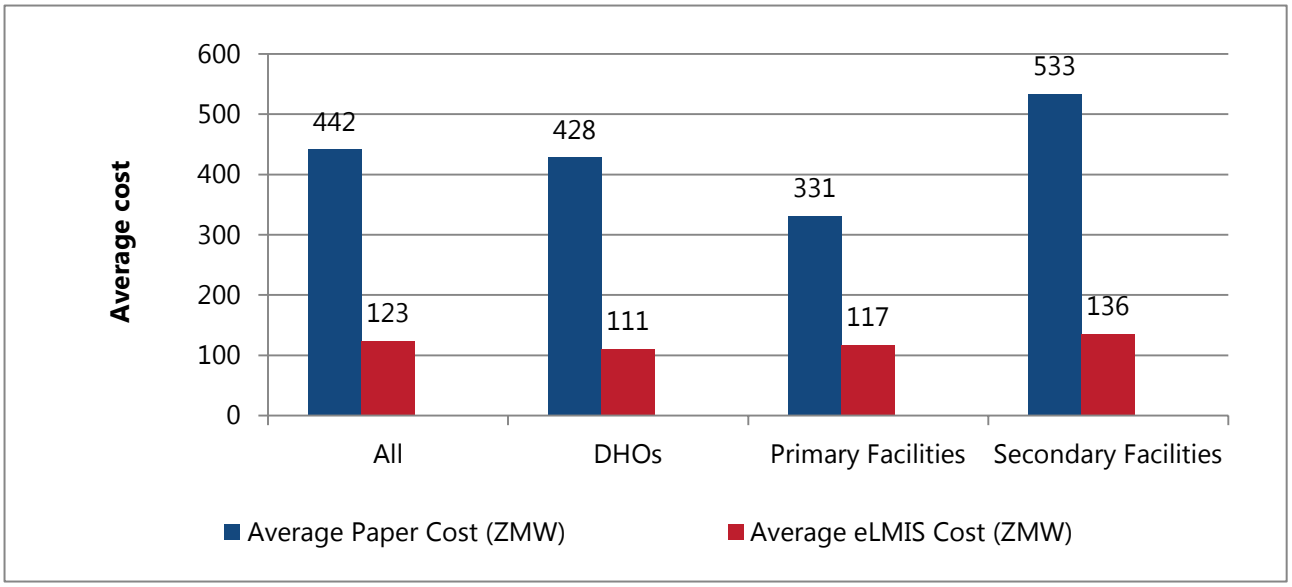
The survey approach and subsequent analysis process described above produced a dataset of 47 responses. Most respondents provided their position as pharmacy technologist (18/47), laboratory technologist (9/47), or biomedical technologist (7/47). Civil service grades reported ranged from A to J, with G being the most common (36/47). Most (35/47) respondents stated that other staff at the facility assisted with eLMIS completion, with a wide range in the number and grade of staff involved. Costing of these responses and calculating the net difference in cost following eLMIS introduction are summarized in Table 12.

Table 12. Summary Statistics for Facility Costing Survey Responses: Per Period and Annual Reported Costs, ZMW

	Number of Facility/Respondents by Facility Type	Average Labor Cost per Facility Paper System (ZMW)	Standard Deviation (ZMW)	Average Labor Cost per Facility eLMIS (ZMW)	Standard Deviation (ZMW)	Average Monthly Per Facility Savings (ZMW)	% Savings	Average Annual Savings	Average Annual Savings US$	Two-tailed p values*
All	47	442	462	123	153	319	72	3,821.06	394.33	.00003
DHOs	12	428	524	111	99	317	74	3,812.95	393.49	0.057
Primary Facilities	15	331	286	117	224	214	65	2,565.92	264.80	0.035
Secondary Facilities	20	533	507	136	107	397	75	4,767.28	491.98	0.003

*For Calculated Per-Facility Labor Cost Savings.

Figure 18. Average Monthly LMIS Labor Costs, Paper-Based and eLMIS



As shown in Figure 18, as reported on the monthly LMIS, average costs for all facility types, labor costs decreased from 442 to 123 kwacha (ZMW), a 72 percent savings. DHO responses fell close to this average, while primary facilities reported lower monthly costs, and secondary facilities reported higher monthly costs. The higher costs for secondary facilities under the paper-based LMIS was expected, given the higher number of products managed and the higher volumes handled.

While the response average showed a decrease in costs from moving to the eLMIS, five of the 47 responses reported that costs increased under the eLMIS, and another two reported costs stayed the same. One urban health center, for example, reported that respondents' time per reporting cycle rose from eight to 12 hours and their assistants' time rose from eight to 24 hours, meaning that costs tripled under the transition to eLMIS. This may reflect that certain facilities have experienced challenges in transitioning to a computer-based reporting system.

The ranges in calculated costs are captured in the standard deviations, as reported in Table 12. Given the large standard deviations around the means or averages, paper LMIS costs at DHOs and eLMIS costs at primary facilities appear to have relatively wide distributions. Much of these large standard deviations can be attributed to one or two unusual observations, such as the urban health center mentioned previously. These deviations reflect the range of resources (total staff hours required and staff grades) used for logistics management at the facility and DHO levels. It may reflect relative volumes of commodities managed, computer literacy of staff, or other factors that could drive resource requirements.

Despite the relatively large standard deviations in results, paired t-tests for significance indicate that there is a statistically observable difference in average costs for the paper-based LMIS and

eLMIS. Table 12 shows that that this observation applies to each facility type sampled this way. These observations provide confidence in the conclusion that transition to eLMIS leads to reduced labor cost at DHOs and primary and secondary facilities.

Comparing the average annual per-facility savings to historical and planned scale-up of the eLMIS, total annual labor savings can be projected as shown in Table 13. Note that this analysis applied a ZMW to US$ conversion rate of 9.69.

Table 13. Estimated Historical and Projected Annual Cost Savings from eLMIS Introduction

	2014	2015	2016	2017	2018	2019
Number of Facilities on eLMIS FE	48	148	248	380	490	600
US$ Savings	18,928	58,361	97,794	149,845	193,222	236,598
ZMW Savings	183,411	565,517	947,623	1,452,003	1,872,319	2,292,636

Using this approach, the cumulative labor savings of transitioning 600 facilities to the eLMIS FE by 2019 would equal US$754,758. This represents approximately 142,000 hours, or 70.4 years, of a staff person's time at Grade G.

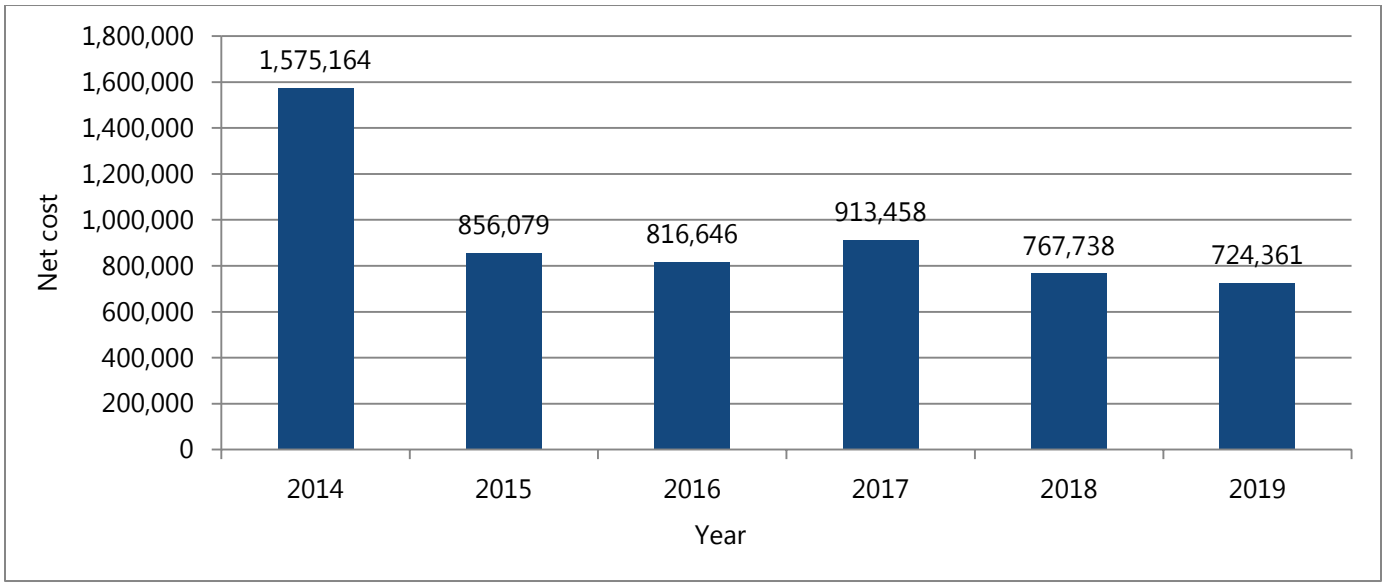
Research Question 8: What is the net cost implication of introducing and scaling the eLMIS through 2019?

Typical cost-benefit approaches compare one-time investment costs with incremental net operating costs (any operating cost increases and reductions) over a specified time horizon. In this case, the eLMIS development costs can be compared to the ongoing operating costs after subtracting the cost reductions from reduced labor requirements.

Overall, the cost savings through reductions to facility staff labor requirements do not offset the associated training and hardware costs. However, the researchers could not calculate the value of improved system performance or decreased expiries (or other systemic benefits) because of the difficulty in attributing those benefits to the eLMIS intervention. For an average individual facility, eLMIS introduction saves approximately US$394 per year, while hardware (annualized assuming a five-year straight-line depreciation) costs US$930 per year. Per-facility training costs should also be added to this comparison, but because their costs are aggregated with fixed overhead for system maintenance, a per-facility training cost cannot be attributed. Regardless, using this approach, introduction of the eLMIS results in a direct cost *increase* of approximately US$540 per year. In this way, direct cost savings over time will not lead the eLMIS implementation to "break even" when compared to overhead and upfront investment costs over any time horizon.

