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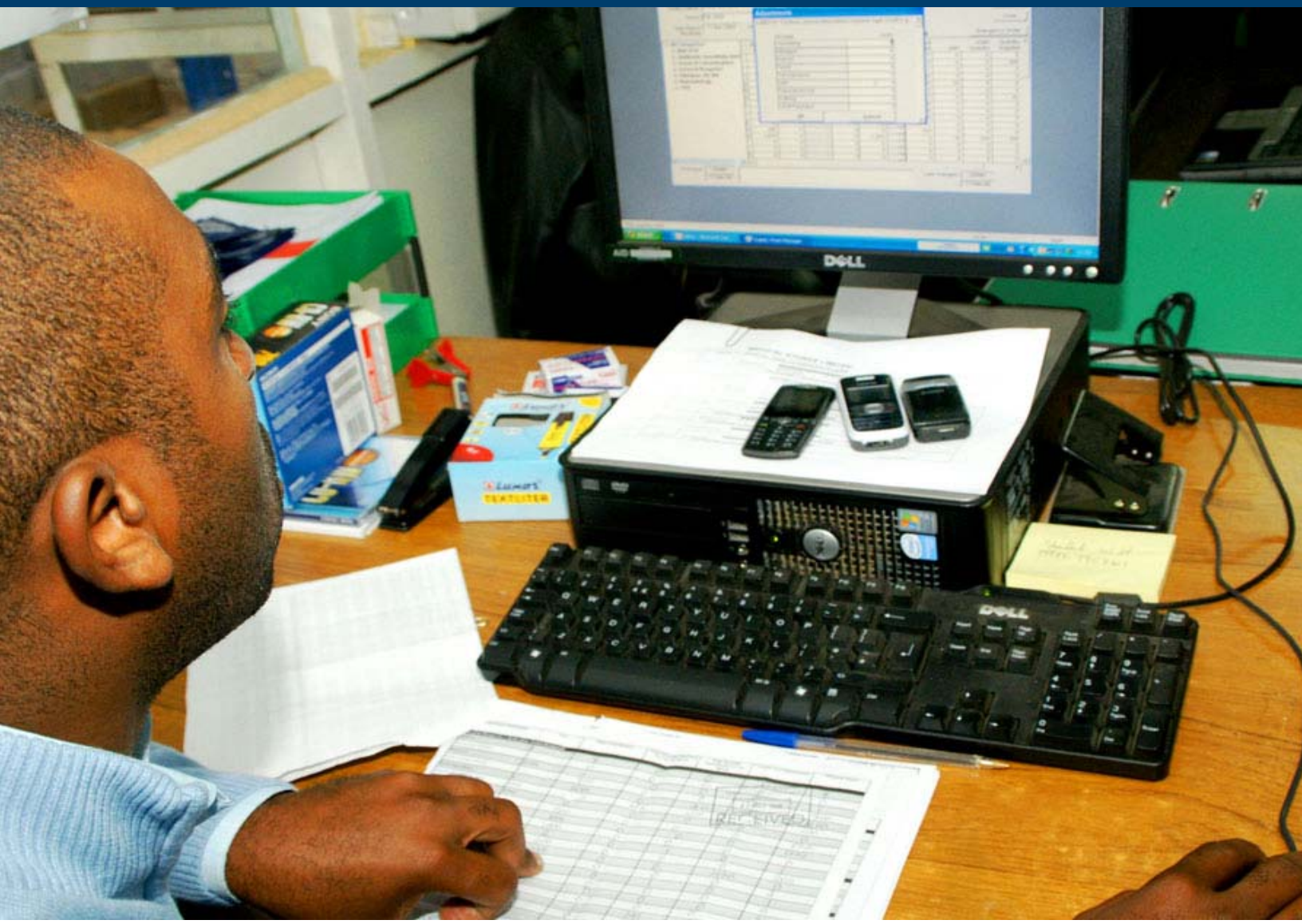
Digging into Malaria Data: Comparing HMIS and LMIS Data to Improve Program Management in Zambia



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PRESIDENT'S MALARIA INITIATIVE

Digging into Malaria Data:

Comparing HMIS and LMIS Data to Improve Program Management in Zambia

The authors' views expressed in this publication do not necessarily reflect the views of the U.S. Agency for International Development or the United States government.