Figure 19 displays the net cost implications of eLMIS introduction through 2019.

Figure 19. Net Cost Implications of eLMIS Introduction 2014–2019 (US$)



DISCUSSION AND RECOMMENDATIONS

Discussion

The AIDSFree eLMIS Zambia evaluation employed a formative evaluation method that examines overall supply chain performance. Results of this evaluation will be compared with the end-of-project results as it provides a baseline for the entire project. Based on the findings of this evaluation, the following questions are discussed.

1. To what extent has the eLMIS improved reporting frequency, timeliness, and accuracy?

There has been a noticeable increase in reporting rates (frequency) since the introduction of eLMIS, with some respondents stating a reporting rate of 100 percent in the districts. Overall the results indicate that reporting rates have improved, with three program areas scoring above 90 percent. EM shows a slight decline from 94 to 88 percent. In the SCMgr period, the number of sites using the eLMIS CE to report on EM was 652 in February 2013 versus 2,117 in March 2017 during the reporting period for eLMIS. This increase was because the EM logistics system was in the process of being rolled out through 2015. This may also be a reason for the small decrease in reporting rates in the commodity area. Ultimately, the reporting rates for EM showed steady increase in eLMIS. By the end of the period under review, the rates were above 90 percent. During the comparison period for SCMgr, there were more extreme variances from month to month, especially for HIV test kits and laboratory commodities. Similarly, sites using FE also consistently have 90 percent reporting rate averages for all commodity areas over the year of reporting in eLMIS.

Improvement in reporting timeliness is difficult to determine. The data presented in the findings section show that facilities with FE reported on time more often than those using CE. However, of the facilities using FE, 5.4 percent reported using CE and not using FE to CE as expected. For those facilities that reported using FE, 51 percent were actually on time. There are several reasons that on-time reporting in CE is low. When the districts enter the data for all sites not using FE, the reports are filed according to the MSL delivery schedule and not by the 10th of the month as is mandated by the MOH. Therefore, on-time reporting rates often look low even if the reports were sent to the DHO before the 10th.

As timeliness was not a point captured in SCMgr, there is no way to compare the two systems quantitatively. The qualitative answers must be assumed to show that timeliness has improved at both the facility level and the central level. Respondents did observe an increase in reporting rates and reporting timeliness. Before eLMIS FE implementation, facilities completed manual, handwritten reports for all commodities; they had to gather data from multiple dispensing and

stock-holding locations in the facility; and they had to do manual calculations on AMC reorder quantities.

> *"Previously, I would move from department to department looking for data. I used to query almost everyone in the department because when it is the end of the month they know I am looking for data. But now they just have to click and submit it, and I will find it. I have stopped being looked at as an enemy and am now seen as a good guy."* —Psychosocial Counselor

Many respondents mentioned an increase in both data and reporting accuracy, reporting two functions in the eLMIS that can reduce human error. First, the automatic calculations reduce the likelihood that a wrong number will be manually calculated or entered. Second, the error messages ensure that data match logically and are correct before submission. This reduces the ability of users to input incorrect or inaccurate data. Respondents reported that these checks and balances in the system allow only valid data. They believe that there is no way to cheat the system now. Previously, users could make up numbers to report; however, that is no longer possible with the built-in validation functions in the eLMIS.

> *"The system has auto-check (built-in calculations) which make data entered on the system more accurate. You can tell from the system if the reported beginning balance is wrong; the system will reject it. The system also automatically calculates or generates the AMCs, order quantity, and maximum quantity for you (therefore no arithmetic errors)."* —Pharmacy Technologist

> *"Yes, errors that were committed by one's fingers and hands have been reduced by the machine; for example, when you are writing a report and you are tired. One can still make an error, but the system won't make such errors. The system will just do the right thing, even reminding you when you make an error and that there is a problem."* —Psychosocial Counselor

The thoroughness of the system also seems to have added a bit more work. One respondent, for example, mentioned that there is a redundancy in data entry to ensure a complete physical count of all the commodities in the system.

> *"You can't complete your report if you have not completed your physical count. That is what is expected, but for products that may be, or are, stocked out for some time, with eLMIS you are still expected to write a physical count of zero, which never used to happen with the hard copy. We never used to write zeros on the hard copy. If you run out of certain things you just put the stock control card away together with the cards for stocked-out commodities. But for eLMIS, you have to indicate it in the system. You have to do physical counts for all the products that are in the system."* —Pharmacy Technologist

To confirm these qualitative inputs from users, data were run from SCMgr and eLMIS looking at one reporting accuracy data point: the average percent of facilities where the beginning balance for the current month equals the closing balance (physical count) of the previous month. Logically, these two figures should be the same, as no transactions are missed between the close of one month and the start of the new month. In eLMIS, this calculation is automatic and will always reach 100 percent as the system does not allow a mismatch. Obviously, eLMIS has significantly improved this statistic. Although eLMIS does not allow ending balance from the previous month and beginning balance from the current month to be different, it does allow for computer-generated adjustments. These are basically unaccounted stock and increase the risk of loss of accountability of stocks.

2. To what extent has the eLMIS improved data accessibility, transparency, and quality?

Generally, respondents believed that the quality of data has improved with the implementation of eLMIS. The differences between data management from the paper-based system to the electronic system included less loss due to lost papers, less bulky paperwork, and more ease with doing calculations in the electronic system.

That said, the data at the sites with FE are meant to be entered in real time. Unfortunately, it is apparent that 34 percent of the time, the data were not being entered in real time at the sites. Additionally, even if the data are updated at the sites with FE in real time, it is not yet visible at higher levels in real time, meaning higher level decisions are being made on data from the previous month.

With the built-in eLMIS data checks, it is impossible to falsify data; however, there are not enough checks on outlying data, as was shown with consumption data from Levy Mwanawasa General Hospital (Table 6).

3. Has the availability of eLMIS data led to increased data use and/or data-driven decision-making?

The visibility of data has made redistribution of commodities much easier and more transparent. Having this data in real time will make it even more effective. It is apparent that the use of the system has steadily grown, and that overall, users are satisfied with the system.

The system's inherent ability to show data from a large geographic area and in close to real time allows its users not only to make decisions on stock but to also make better decisions. The system allows an accurate representation of stock at each facility, making it possible and easier for users to relocate stock based on facility needs or to place emergency orders. This improves supply chain management and reduces the likelihood of stockout and expired stocks. Facilities with excess can now send their stock to others that are in need rather than have it sit on their shelves until it potentially expires.

For sites with the facility edition of the system, users can get a better picture of stock status in facilities and thus make well-informed decisions for redistribution of materials and resources. Additionally, respondents state that data are more easily accessed over time, further contributing to better informed decisions on redistribution and stock status.

4. To what extent is the eLMIS FE usable and acceptable among different users?

Results also showed that 94 percent of users interviewed were satisfied with the software, and 90 percent had functional software on the day of the visit. Every site visited had at least one person trained in the needed departments. There is also a workforce that can complete the tasks. Although there is always room for improvement, this is a positive reflection of acceptability of the software.

Eighty-one percent of the R&Rs were sent electronically, which is an excellent start. Of the 19 percent that were not sent electronically, the most common reason was internet challenges in the facilities. These issues urgently need to be addressed to ensure the system is fully functional and online at all times.

Even with the positive feedback about the usability of the system, there were key areas that users wanted to see addressed, including the following:

1. Inability to use the system when there are power outages at the facility
2. Slow networks making it frustrating to work in real time
3. Poor network reception (when the internet is needed) make it difficult for the districts to enter reports online and for the facilities to send their reports
4. Some products are not in the system and some product codes are mismatched between eLMIS and the paper-based LMIS forms
5. The system does not provide a flag for products nearing expiration date
6. SmartCare and eLMIS have an overlapping mandate. Users want to merge the two so that there is no need for duplicate data entry.

Products missing in the system (no. 4) is an interesting challenge as it sometimes relates to MOH policy. Previously, some products that were not allowed at certain levels of health facilities but were ordered and received at facilities were not monitored. Now, users are frustrated because the system enforces the MOH product standardization by level of health facility, meaning that some products that they previously ordered and received are not reflected for that level of health facility in eLMIS as required by the MOH policy.

Interestingly, supervisors are using the system very effectively. The new system has made supervision easier, more targeted, and more efficient. Some costly supervisory visits are no longer needed since the information gathered is easily viewed through the system. The site visits supervisors do conduct are more focused on problematic facilities. After identifying issues, supervisors can address them by phone rather than having to visit the facility. They can also

more easily follow up with facilities on a problem that was addressed. Supervisors now have a better idea on the needs of a facility and can focus their visits on mitigating that facility's issues. Supervisors now have access to information on who is or isn't reporting, the quality of their reporting, and their inventory. User performance is easily monitored and evidence for performance is readily available. The reduction in number of supervisory visits needed has led to more productive supervisors allowing them to focus on other priority work.

5. To what extent has the eLMIS contributed to improved overall supply chain performance?

Results indicate general improvements in supply chain performance for one of the most important indicators—stock availability. These improvements have been more pronounced in the eLMIS implementation period than the SCMgr period, an indication that the eLMIS has achieved the intended goal of improving supply chain performance.

That said, external factors contributing to the supply chain performance have been declining as well. MSL has moved to bimonthly distribution. Although at first glance this does not seem to be impacting the supply chain (given the improvement in stock availability discussed above), the eLMIS CE shows a massive increase in emergency orders. This means that there is a problem with the supply chain: sites may not be stocking out, but they are *not* receiving supplies timely or in the quantities needed. This is not a reflection on the performance of eLMIS, but simply something visible through eLMIS which should be monitored.

6. What is the net cost implication of introducing and scaling-up the eLMIS through 2019?

As noted above, introduction of the eLMIS results in a direct cost *increase* of approximately US$540 per year per facility. This shows that direct cost savings over time will not lead the eLMIS implementation to "break even" as compared to overhead and upfront investment costs over any time horizon. Overall, net implementation costs (net incremental cost increases after subtracting incremental cost reductions) are approximately US$725,000 annually by 2019.

Note that this cost-benefit analysis only focuses on direct attributable costs and benefits of eLMIS implementation. It does not include any direct benefits that can be estimated with confidence (such as reductions in emergency orders, reduced expiries, or other performance improvements), nor does it estimate benefits to Zambia's wider economy through improved health as a result of improved supply chain performance. The increased annual costs to Zambia's public health supply chain offer opportunities for eventual reduction, but may generally be acceptable given the improved ability of Zambia's public health supply chain to meet its performance targets.

Opportunities to improve the relative cost-benefit of the eLMIS include the following:

- Reducing per-facility hardware costs to below US$400 per year on average (or US$2,000 total with a five-year replacement cycle). This would allow per-facility variable costs of the eLMIS implementation to eventually offset fixed costs for system development and overhead.
- Improving average labor cost reductions by focusing supervision efforts on facilities that observe an increase in required labor for the eLMIS. As noted, the per-facility average annual labor savings of approximately $400 per year includes several facilities that reported net increases in time required compared to the paper-based LMIS. Follow-up conversations and training for these facilities might help improve their experience with the eLMIS and increase the benefits of introducing the system. Future planned improvements to the eLMIS may also help.

Recommendations

Based on discussion of the evaluation, the evaluation committee recommends three thematic areas be addressed to improve eLMIS implementation.

1. **The implementation of the FE and use of the CE should do the following:**
    - Incorporate into the FE "real-time" data visibility functionality that now exists in the CE version to allow for real-time decision-making and not decision-making based on data from the previous month.
    - Roll out the new SmartCare[3]–eLMIS interface to all sites with these two systems to ensure there is no duplication of work by FE users.
    - Address power problems at sites with FE that experience frequent power interruptions to minimize the time sites are offline. Options include inverters, use of low-power technology, and solar solutions.
    - Expedite the rollout of FE to more sites to improve frequency, timeliness, and quality of data reported, as well as to address challenges at districts with real-time visibility of data at facilities.
    - Address internet challenges causing sites not to submit their reports from FE to CE.
2. **Future software enhancements and fixes for FE and CE should address the following:**
    - Ensure offline district module is working properly for districts with poor internet connectivity.

[3] SmartCare is an electronic health record system which captures clinical information of patients at health facilities.

- Expand the eLMIS FE and move to "real-time" stock status visibility through the eLMIS CE.
- Disable computer-generated adjustments so that facilities are required to report what has happened with all stocks without any vagueness. This will ensure that staff must account for all stock transactions when they have the FE and they must state if items are lost or found with an explanation. This increases accountability.
- There are not enough checks on outlying data, as was shown with consumption data from Levy Mwanawasa General Hospital (Table 6). Such situations should be flagged and supervisors required to approve and comment on these outliers. The system needs to include more alerts for situations like outlying consumption, products at emergency order point, and others.
- Ensure product codes on the paper and electronic system are synchronized.
- Ensure simple ways to update the product list for new products.
- Make a flag for products close to expiry.

3. MOH policy needs to address the following with regard to eLMIS:

- MOH needs to mandate eLMIS to be e-first[4]. As e-first may take time to be implemented and adapted to, eLMIS should be incorporated into the MOH Performance Assessment tool as a component requiring real-time updating to be considered a performing site or individual. Sites reported as paperless, like Chipata General Hospital and Livingstone General Hospital, should be highlighted as examples.
- MOH should ensure all managers are using the data in eLMIS to continuously review the supply chain performance. A quarterly supply chain performance review meeting using this system should be instituted. If there are questions that cannot be answered with the reports currently in the system, enhancements should be requested to ensure the system responds to the continuously changing environment.
- MOH should carefully review the impact of the MSL bimonthly distribution schedule, including data points such as increases in emergency orders, for its impact on the supply chain. Such review could identify and address supply chain problems such as increases in emergency orders.
- MSL, MOH, and key partners should review the product standard list by level. In addition to standardizing the product pack sizes, the MOH needs to communicate the standard

[4] E-first refers to entering information in eLMIS in real time rather than after or at the end of the day, which is refered to as e-last.

product list to all facilities so that there is no confusion over the eLMIS software and MOH policy. Currently, eLMIS is seen to be faulty because it is implementing the MOH policy. MOH needs to clarify with all facilities the approval process for receiving products that are only approved for higher level facilities.

- MOH should incorporate internet connectivity into all facilities budgets and ensure connections work to allow for real-time data access all the time.

4. **Conduct a full costing evaluation of eLMIS.**

   As noted above this cost-benefit analysis only focused on direct attributable costs and benefits of eLMIS implementation. It did not include any direct benefits that can be estimated with confidence (such as reductions in emergency orders, reduced expiries, or other performance improvements). Conducting a full-scale costing evaluation would help to to determine the impact eLMIS has had on those variables also.

CONCLUSIONS

The evaluation of the Zambia eLMIS system was based on the following three hypotheses:

1. **That eLMIS will improve supply chain performance compared to SCMgr.** eLMIS has improved supply chain performance in the key indicators of reporting and commodity availability. Overall reporting rates for the period under eLMIS implementation have improved compared to the SCMgr period. Improvement in the reporting rates under eLMIS has been accompanied by further improvement in the timeliness of reporting compared to the SCMgr period. Similarly, there have been improvement in commodity availability, products stocked according to plan, and reduced stockout rates. On the other hand, expiries have increased after eLMIS implementation. This increase could be artificial, because of improvements in the way losses and adjustments are captured in eLMIS compared to SCMgr.
2. **That eLMIS will introduce more efficiency than SCMgr.** Key informant qualitative interviews at facility, district, and central levels have shown that users perceive eLMIS as more efficient than SCMgr. At the facility-level users generally reported that eLMIS reduced time for preparing monthly logistics reports (R&R), which freed up time for attending to patients. At the district level, respondents indicated that it takes more work to enter reports on behalf of the facilities without FE; where it has been adopted, FE has given respondents an opportunity to critically review facility reports as they are being entered. Thus they find that FE facilities produce more accurate reports, unlike the previous system where reports would be approved by the district without critical review. Central-level respondents also indicated that they are receiving fewer hard-copy reports from facilities and districts, and that those reports are easily entered into the system because of its friendlier user interface compared to SCMgr. This has given central-level staff more time to provide customer care support to facility and district staff.
3. **That eLMIS will generate cost savings in specific areas through improved supply chain processes.** While certain cost-related impacts can potentially be assumed when evaluating the switch from a paper-based to eLMIS, Zambia's public health supply chain has undergone numerous interventions that complicate the ability to attribute certain outcomes to the eLMIS itself. For example, an improved information system should reduce emergency orders and expiries. However, given the numerous management-related interventions that have taken place in Zambia, it would be difficult to accurately attribute observed savings in these areas only to introduction of eLMIS.

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APPENDIX 1. ELMIS EVALUATION FACILITY LIST

Province	District	Facility Code	Facility Name	Facility Type
Central	Kabwe	102015	Mahatma Gandhi Urban Health Center	HC
Central	Kabwe	102001	Kabwe Mine Hospital	HC
Central	Kabwe	102016	Makululu Urban Health Center	HC
Central	Kapiri-Mposhi	103014	Mpunde Mission Rural Health Center	HC
Central	Chibombo	101029	Mwachisompola Demo Rural Health Center	HC
Central	Mumbwa	105001	Mumbwa District Hospital	LVL1
Central	Itezhi-tezhi	803001	Itezhi-tezhi District Hospital	LVL1
Central	Mkushi	104001	Mkushi District Hospital	LVL1
Central	Chibombo	101001	Liteta District Hospital	LVL1
Central	Mumbwa	105001	Nangoma Mission Hospital	LVL1
Central	Kabwe	102002	Kabwe General Hospital	LVL2
Copperbelt	Kitwe	204016	Chimwemwe Urban Health Center	HC
Copperbelt	Chingola	202012	Chiwempala Urban Health Center	HC
Copperbelt	Kitwe	204021	Ipusukilo Urban Health Center	HC
Copperbelt	Kalulushi	203014	Kalulushi Government Urban Health Center	HC
Copperbelt	Kitwe	204036	Ndeke Urban Health Center	HC
Copperbelt	Chingola	202013	Kabundi East Urban Health Center	HC
Copperbelt	Kitwe	204027	Luangwa Urban Health Center	HC
Copperbelt	Chililabombwe	201010	Kakoso Urban Health Center	HC
Copperbelt	Ndola	210045	Twapia Urban Health Center	HC
Copperbelt	Ndola	2100Q9	Catholic Diocese of Ndola	HC
Copperbelt	Ndola	210031	Kalewa Barracks Urban Health Center	HC
Copperbelt	Luanshya	205003	Thomson District Hospital	LVL1