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Abstract
To improve malaria program management, it is important to compare data from the health management information system (HMIS) on the number of cases of malaria with data from the logistics management information system (LMIS) on the quantities of treatments dispensed. This report compares such data in Zambia. In addition to conducting a quantitative analysis of the data, USAID | DELIVER PROJECT staff also analyzed information system procedures for the HMIS and LMIS. The report concludes that even though data quality is a major challenge to conducting a robust comparison of HMIS and LMIS data, such comparisons are useful in revealing system weaknesses and strengths.

Cover photo: A clinician analyzes patient data in Liberia. (USAID | DELIVER PROJECT, 2009).

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Contents

Acronyms v
Acknowledgments vii
Executive Summary ix
Introduction 1
Objectives 1
Overview of Malaria, HMIS, and LMIS in Zambia 3
Malaria in Zambia 3
Logistics Management Information System 3
Health Management Information System 6
Methodology 9
Analysis of Documented Procedures and Process 9
Quantitative Analysis of Data 9
Assumptions, Constraints, and Considerations 12
Findings 13
Process/Procedures 13
Overall Quantitative Data Findings 15
Findings on Facilities with Consistent Ratios 21
Recommendations 23
Conclusion 27
References 29
Appendices 31
A. Report and Requisition Form 33
B. Health Management Information Systems Data 35

Figures

1. Zambia 3
2. Movement of Essential Medicines and LMIS Data 5
3. Movement of HMIS Data 7
4. EMLIP Districts Included in Analysis 11
5. Percentage of Facilities Where the Ratio of Number of Cases of Malaria vs. Quantities of ACTs Dispensed Are Less than 1, Equal to 1, or More Than 1 15
6. Range of Ratios: Number of Malaria Cases Receiving Treatment vs. Number of Cases of Malaria 17

7. Range of Ratios: Number of Malaria Cases Receiving Treatment vs. Quantities of ACTs Dispensed 17
8. Range of Ratios: Number of Cases of Malaria vs. Quantities of ACTs Dispensed 18
9. Facilities with consistent ratios of the number of malaria cases and the Quantities of ACTs dispensed 19
10. Facilities with Consistent Ratios of the Number of Malaria Cases that Received Treatment and the Quantities of ACTs Dispensed 19
11. Ratio of Number of Malaria Cases to Quantities of ACTs Dispensed: Inconsistent Facilities 20
12. Number of Facilities Reporting on Each Data Item 21
13. Cases of Malaria vs. Treatments Dispensed: Consistent Facilities .... **Error! Bookmark not defined.**

Tables

1. Data from the DHIS and the HMIS Procedures Manual 13
2. Percentage of Facility Names Matching between the HMIS and LMIS 14

Acronyms

AL	artemether-lumefantrine
ACT	artemisinin-based combination therapy
DHIS	district health information system
DHO	district health office
EMLIP	Essential Medicines Logistics Improvement Program
HIA	health information aggregation
HMIS	health management information system
IPD	inpatient department
LMIS	logistics management information system
LMU	logistics management unit
MOH	Ministry of Health
MSL	Medical Stores Limited
OPD	outpatient department
R&R	report and requisition (form)
RDT	rapid diagnostic test
USAID	U.S. Agency for International Development

Acknowledgments

Many thanks are offered to the Zambia office of the USAID | DELIVER PROJECT, which provided the data from the health management information system and the logistics management information system that made this analysis possible. Specifically, the authors wish to thank Sydney Chanda, Wendy Nicodemus, Derrick Nyimbili, John Sikasote, Gamariel Simpungwe, and Rabson Zyambo. Thanks also go to the Ministry of Health of Zambia, which owns the data that were used in this analysis. We hope that the recommendations offered in this paper will ultimately help improve the malaria services offered in-country.

We are grateful to the professionals in the President's Malaria Initiative for their encouragement, advice, and commitment to improving malaria and public health programs through logistics.