Province	District	Facility Code	Facility Name	Facility Type
Copperbelt	Mufulira	209002	Malcom Watson Hospital	LVL1
Copperbelt	Mufulira	209001	Kamuchanga District Hospital	LVL1
Copperbelt	Mpongwe	208002	Mpongwe Mission Hospital	LVL1
Copperbelt	Mpongwe	208003	St. Theresa Mission Hospital	LVL1
Copperbelt	Chililabombwe	201001	Konkola Mine Hospital	LVL1
Copperbelt	Kitwe	204003	Wusakile Mine Hospital	LVL2
Copperbelt	Luanshya	205002	Roan General Hospital	LVL2
Copperbelt	Chingola	202001	Nchanga North General Hospital	LVL2
Copperbelt	Mufulira	209003	Ronald Ross General Hospital	LVL2
Copperbelt	Chingola	202002	Nchanga South General Hospital	LVL2
Copperbelt	Kitwe	204001	Kitwe Central Hospital	LVL3
Eastern	Petauke	308001	Petauke District Hospital	LVL1
Eastern	Chipata	303002	Mwami Mission Hospital	LVL1
Eastern	Lundazi	305032	Lundazi District Hospital	LVL1
Eastern	Chadiza	301001	Chadiza District Hospital	LVL1
Eastern	Nyimba	307001	Nyimba District Hospital	LVL1
Eastern	Mambwe	306001	Kamoto Mission Hospital	LVL1
Eastern	Chipata	303097	Kapata Urban Health Center	HC
Eastern	Chipata	303001	Chipata General Hospital	LVL2
Luapula	Samfya	407028	Samfya Stage II Rural Health Center	HC
Luapula	Nchelenge	406001	St. Pauls Mission Hospital	LVL1
Luapula	Kawambwa	402001	Kawambwa District Hospital	LVL1
Luapula	Mwense	405021	Mambilima Mission Hospital	LVL1
Luapula	Mansa	403001	Mansa General Hospital	LVL2
Lusaka	Lusaka	504021	Kanyama Urban Health Center	HC
Lusaka	Lusaka	504017	George Urban Health Center	HC
Lusaka	Lusaka	504012	Chawama Urban Health Center	HC
Lusaka	Lusaka	504014	Chilenje Urban Health Center	HC
Lusaka	Lusaka	504013	Chelstone Urban Health Center	HC
Lusaka	Lusaka	504059	Chreso Ministries	HC
Lusaka	Lusaka	504028	Mtendere Urban Health Center	HC
Lusaka	Lusaka	504026	Matero Main Urban Health Center	HC
Lusaka	Chongwe	501013	Chongwe Rural Health Center	HC

Province	District	Facility Code	Facility Name	Facility Type
Lusaka	Lusaka	504058	Circle of Hope	HC
Lusaka	Lusaka	5040HG	Kara Clinic	HC
Lusaka	Lusaka	504018	Kabwata Urban Health Center	HC
Lusaka	Lusaka	504029	Ng'ombe Urban Health Center	HC
Lusaka	Lusaka	504034	Chazanga Urban Health Center	HC
Lusaka	Lusaka	504010	Bauleni Urban Health Center	HC
Lusaka	Lusaka	504057	UNZA Health Center	HC
Lusaka	Luangwa	503001	Katondwe Mission Hospital	LVL1
Lusaka	Rufunsa	501001	St. Luke Mission Hospital	LVL1
Lusaka	Lusaka	5040T9	Levy Mwanawasa Hospital	LVL2
Lusaka	Chirundu	811002	Mtendere Mission Hospital	LVL2
Lusaka	Lusaka	504004	Maina Soko Military Hospital	LVL2
Lusaka	Lusaka	504002	University Teaching Hospital	LVL3
Muchinga	Mpika	608002	Mpika District Hospital	LVL1
Muchinga	Isoka	603001	Isoka District Hospital	LVL1
Muchinga	Chama	302001	Chama District Hospital	LVL1
Northern	Kasama	605014	Kasama Urban Health Center	HC
Northern	Mpulungu	611016	Mpulungu Urban Health Center	HC
Northern	Luwingu	606001	Luwingu District Hospital	LVL1
Northern	Kasama	605001	Kasama General Hospital	LVL2
Northern	Mbala	607001	Mbala General Hospital	LVL2
NorthWestern	Solwezi	706038	Solwezi Urban Health Center	HC
NorthWestern	Kasempa	703001	Mukinge Mission Hospital	LVL1
NorthWestern	Solwezi	706001	Solwezi General Hospital	LVL2
Southern	Livingstone	806010	Maramba Urban Health Center	HC
Southern	Livingstone	806008	Mahatma Gandhi Urban Health Center	HC
Southern	Choma	801028	Shampande Urban Health Centre	HC
Southern	Namwala	809011	Chitongo Rural Health Center	HC
Southern	Kalomo	804002	Kalomo District Hospital	LVL1
Southern	Namwala	809001	Namwala District Hospital	LVL1
Southern	Monze	808031	Chikuni Mission Hospital	LVL1
Southern	Siavonga	811001	Siavonga District Hospital	LVL1
Southern	Sinazongwe	812001	Maamba District Hospital	LVL1
Southern	Choma	801001	Choma General Hospital	LVL2

Province	District	Facility Code	Facility Name	Facility Type
Southern	Monze	808001	Monze Mission Hospital	LVL2
Southern	Livingstone	806001	Livingstone General Hospital	LVL2
Southern	Choma	801002	Macha Mission Hospital	LVL2
Western	Sesheke	906002	Yeta District Hospital	LVL1
Western	Kaoma	902001	Kaoma District Hospital	LVL1
Western	Mwandi	906001	Mwandi Mission Hospital	LVL1
Western	Kalabo	901001	Kalabo District Hospital	LVL1
Western	Lukulu	903001	Lukulu District Hosptial	LVL1
Western	Kalabo	901002	Yuka Mission Hospital	LVL1
Western	Senanga	905001	Senanga District Hospital	LVL1

Note: Facility type HC refers to health center; LVL1, 2, or 3 refers to hospital level 1, 2, or 3.

APPENDIX 2. INDICATOR PRODUCTS

Product Category	Product Name
Antiretroviral Drugs	Tenofovir 300 mg/Lamivudine 300 mg/Efavirenz 600 mg (TLE)
Antiretroviral Drugs	Abacavir 30 mg/Lamivudine 60 mg (ABC/3TC)
Essential Medicine- Antibiotic	Cotrimoxazole tablets 480mg
Malaria	Artemether 120mg/Lumefantrine 20mg (ALs) 1*6tabs
Malaria	Malaria RDT
Reproductive Health	Depo-Provera
Reproductive Health	Ethinyloestradiol/Levonorgestrel 130 mg/150 mcg
Reproductive Health	Male Condoms
Laboratory	BD Facs Count CD4% reagent
HIV Tests	Determine HIV Test Kits
Laboratory	EDTA Vacutainer (4ml)
Laboratory	Rapid test kit for syphilis (RPR)
Laboratory	DBS Bundles for 50 Tests
Laboratory	ABX Minoton (Minidil)

APPENDIX 3. KEY EVALUATION INDICATORS

Research Question	Category	Indicator	Indicator Definition	Target Respondent	Data Source
To what extent has the eLMIS improved reporting frequency, timeliness, and accuracy?	Reporting Frequency	Average annual reporting rates by commodity area	Number of reports submitted in a 12-month period/ 12 months	N/A	eLMIS; SCMgr
	Reporting Frequency	% of facilities submitting reports	Number of facilities submitting reports per month /Total facilities expected to report per month	N/A	eLMIS; SCMgr
	Reporting Frequency	% of facilities using FE that submitted reports	Number of facilities submitting reports per month /Total facilities expected to report per month	N/A	eLMIS
	Reporting Timeliness	User perception on reporting time	User perceptions of ease of reporting with FE	Pharmacists and lab techs (SDP)	In-depth interviews
	Reporting Timeliness	% of facilities submitting timely reports (CE and FE)	Number of facilities submitting reports before cutoff date in a 12-month period/Total facilities reporting	N/A	eLMIS ONLY
	Reporting Accuracy	User perception on reporting accuracy	User perceptions of reporting accuracy with FE and CE	Pharmacists and lab techs (SDP and	In-depth interviews
	Reporting Accuracy	Average % of facilities per month whose beginning balance is equivalent to end balance of previous	(Number of facilities whose beginning balance is equivalent to end balance of previous month/Total facilities) Average over 1 year	N/A	eLMIS; SCMgr

Research Question	Category	Indicator	Indicator Definition	Target Respondent	Data Source
To what extent has the eLMIS improved data accessibility, transparency, and quality?	Data Accessibility	User perception on data accessibility	User perceptions of accessibility of data (Do they have access to different types of data, e.g., inventory, issues, management, etc.?)	Pharmacists and lab techs (SDP and district levels), IT unit (central level)	In-depth interviews
	Data Transparency	User perception on data transparency	User perception of transparency of data	Pharmacists and lab techs (SDP and district levels), IT Unit (central level)	In-depth interviews
	Data Quality	User perception on data quality	User perception on data quality	Pharmacists and lab techs (SDP and district levels), IT Unit (central	In-depth interviews
	Data Quality	% of facilities with SCC balance matching physical count	The number of facilities that have a SCC balance of +/- 5% / Total facilities	N/A	Facility survey
Has the availability of eLMIS data led to increased data use and/or data-driven decision-making?	Data usage	User perception on data usage	Do they have access to the data that they need for decision-making?)	Pharmacists and lab techs (SDP and district levels), IT Unit (central	In-depth interviews
	Data usage	Number of user sessions	Number of user sessions per month from 2015–17	N/A	eLMIS
To what extent is the eLMIS FE usable and acceptable among different users?	eLMIS satisfaction	% Satisfaction with eLMIS FE	Number of interviewees satisfied with the software installation/Total number of people interviewed	Pharmacists and lab techs (SDP)	In-depth interviews
	Functional software	% of facilities with functional eLMIS software	Number of facilities with functional software/Number of facilities with software installed	Pharmacists and lab techs (SDP)	Facility survey