Executive Summary

Information is the engine that drives an entire logistics system. A logistics management information system (LMIS) collects and reports data on quantities dispensed, stock on hand, and losses and adjustments. A health management information system (HMIS) collects and reports program data, such as incidence of disease, client/patient information, and health services rendered. To manage malaria and its commodities, it is important to bring together these two sources of data.

In this paper, LMIS and HMIS data from Zambia are analyzed, differences are quantified, and explanations for some of the root causes of those differences are offered. Two types of analysis were done. The first looked at the defined procedures on the data collection, reporting, flow of data, and human resources across the LMIS and the HMIS. The second type of analysis was quantitative, and it compared HMIS and LMIS data at the facility level. The data that were compared are (a) the number of malaria cases that received treatment (HMIS), (b) the number of confirmed plus clinical cases of malaria (HMIS), and (c) the quantities of artemisinin-based combination therapies (ACTs) dispensed. Ratios for each of those comparisons were calculated.

Major findings include the following:

- The HMIS data and LMIS data are not set up for easy or routine comparison.
- At most facilities, the HMIS records and reports are completed by a different person and in a different location from that of the LMIS records and reports.
- The HMIS does not distinguish between uncomplicated and severe malaria cases—only outpatient and inpatient cases. An assumption was made that outpatient cases were uncomplicated malaria.
- More frequently, facilities report that more quantities of ACTs are dispensed compared to the number of cases of malaria seen. However, there are still a significant number of facilities where the cases of malaria seen are higher than the quantities of ACTs dispensed.
- Ratios vary widely across facilities. Very few facilities had consistent ratios; within a single facility, ratios were not consistent across time. Even for the facilities that had consistent ratios, the ratios are not necessarily valid.
- Facilities consistently report on the number of malaria cases but *not* on the number of cases that receive ACTs.
- During the malaria season, there are more cases of malaria occurring than there are treatments being dispensed.
- There are fewer malaria cases that receive treatment than there are quantities of ACTs dispensed.

Theoretically, HMIS and LMIS data should match; however, there are a multitude of reasons those numbers will not match. In some sense, it is reasonable that HMIS and LIMIS data do not match. It is important to compare them, to see what are the differences and the magnitude of those

differences, and to take specific actions that will help improve the data quality. Doing such analysis has the following programmatic benefits:

- Improve the quantification process.
- Measure the adherence to policies and procedures.
- Enhance communication between program managers and supply chain managers.
- Increase understanding of the effect of stockouts and of informing resupply.
- Identify facilities where the discrepancies between the data sources are large, and provide the necessary feedback and supervision.

The strengths and weaknesses of all data should be understood, and HMIS data and LMIS data on malaria should be routinely compared to get a more complete picture of malaria services and supplies in-country. Doing so can help ensure that antimalarial supply responds to the epidemiological drivers of malaria.

Introduction

Information is the engine that drives an entire logistics system. Information is collected to make decisions; the better the information we have, the better the decisions we can make. A logistics management information system (LMIS) is the system of records and reports that is used to collect, organize, and present logistics data gathered from all levels of the system. An LMIS collects data about health products. For malaria, examples of the type of data collected in an LMIS include (a) stock on hand of artemisinin-based combination therapies (ACTs) and rapid diagnostic tests (RDTs), (b) quantities of ACTs or RDTs dispensed, and (c) any losses or adjustments of ACTs or RDTs. Most important, an LMIS enables logisticians to collect the data needed to make informed decisions that will ultimately improve product availability and customer service. One immediate decision that is made based on logistics data is the quantities of products that should be resupplied to health facilities.

A health management information system (HMIS) collects and reports information that is different from that of an LMIS. Those data are program information, such as incidence of disease; client/patient information; and health services rendered. HMIS data can be used to determine disease patterns or to track health service usage, as well as to monitor and evaluate health service delivery. For malaria, examples of the type of data collected in an HMIS include (a) cases of malaria seen, (b) cases of malaria treated, (c) cases of malaria confirmed by RDT and/or microscopy, and (d) number of deaths resulting from malaria. HMIS data are often broken down by age (i.e., cases under 1 year old, cases 1 to 5 years old, and cases over 5 years old).