Research Question	Category	Indicator	Indicator Definition	Target Respondent	Data Source
	Functional hardware	% of facilities with working computer and reliable internet	Number of facilities with functional hardware/Number of facilities with hardware installed	Pharmacists and lab techs (SDP)	Facility survey
	Competence	Number of facilities with staff trained in eLMIS who are competent in the software	Number of facilities with staff trained in eLMIS who are competent in the software	Pharmacists and lab techs (SDP)	Facility survey
	Usability and acceptance	User perception on system usability and acceptance	Do they find the system usable and acceptable?	Pharmacists and lab techs (SDP and district levels), IT unit (central level)	In-depth interviews
	Last R&R submission mode	Mode of submission of last R&R	No. of R&Rs submitted by different modes of submission/No. of facilities submitting R&Rs	Pharmacists and lab techs (SDP)	Facility survey; eLMIS FE
To what extent has the eLMIS contributed to improved overall supply chain perfor-mance?	Product availability	% of facilities stocked out of one or more of the tracer commodities within the 12-month reporting period No. of times facilities reported a stockout within the period of 12 months	Percentage of facilities stocked out of one or more of the tracer commodities within the 12-month reporting period Number of times facilities reported a stockout within the period of 12 months	None	eLMIS; SCMgr
	Stock status	% of facilities SATP for one or more of the tracer commodities within the 12-month reporting period	Percentage of facilities stocked according to plan for one or more of the tracer commodities within the 12-month reporting period	None	eLMIS; SCMgr

Research Question	Category	Indicator	Indicator Definition	Target Respondent	Data Source
	Stock status	% of facilities below minimum for one or more of the tracer commodities within the 12-month reporting period	Percentage of facilities below minimum for one or more of the tracer commodities within the 12-month reporting period	None	eLMIS; SCMgr
	Stock status	% of facilities overstocked for one or more tracer commodities within the 12-month reporting period	Percentage of facilities overstocked for one or more tracer commodities within the 12-month reporting period	None	eLMIS; SCMgr
	Order fill rates	% of items ordered received with correct products and quantities	Percentage of items ordered received with correct products and quantities	None	eLMIS; SCMgr
	Expiry	% of facilities with expiries of tracer commodities in last 6 months	Percentage of facilities with expiries of tracer commodities in last six months	None	Facility survey
	Lead time	Average lead time from submission of R&R form to delivery of commodities to SDPs	Average time from submission of Report to delivery of commodities to health facility	None	Facility survey

APPENDIX 4. QUESTIONNAIRES

4.1 Qualitative Tool for Health Center and Hospital

Midline Evaluation 23rd April – 29th May 2017
Zambia eLMIS Evaluation: Health Center and Hospital Interview Guide (QUALITATIVE TOOL)

Instructions to facilitators:
The following questions are a guide. An in-depth interview should feel like a conversation (where the respondent does most of the talking). It is best to begin with easy, open-ended questions so the respondent feels comfortable and it allows them to convey in their own words their experience. Focus on the respondent's experience and weave the topics and subtopics into the conversation (rather than worrying about asking each question as written). Try not to ask them to generalize or summarize their opinions on the eLMIS until the very end. Try not to ask yes/no questions or leading questions. Ask respondents to illustrate their opinions with examples or use their examples to draw out their feelings and perceptions. You should probe and ask follow-up questions only where appropriate.

Name of Facilitator: _____

Name of Note taker: _____

Date: _____

Province: _____

District: _____

Facility Name: _____

Facility Code: _____

Respondent's sex (please circle one): Male Female

Respondent's job title: _____

Interview start time: End time:

Instructions: Please introduce yourself to the respondent and thank him or her for their time. Explain the objectives of the midterm data collection: **The purpose of this**

evaluation is to assess the extent to which the eLMIS has improved supply chain processes compared to the previous paper-based system. The evaluation will focus on supply chain performance, data quality and use, and acceptability of the system.

We would like to find out a little more about your use of the eLMIS. Let's begin by talking a little bit about your job and your interaction with the eLMIS.

1. **How long have you been working in your position?**
2. **What are some of your activities as a___?.** (Use their job title)
   {Probe for descriptions or examples.}
3. **What are some of the challenges that you face as part of your job?**
   {Probe for examples.}

   ---------- eLMIS Questions ----------

   Let's talk about the eLMIS and how you use it in your job.
4. **How do you use the eLMIS as part of your job?**
   {Probe for:
   How often.
   How long they have been using it.}
5. **Can you describe your most recent experience of using the eLMIS?**
   {Probe for:
   Last time used.
   What they used it for.
   What they like or don't like about using eLMIS.
   What modules they find useful and which ones they feel are not useful.
   Advantages and disadvantages.}

   ----------Information questions----------

   Let's talk about the information that's in the eLMIS.
6. **Has using logistics data changed since the introduction of the eLMIS in your health facility?**
   {Probe for:
   How it has changed.}
7. **Has the quality of data changed since the introduction of the eLMIS?**
   {Probe for:
   How it has changed.
   Data quality before (get example).
   Issues/challenges with data quality before (get example).}
8. **Before eLMIS, was the information that you needed for reporting or decision-making complete or was some of it missing?**
9. (Follow-up to question 8) **With the eLMIS, has this remained the same or has it changed?**

{Probe for:
How has it changed?}

10. **Before the eLMIS, was the information that you needed for past months available?**

{Probe for:
Accessibility of past reports.}

11. (Follow-up question to 10) **With the eLMIS, has this remained the same or has** it changed?

{Probe for:
How it has changed (if it has).}

12. **After data are entered in the eLMIS, what do you do with the information?**

{Probe for:
Data availability.
What data are missing in the eLMIS.
How the missing data might be useful.}

13. **Do you review data in the eLMIS?**

{Probe for:
How
What they check for when reviewing.
What actions they take after reviewing the data.}

14. **Do you use eLMIS information to produce <u>any other</u> reports?**

{Probe for:
What reports (e.g., TB reports)?
What the reports are for.}

15. **Are there any *other* decisions you make using data from eLMIS? If so, can you give an example?**

----------Supervision questions----------

Supervision:

a. **Do you do any type of supervision in your role?**

(If no, skip to question 17)

If yes,

b. **What kind of supervision do you do?**
c. **How has your supervision changed since the introduction of eLMIS and can you give specific examples?**
d. **Do you use data from the eLMIS to help with supervision? What data do you use? How do you use this data?**

----------Impact question ----------

Let's talk about the eLMIS and its impact on your job.

16. **Has using the eLMIS had an impact on your overall job? If so how?**
    {Probe:
    Daily impact.}
17. **Are you spending more, or less time,reporting data with eLMIS FE?**
    If less
    a. **What are they doing with the extra time?**
    If more
    b. **What activities in eLMIS takes more time?**
18. **Since the introduction of the eLMIS, have your reporting responsibilities become more or less time-consuming?**
19. **Based on your experience with the eLMIS so far, would you recommend that other health facilities have it, or not? Why, or why not?**
20. **With your experience working with the system, what limitations do you feel the system has and what solutions would you recommend for those limitations?**
21. **What suggestions for improvement do you have for the eLMIS?**

You have now reached the end of the questionnaire

4.2 Qualitative Tool for District Health Office

Midline 23rd April – 29th May 2017
Zambia eLMIS Evaluation: DISTRICT HEALTH OFFICE Interview Guide (QUALITATIVE TOOL)

Instructions to facilitators:
The following questions are a guide. An in-depth interview should feel like a conversation (where the respondent does most of the talking). It is best to begin with easy, open-ended questions so the respondent feels comfortable and it allows them to convey in their own words their experience. Focus on the respondent's experience and weave the topics and subtopics into the conversation (rather than worrying about asking each question as written). Try not to ask them to generalize or summarize their opinions on the eLMIS until the very end. Try not to ask Yes/No questions or leading questions. Ask respondents to illustrate their opinions with examples or use their examples to draw out their feelings and perceptions. You should probe and ask follow-up questions only where appropriate.

Name of Facilitator: _____

Name of Note taker: _____

Date: _____

Province: _____

District: _____

Facility Name: _____

Facility Code: _____

Respondent's sex (Please circle one): Male Female

Respondent's job title: _____

Interview Start Time: End Time:

Instructions: Please introduce yourself to the respondent and thank him or her for their time. Explain the objectives of the midterm data collection: **the purpose of this evaluation is to assess the extent to which the eLMIS has improved supply chain processes compared to the previous paper-based system**. The evaluation will focus on supply chain performance, data quality and use, and acceptability of the system.

We would like to find out a little more about your use of the eLMIS. Let's begin by talking a little bit about your job and your interaction with the eLMIS

1. **How long have you been working in your position?**
2. **What are some of your activities as a__?** (Use their Job title)
   {Probe for descriptions or examples.}
3. **What are some of the challenges that you face as part of your job?**
   {Probe for examples.}

   ---------- eLMIS Questions ----------

   Let's talk about the eLMIS and how you use it in your job.
4. **How do you use the eLMIS as part of your job?**
   {Probe for:
   How often?
   How long they have been using it.}
5. **Can you describe your most recent experience of using the eLMIS?**
   {Probe for:
   Last time used.
   What they used it for.
   What they like or don't like about using eLMIS.

What modules they find useful and which one they feel are not useful.
Advantages and disadvantages.}

----------Information questions----------

Let's talk about the information that's in the eLMIS.

6. **Has using logistics data changed since the introduction of the eLMIS in your health facility?**
   {Probe for:
   How it has changed.}
7. **Has the quality of data changed since the introduction of the eLMIS?**
   {Probe for:
   How?
   Data quality before (get example).
   Issues/challenges with data quality before (get example).}
8. **Before eLMIS, was the information that you needed for reporting or decision-making complete or was some of it missing?**
9. (Follow-up to question 8) **With the eLMIS, has this remained the same or has it changed?**
   {Probe for:
   How it has changed?}
10. **Before the eLMIS, was the information that you needed for past months available?**
    {Probe for:
    Accessibility of past reports.}
11. (Follow-up question to 10) **With the eLMIS, has this remained the same or has it changed?**
    {Probe for:
    How has it changed, if it has?}
12. **After data are entered in the eLMIS, what do you do with the information?**
    {Probe for:
    Data availability.
    What data are missing in the eLMIS?
    How the missing data be useful.]
13. **Do you review data in the eLMIS?**
    {Probe for:
    How?
    What they check for when reviewing
    What actions they take after reviewing the data.}

14. **Do you use data visualization features of the eLMIS to analyze and summarize data from the system? If yes, how do you use it?**

    {Probe for examples}

15. **Do you use eLMIS information to produce <u>any other</u> reports?**

    {Probe for:
    What reports (e.g. TB reports)
    What the reports are for.}

16. **Are there any <u>other</u> decisions you make using data from eLMIS? If so, can you give an example?**

    ----------Supervision questions----------

    Supervision:

    a. **As a district supervisor, what does your supervisory role involve?**
    b. **How has your supervision changed since the introduction of eLMIS? If so, can you give specific examples?**
    c. **Do you use data from the eLMIS to help with supervision? If so, what data do you use and how do you use it?**

    ----------Impact question ----------

    Let's talk about the eLMIS and its impact on your job.

17. **Has using the eLMIS had an impact on your overall job? If so how?**

    {Probe:
    If so, how?
    Daily impact.}

18. **Are you spending more or less time reporting data with eLMIS?**

    If less:

    What are they doing with the extra time?

    If more:

    What activities in eLMIS take more time?

19. **Since the introduction of the eLMIS, have your reporting responsibilities become more, or less, time consuming?**
20. **Based on your experience with the eLMIS so far, would you recommend that other health facilities have it, or not? Why, or why not?**
21. **With your experience working with the system, what limitations do you feel the system has? What solutions would you recommend for those limitations?**
22. **What suggestions for improvement do you have for the eLMIS?**

You have now reached the end of the questionnaire.

4.3 Qualitative Tool for Commodity Security Center

Midline Evaluation 23rd June 2017
Zambia eLMIS Evaluation: CSC/LMU Interview Guide
(QUALITATIVE TOOL)

Instructions to facilitators:
The following questions are a guide. An in-depth interview should feel like a conversation (where the respondent does most of the talking). It is best to begin with easy, open-ended questions so the respondent feels comfortable and it allows them to convey in their own words their experience. Focus on the respondent's experience and weave the topics and subtopics into the conversation (rather than worrying about asking each question as written). Try not to ask them to generalize or summarize their opinions on the eLMIS until the very end. Try not to ask Yes/No questions or leading questions. Ask respondents to illustrate their opinions with examples or use their examples to draw out their feelings and perceptions. You should probe and ask follow-up questions only where appropriate.

Name of Facilitator: _____

Name of Note taker: _____

Date: _____

Province: _____

District: _____

Facility Name: _____

Facility Code: _____

Respondent's sex (Please circle one): Male Female

Respondent's job title: _____

Interview Start Time: End Time:

Instructions: Please introduce yourself to the respondent and thank him or her for their time. Explain the objectives of the midterm data collection: **The purpose of this evaluation is to assess the extent to which the eLMIS has improved supply chain processes compared to the previous paper-based system**. The evaluation will focus on supply chain performance, data quality and use, and acceptability of the system.

We would like to find out a little more about your use of the eLMIS. Let's begin by talking a little bit about your job and your interaction with the eLMIS

1. **How long have you been working in your position?**
2. **What are some of your activities as a……..** (Use their job title)**?**
   {Probe for descriptions or examples.}
3. **What are some of the challenges that you face as part of your job?**
   {Probe for examples.}

   ---------- eLMIS Questions ----------

   Let's talk about the eLMIS and how you use it in your job.
4. **How do you use the eLMIS as part of your job?**
   {Probe for:
   How often
   How long they have been using it.}
5. **Can you describe your most recent experience of using the eLMIS?**
   {Probe for:
   Last time used.
   What they used it for.
   What they like or don't like about using eLMIS.
   What modules they find useful and which one they feel are not useful
   advantages and disadvantages.}

   ----------Information questions----------

   Let's talk about the information that's in the eLMIS.
6. **Has using logistics data changed since the introduction of the eLMIS in this department?**
   {Probe for:
   How it has changed.}
7. **Has the quality of data changed since the introduction of the eLMIS?**
   {Probe for:
   How?
   Data quality before **introduction of the eLMIS** *(get example)*
   Issues/challenges with data quality before (get example).}
8. **Before eLMIS, was the information that you needed for decision-making complete or was some of it missing?**
9. (Follow-up to question 8) **With the eLMIS, has this remained the same or has it changed?**
   {Probe for:

How it has changed.}

10. **Before the eLMIS, was the information that you needed for past months available?**

    {Probe for:
    Accessibility of past reports.}

11. (Follow-up to question 10) **With the eLMIS, has this remained the same or has it changed?**

    {Probe for:
    How has it changed, (if it has).}

12. **After data are entered in the eLMIS, what do you do with that information?**

    {Probe for:
    Data availability.
    What data are missing in the eLMIS.
    How the missing data has been useful.}

13. **Do you review data in the eLMIS?**

    {Probe for:
    How?
    What they check for when reviewing.
    What actions they take after reviewing the data.}

14. **Do you use data visualization features of the eLMIS to analyze and summarize data from the system; if yes, how do you use it?**

    {Probe for examples.}

15. **What other reports do you produce using information in eLMIS and what do you use these reports for?**

    {Probe for: What the reports are for.}

16. **Are there any *other* decisions you make using data from eLMIS? If so, can you give an example?**

----------Supervision questions----------

Supervision:

a. **As a central-level supervisor, what does your supervisory role involve?**
b. **How has your supervision changed since the introduction of eLMIS? If so, can you give specific examples?**
c. **Do you use data from the eLMIS to help with supervision? If so, what data do you use and how do you use it?**

----------Impact question ----------

Let's talk about the eLMIS and its impact on your job.

17. **Has using the eLMIS had an impact on your overall job, and if so how?**
    {Probe: Daily impact}
18. **Since the introduction of the eLMIS, has data entry responsibilities become more, or less, time consuming?**
    If less
    What are you doing with the extra time?
    If more
    What activities in eLMIS takes more time?
19. **Since the introduction of the eLMIS, what are some changes to the central-level process cycle?**
20. **Are orders moving more quickly through the system?**
21. **Has order processing become easier or more difficult?**
22. **Have you had any experience of using *both* eLMIS and MACS warehouse management system?**
    If yes:
    i. **What has been your experience using the both systems?**
    {Probe for:
    Systems interoperability (meaning do they communicate and exchange data with ease?)}
23. **With your experience working with the eLMIS, what limitation do feel the system has, and what solutions would you recommend for those limitations?**
24. **What suggestions for improvement do you have for the eLMIS?**

You have now reached the end of the questionnaire.

4.4 Costing Qualitative Tool for Health Centers and Hospitals

Midline 23rd April – 29th May 2017

Zambia eLMIS Evaluation: HEALTH CENTER AND HOSPITAL Interview: Data Entry Costs (COSTING TOOL)

The following questions are a guide. An in-depth interview should feel like a conversation (where the respondent does most of the talking). It is best to begin with easy, open-ended questions so the respondent feels comfortable and it allows them to convey in their own words their experience. Focus on the respondent's experience and weave the topics and subtopics into the conversation (rather than worrying about asking each question as written). Try not to ask them to generalize or summarize their opinions on the eLMIS until the very end. Try not to ask Yes/No questions or leading questions. Ask respondents to illustrate their opinions with

examples or use their examples to draw out their feelings and perceptions. You should probe and ask follow-up questions only where appropriate.

Name of Facilitator: _____

Name of Note taker: _____

Date: _____

Province: _____

District: _____

Facility Name: _____

Facility Code: _____

Respondent's sex (Please circle one): Male Female

Respondent's job title: _____

Interview Start Time: End Time:

Instructions: Please introduce yourself to the respondent and thank him or her for their time. Explain the objectives of the midterm data collection: **the purpose of this evaluation is to assess the extent to which the eLMIS has improved supply chain processes compared to the previous paper-based system**. The evaluation will focus on supply chain performance, data quality and use, and acceptability of the system.

1.0 Please provide your civil service grade (scale): (Response will be civil service grade (scale) number.)

----------**eLMIS BASED QUESTIONS**----------

2.0 For the eLMIS, how many hours do you normally spend completing and submitting the electronic R&R in each reporting cycle?

{Please only include time spent on the R&R—for example, if you spend 1 hour completing the form, then 1 hour interacting with patients, then return to the form for 1 hour, please only count 2 hours total. (Response will be number, rounded to one decimal place.)}

2.1. Do any other staff normally support this activity? (Y/N)

2.2 If Yes:

Please provide their civil service grade(s): (Response will be civil service grade (scale) number(s).)

1. 3.
2. 4.

2.3 For the eLMIS, how many hours do each of these staff normally spend completing and submitting the electronic R&R in each reporting cycle?

1. 3.
2. 4.

If No: end question 2

----------**PAPER-BASED QUESTIONS**----------

3.0 For the previous paper-based R&R, how many hours did you normally spend completing the paper R&R in each reporting cycle?

{Please only include time spent on the R&R—for example, if you spent 1 hour completing the form, then 1 hour interacting with patients, then returned to the form for 1 hour, please only count 2 hours total. (Response will be number, rounded to one decimal place.)}

3.1 Did any other staff normally support this activity? (Y/N)

If Yes:

3.2 **Please provide their civil service grade(s) (scale): (Response will be civil service grade number(s).)**

1. 3.
2. 4.