In most countries, the HMIS is managed separately from the LMIS. To manage malaria and its commodities, it is important to bring together these two sources of data. Both types of data are needed (a) to conduct national-level quantifications, (b) to help high-level decisionmaking on financing and procurement of commodities, (c) to inform program policies and plans over time, and (d) to improve overall quality of care for malaria. Although program managers and logistics managers may be eager to compare and analyze HMIS and LMIS data, the operational linking between the two types is often weak or non-existent.

Objectives

Theoretically, the data from the HMIS should directly correspond to the data from the LMIS. For malaria, for example, the number of cases of uncomplicated malaria treated should match the quantities of ACTs dispensed. However, often there are discrepancies between the HMIS and the LMIS data.

The objectives of this study were to accomplish the following:

1. Obtain LMIS and HMIS data from a country and analyze the differences between the data.
2. Investigate what some of the root causes of those discrepancies may be.
3. Propose solutions for managing those discrepancies.

Overview of Malaria, HMIS, and LMIS in Zambia

Malaria in Zambia

Malaria is endemic in all nine provinces in Zambia (figure 1); the entirety of Zambia's population of 12 million people is at risk. Malaria is a leading cause of morbidity and mortality, and it accounts for 36 percent of all outpatient attendances and for an estimated 50,000 deaths per year, including up to 20 percent of maternal mortality. Children are especially vulnerable; 48 percent of cases are among children under 5 years of age, and malaria is the cause of 40 percent of infant mortality. Zambia's national strategic plan for malaria estimates that there are 4.3 million clinical cases per year.

Most malaria cases occur from November to May, during the rainy season. Zambia is experiencing an epidemiological transition of malaria; the incidence rate declined by 39 percent between 2006 and 2008, and there was a 60 percent decline in the number of inpatient malaria cases between 2001 and 2008. Parasite prevalence also continues to decline.

The government of Zambia considers malaria control to be among its highest priorities, and it has made significant progress in improving malaria control. More than 5 million long-lasting insecticide-treated bed nets were distributed from 2007 to 2009 and were estimated to cover 80 percent of the population. Indoor residual spraying has also recently been expanding, thereby reaching 5.6 million people. Rapid diagnostic tests (RDTs) were introduced in 2006, and diagnosis continues to improve. Artemisinin-based combination therapies (ACTs) were introduced in 2003; artemether-lumefantrine (AL) is the standard treatment for uncomplicated malaria in Zambia. Public sector health facilities provide most health care services in Zambia.

Figure 1. Zambia

Logistics Management Information System

Malaria products, including ACTs and RDTs, are managed as part of the national Essential Medicines Logistics Improvement Program (EMLIP). This system began as a pilot project in April 2009. A total of 16 districts (out of the national total of 72) were selected to implement one of the two supply chain models: model A or model B. Districts in both models showed decreases in stockout rates; those decreases were far more pronounced in the model B districts. In model A districts, adult ACT stockout rates were reduced from 43 to 22 percent, whereas in model B districts

the adult ACT stockout rates were reduced from 48 to 6 percent. The success of the pilot project resulted in stakeholder consensus to roll out nationally the model B version of the pilot.

Facility Level

In the EMLIP, essential logistics data are collected at the facility level. The Pharmacy in-charge or Facility in-charge uses Stock Control Cards to record the following data:

- receipts
- issues
- losses and adjustments
- stock on hand

The Stock Control Cards are kept in the facility storeroom, and products are issued from the facility storeroom to the dispensary or wards. The Pharmacy in-charge or Facility in-charge also issues products to community health workers.