3.3 For the previous paper-based R&R, how many hours did these staff normally spend completing the paper R&R in each reporting cycle?

1. 3.
2. 4.

If No: end question 3.

This is the end of the interview

4.5. Costing Qualitative Tool for District Health Offices

Midline 23rd April – 29th May 2017

Zambia eLMIS Evaluation: DISTRICT HEALTH OFFICE Interview (COSTING TOOL)

Instructions to facilitators: Before you begin, you must have the respondent complete a consent form.

The following questions are a guide. An in-depth interview should feel like a conversation (where the respondent does most of the talking). It is best to begin with easy, open-ended questions so the respondent feels comfortable and it allows them to convey in their own words their experience. Focus on the respondent's experience and weave the topics and subtopics into the conversation (rather than worrying about asking each question as written). Try not to ask them to generalize or summarize their opinions on the eLMIS until the very end. Try not to ask yes/no questions or leading questions. Ask respondents to illustrate their opinions with

examples or use their examples to draw out their feelings and perceptions. You should probe and ask follow-up questions only where appropriate.

Name of Facilitator: _____

Name of Note taker: _____

Date: _____

Province: _____

District: _____

Facility Name: _____

Facility Code: _____

Respondent's sex (Please circle one): Male Female

Respondent's job title: _____

Interview Start Time: End Time:

Instructions: Please introduce yourself to the respondent and thank him or her for their time. Explain the objectives of the midterm data collection: **the purpose of this evaluation is to assess the extent to which the eLMIS has improved supply chain processes compared to the previous paper-based system**. The evaluation will focus on supply chain performance, data quality and use, and acceptability of the system.

1.0 Please provide your civil service grade (scale): (Response will be civil service grade (scale) number.)

----------**eLMIS BASED QUESTIONS**----------

2.0 For the eLMIS, how many hours do you normally spend reviewing and approving the electronic R&R forms in each reporting cycle? (This question is asking for both FE sites and CE for paper-based sites. Record both times)

{Please only include time spent on the R&R—for example, if you spend 1 hour reviewing the forms, then 1 hour in a separate meeting, then return to the forms for 1 hour, please only count 2 hours total. (Response will be number, rounded to one decimal place.)}

2.1 Do any other staff normally support this activity? (Y/N)

If Yes:

2.2 Please provide their civil service grade(s) (scale): (Response will be civil service grade (scale) number(s))

1. 3.
2. 4.

2.3 For the eLMIS, how many hours do each of these staff normally spend reviewing and approving the electronic R&R forms in each reporting cycle?

1. 3.

2. 4.

If No: end question 2.

----------**PAPER-BASED QUESTIONS**----------

3.0 For the previous *paper-based R&R*, how many hours did you normally spend reviewing and approving the paper R&R forms in each reporting cycle*?*

{Please only include time spent on the R&Rs—for example, if you spent 1 hour completing the form, then 1 hour in a separate meeting, then returned to the form for 1 hour, please only count 2 hours total. (Response will be number rounded to one decimal place.)}

3.1 Did any other staff normally support this activity? (Y/N)

Please turn over

If Yes:

3.2 Please provide their civil service grade(s) (scale): (Response will be civil service grade (scale) number(s))

1. 3.
2. 4.

3.3 For the previous paper-based R&R, how many hours did these staff normally spend reviewing and approving the paper R&R forms in each reporting cycle?

1. 3.
2. 4.

If No: end question 3.

This is the end of the interview

4.6. Costing Qualitative Tool for Commodity Security Center

Midline 23rd June 2017

Zambia eLMIS Evaluation: CSC {LMU} Interview

(COSTING TOOL)

Instructions to facilitators: Before you begin, you must have the respondent complete a consent form.

The following questions are a guide. An in-depth interview should feel like a conversation (where the respondent does most of the talking). It is best to begin with easy, open-ended questions so the respondent feels comfortable and it allows them to convey in their own words their experience. Focus on the respondent's experience and weave the topics and subtopics into the conversation (rather than worrying about asking each question as written). Try not to ask them to generalize or summarize their opinions on the eLMIS until the very end. Try not to ask Yes/No questions or leading questions. Ask respondents to illustrate their opinions with examples or use their examples to draw out their feelings and perceptions. You should probe and ask follow-up questions only where appropriate.

Name of Facilitator: _____

Name of Note taker: _____

Date: _____

Province: _____

District: _____

Facility Name: _____

Facility Code: _____

Respondent's sex (Please circle one): Male Female

Respondent's job title: _____

Interview Start Time: End Time:

Instructions: Please introduce yourself to the respondent and thank him or her for their time. Explain the objectives of the midterm data collection: **the purpose of this evaluation is to assess the extent to which the eLMIS has improved supply chain processes compared to the previous paper-based system**. The evaluation will focus on supply chain performance, data quality and use, and acceptability of the system.

1.0 Please provide your civil service grade (scale): (Response will be civil service grade (scale) number) *{this may not apply to MSL staff hence it would be good to tactfully find out}*

----------**eLMIS BASED QUESTIONS**----------

2.0 For the eLMIS, how many hours do you normally spend reviewing and converting the electronic R&R forms in each reporting cycle?

{Please only include time spent on the R&R—for example, if you spend 1 hour reviewing the forms, then 1 hour in a separate meeting, then return to the forms for 1 hour, please only count 2 hours total. (Response will be number – rounded to one decimal place.)}

2.1 How many other staff members normally are assigned to support this activity?

2.2 Please provide their civil service grade(s) (scale): (Response will be civil service grade (scale) number(s))

1. 3.
2. 4.
5. 6.
7. 8.
9. 10.

2.3 While using eLMIS, how many hours do <u>each</u> of these staff normally spend reviewing and processing each electronic R&R in a day? *{Focusing on only one (1) R&R per person}*

----------**SUPPLY CHAIN MANAGER QUESTIONS**----------

3.0 Regarding the time the department used supply chain manager software, how many staff were dedicated to entering data and processing orders? *(Response is whole number)*

4.0 What is the typical civil service grade (scale) for these positions?

(Response is numerical Civil Service Grade)

5.0 How many reports does each staff person typically enter in each reporting period?

(Response is whole number).

This is the end of the interview.

4.7 Quantitative Tool for Health Centers and Hospitals

Form: eLMISEvaluation_Facility_Quantitative_Tool

99 Questions

==========

Zambia eLMIS Evaluation Facility Survey.

2. Please enter the interviewer's name.

3. Please enter the date that this interview is taking place.

4. Please enter province.

Choose one response.

- Central
- Copperbelt
- Eastern
- Lusaka
- Luapula
- Muchinga
- Northern
- Northwestern

- Southern
- Western

5. Please enter district.

Choose one response.

- Chadiza
- Chama
- Chibombo
- Chililabombwe
- Chingola
- Chipata
- Chirundu
- Choma
- Chongwe
- Isoka
- Kabwe
- Itezhi-tezhi
- Kalulushi
- Kalabo
- Kalomo
- Kaoma
- Kapiri-mposhi
- Kasama
- Kawambwa
- Kasempa
- Livingstone
- Kitwe
- Luangwa
- Luanshya
- Lukulu
- Lundazi
- Lusaka
- Luwingu
- Mambwe
- Mansa
- Mbala
- Monze
- Mkushi
- Mpongwe
- Mpika
- Mpulungu
- Mufulira
- Mwandi
- Mumbwa
- Mwense
- Namwala
- Nchelenge
- Ndola
- Nyimba
- Petauke
- Rufunsa
- Samfya
- Senanga
- Sesheke
- Siavonga
- Sinazongwe
- Solwezi

6. Please enter the facility name.

7. Please enter the facility code.

8. Please enter the facility type.

Choose one response.

- Health Center
- Level 1 Hospital
- Level 2 Hospital

- Level 3 Hospital

9. Please enter department completing the questionnaire.

Choose one response.

- Pharmacy

- Laboratory

10. I will now ask you about information communication technologies (ICT) availability.

11. Other than eLMIS - Does this department use any form of ICT systems, such as phones, computers, the internet, etc.?

Choose one response

- Yes (enumerator verifies availability)

- Yes (availability not verified)

- No (ICT not used) If this response, jump to 18.

12.If Yes; which of the following types of ICTs are used in the department? (Please select all that apply.)

Choose all that apply.

- Computers -If this response, jump to 14.

- Mobile Phones - Basic handset If this response, jump to 15

- Mobile Phone (smart phone) If this response, jump to 15

- Tablets

- Other

13. Specify other form of ICT.

14. (IF COMPUTER) Is the computer functioning properly (i.e. turns on/off, can open programs, input information, etc.)?

Choose one response.

- Yes (enumerator verifies)

- Yes (not verified)

- Not functional

15. Does this facility have internet access (LAN or Wifi)?

Choose one response.

- No If this response, jump to 17.

- Yes

16. (If LAN or Wifi) In general, how many weeks out of the month do you have network (internet) access?

Choose one response.

- Always

- 2-3 Weeks

- 1-2 Weeks

- Less than 1 week

17. Does this facility use the eLMIS FE software for commodity management and reporting?

Choose one response.

- No If this response, jump to 99.

- Yes

18. I will now ask you about staff competency.

19. How many people work in stock management in your department?

The answer must be > 0 and < 50.

20. How many facility staff in your department use the eLMIS FE regularly for commodity management and reporting?

The answer must be > 0 and < 50.

21. Number of staff members working in stock management in your department; trained (formal or on-the-job training) in eLMIS FE.

The answer must be > 0 and < 50.

22. I will now ask you about system functionality.

23. Is the equipment provided (i.e., computer and/or LAN) suitable to perform the necessary tasks (i.e., enter transactions and submit reports) on the eLMIS FE System?

Choose one response

- No

- Yes If this response, jump to 25

24. Specify why it is not adequate.

25. Is eLMIS FE program (or software?) functioning as intended (i.e., allowing users to enter and submit data)?

Choose one response

- No

- Yes If this response, jump to 27.

26. How is it not functioning as intended?

27. How was the most recent Report and Requisition report submitted (i.e. monthly report)?

Choose one response

- By eLMIS FE If this response, jump to 29

- Written Hard copy to the District or MSL for hospitals If this response, jump to 29

- Printed Hard copy to the District or MSL for hospitals If this response, jump to 29

- Did not report

28. Specify — Why you did not report.

29. In the past six months, has the facility been unable to submit their R&R using eLMIS FE?

Choose one response.

- No If this response, jump to 31.

- Yes

30. If Yes, why?

Choose one response.

- Internet connectivity

- Lack of trained staff

- Equipment breakdown

- Other - Specify

31. I will now ask you about report accuracy.

32. Which department is completing this section?

Choose one response.

- Pharmacy

- Laboratory If this response, jump to 69.

33. Does this facility manage TDF300/3TC150/EFV300 (Atripla)?

Choose one response.

- No If this response, jump to 37.

- Yes

34. (For data collector: Do a physical count of TDF300/3TC150/EFV300). What is the physical count of this commodity today? (Use smallest unit of count, e.g., piece, vial, cycle, etc.)

The answer must be > 0 and < 100000.

35. What is the balance recorded on the SCC in the eLMIS FE for this commodity?

The answer must be > 0 and < 100000.

36. Does the SCC balance match the physical count for TDF300/3TC150/EFV300?

Choose one response.

- No

- Yes

37. Does this facility manage ABC30/3TC60?

Choose one response.

- No If this response, jump to 41.

- Yes

38. (For data collector - Do a physical count of (ABC30/3TC60). What is the physical count of this commodity today? (Use smallest unit of count, e.g., piece, vial, cycle, etc.)

The answer must be > 0 and < 10000.

39. Does the SCC balance match the physical count for ABC/3TC?

The answer must be > 0 and < 10000.

40. Does the SCC balance match the physical count for (ABC30/3TC60)?

Choose one response.

- No

- Yes

41. Does this facility manage LPV/r20?

Choose one response.

- No If this response, jump to 45.

- Yes

42. (For data collector) Do a physical count of LPV/r20. What is the physical count of this commodity today? (Use smallest unit of count, e.g. piece, vial, cycle, etc.)

43. What is the balance recorded on the SCC in the eLMIS FE for this commodity?

44. Does the SCC balance match the physical count for LPV/r20?

Choose one response –

- No

- Yes

45. Does this facility manage Cotrimoxazole (480mg) tablets?

Choose one response.

- No If this response, jump to 49

- Yes

46.(For data collector) Do a physical count of Cotrimoxazole (480mg) tablets? What is the physical count of this commodity today? (Use smallest unit of count, e.g. piece, vial, cycle, etc.)

47. What is the balance recorded on the SCC in the eLMIS FE for this commodity?

48. Does the SCC balance match the physical count for Cotrimoxazole 480mg) tablets?

Choose one response.

- No

- Yes

49. Does this facility manage Artemether 120mg/Lumefantrine 20mg (ALs) 1*6tabs?

Choose one response.

- No If this response, jump to 53.

- Yes

50. (For data collector) Do a physical count of Artemether 120mg /Lumefantrine 20mg (ALs) 1x6tabs. What is the physical count of this commodity today? (Use smallest unit of count, e.g., piece, vial, cycle, etc.)

51. What is the balance recorded on the SCC in the eLMIS FE for this commodity?

52. Does the SCC balance match the physical count for Artemether 120mg /Lumefantrine 20mg (ALs) 1*6tabs?

Choose one response.

- No

- Yes

53. Does this facility manage the Malaria RDT?

Choose one response.

- No If this response, jump to 57.

- Yes

54. (For data collector) Do a physical count of for Malaria RDT. What is the physical count of this commodity today? (Use smallest unit of count, e.g., piece, vial, cycle, etc.)

55. What is the balance recorded on the SCC in the eLMIS FE for this commodity?

56. Does the SCC balance match the physical count for Malaria RDT?

Choose one response.

- No

- Yes

57. Does this facility manage Depo-Provera?

Choose one response.

- No If this response, jump to 61.

- Yes

58. (For data collector) Do a physical count of Depo-Provera. What is the physical count of this commodity today? (Use smallest unit of count, e.g., piece, vial, cycle, etc.)

59. What is the balance recorded on the SCC in the eLMIS FE for this commodity?

60. Does the SCC balance match the physical count for Depo-Provera?

Choose one response.

- No

- Yes

61.Does this facility manage the oral combined pill?

Choose one response.

- No If this response, jump to 65.

- Yes

62. (For data collector) Do a physical count of the oral combined pill. What is the physical count of this commodity today? (Use smallest unit of count, e.g., piece, vial, cycle, etc.)

63. What is the balance recorded on the SCC in the eLMIS FE for this commodity?

64. Does the SCC balance match the physical count for oral combined pill?

Choose one response.

- No

- Yes

65. Does this facility manage male condoms?

Choose one response.

- No If this response, jump to 93.

- Yes

66. (For data collector) Do a physical count of for male condoms. What is the physical count of this commodity today? (Use smallest unit of count, e.g., piece, vial, cycle, etc.)

The answer must be > 0 and < 1000000

67. What is the balance recorded on the SCC in the eLMIS FE for this commodity?

The answer must be > 0 and < 1000000

68. Does the SCC balance match the physical count for male condoms?

Choose one response

- No If this response, jump to 93

- Yes If this response, jump to 93

69. Does this facility manage BD Facs Count CD4% reagent?

Choose one response

- No If this response, jump to 73

- Yes

70. (For data collector) Do a physical count of BD Facs Count CD4% reagent. What is the physical count of this commodity today? (Use smallest unit of count, e.g., piece, vial, cycle, etc.)

The answer must be > 0 and < 50000

71. What is the balance recorded on the SCC in the eLMIS FE for this commodity?

The answer must be > 0 and < 50000

72. Does the SCC balance match the physical count for BD Facs Count CD4% reagent?

Choose one response.

- No

- Yes

73. Does this facility manage Determine HIV test kits?

Choose one response.

- No If this response, jump to 77.

- Yes

74. (For data collector) Do a physical count of for HIV test kits. What is the physical count of this commodity today? (Use smallest unit of count, e.g., piece, vial, cycle, etc.)?

75. What is the balance recorded on the SCC in the eLMIS FE for this commodity?

76. Does the SCC balance match the physical count for HIV test kits?

Choose one response.

- No

- Yes

77. Does this facility manage EDTA Vacutainer (4ml)?

Choose one response.

- No If this response, jump to 81.

- Yes

78. (For data collector) Do a physical count of EDTA Vacutainer (4ml). What is the physical count of this commodity today? (Use smallest unit of count, e.g., piece, vial, cycle, etc.)

79. What is the balance recorded on the SCC in the eLMIS FE for this commodity?

80. Does the SCC balance match the physical count for EDTA Vacutainer (4ml)?

Choose one response.

- No

- Yes

81. Does this facility manage rapid test kit for syphilis (RPR)?

Choose one response.

- No(If this response, jump to 85)

- Yes

82. (For data collector) Do a physical count of rapid test kit for syphilis (RPR). What is the physical count of this commodity today? (Use smallest unit of count, e.g., piece, vial, cycle, etc.)

83. What is the balance recorded on the SCC in the eLMIS FE for this commodity?

84. Does the SCC balance match the physical count for rapid test kit for syphilis (RPR)?

Choose one response.

- No

- Yes

85. Does this facility manage DBS bundles for 50 tests?

Choose one response.

- No (If this response, jump to 89.)

- Yes

86. (For data collector) Do a physical count of DBS bundles for 50 tests. What is the physical count of this commodity today? (Use smallest unit of count, e.g., piece, vial, cycle, etc.)

87. What is the balance recorded on the SCC in the eLMIS FE for this commodity?

88. Does the SCC balance match the physical count for DBS Bundles for 50 tests?

Choose one response.

- No

- Yes

89. Does this facility manage ABX Minoton (Minidil)?

Choose one response.

- No (If this response, jump to 93.)

- Yes

90. (For data collector) Do a physical count of ABX Minoton (Minidil). What is the physical count of this commodity today? (Use smallest unit of count, e.g., piece, vial, cycle, etc.)

The answer must be > 0 and < 20000.

91. What is the balance recorded on the SCC in the eLMIS FE for this commodity?

The answer must be > 0 and < 20000.

92. Does the SCC balance match the physical count for ABX Minoton (Minidil)?

Choose one response.

- No

- Yes

93. I will now ask you about expiries.

94. Have any indicator products expired in the past six months?

Choose one response.

- No

- Yes

95. Have any indicator products expired in the past three months?

Choose one response.

- No If this response, jump to 97.

- Yes

96. How many indicator products had expiries in the last three months?

The answer must be > 1 and < 30.

97. I will now ask you about lead time.

98. How long does it take for the facility to receive commodities after submission of the report and requisition report?

Choose one response

- One to two weeks

- Three to four weeks

- Five weeks to eight weeks

- Over eight weeks

99. You have completed the questionnaire.

JSI Research & Training Institute, Inc.
Plot 8658
Kudu Road
PO Box 320087
Lusaka, Zambia

JSI Research & Training Institute, Inc.
1616 Fort Myer Drive, 16th Floor
Arlington, VA 22209 USA
Phone: 703-528-7474
Fax: 703-528-7480
Web: aidsfree.usaid.gov