Facility staff members use data from the Stock Control Cards to complete the Report and Requisition Form (R&R Forms). A sample R&R Form can be found in Appendix A. The R&R Form is sent up to the District Health Office (DHO) at the end of each month. Larger hospitals (called level 1, 2, and 3 hospitals—central-, provincial-, or district-level hospitals) send their R&R Forms directly to Medical Stores Limited (MSL) for order fulfillment. The data included in the report section of the R&R form, which facility staff members complete, are the following:

- beginning balance
- quantity received
- quantity issued
- losses and adjustments
- physical count

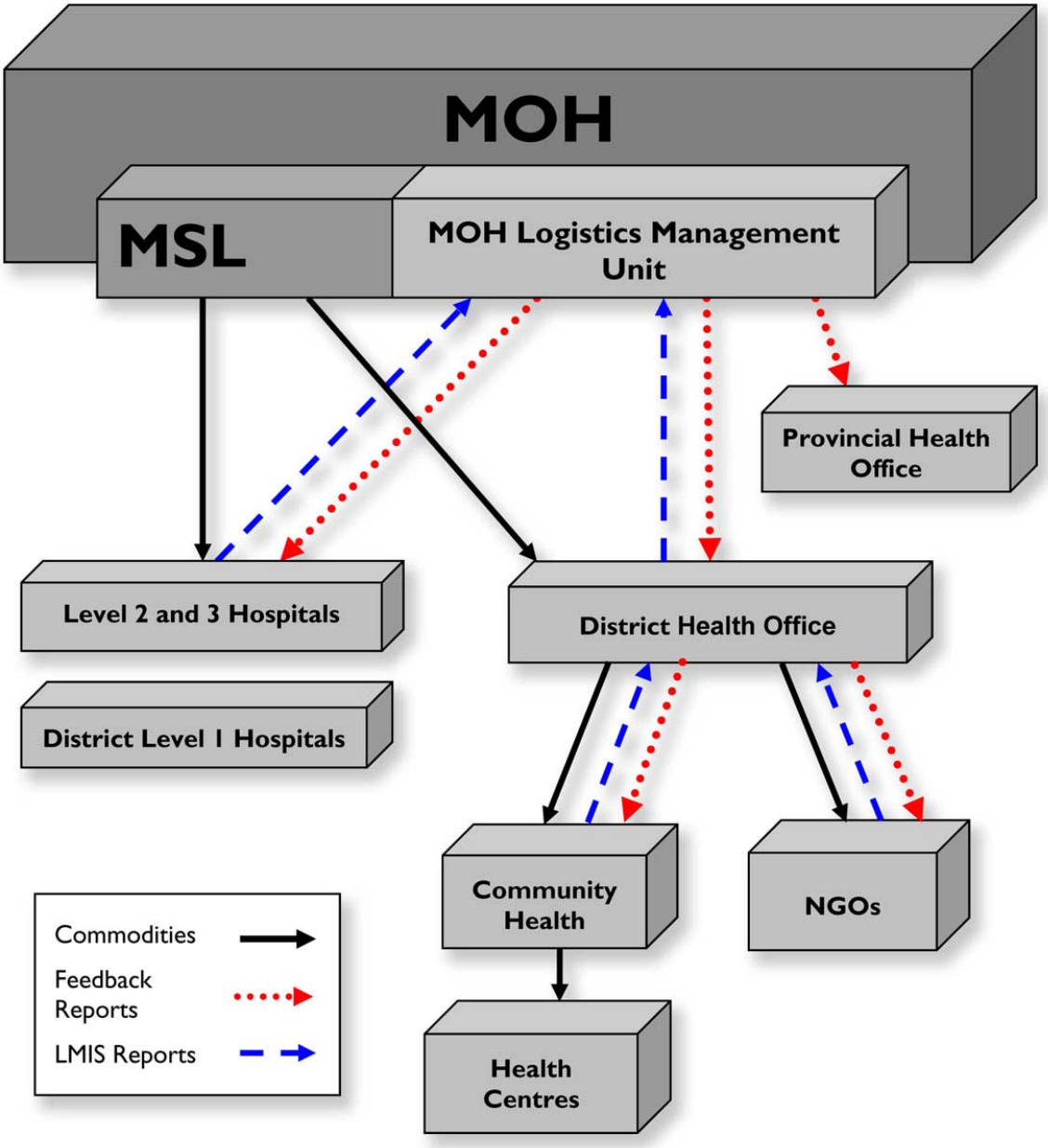
District Level

At the DHO, the District pharmacy in-charge or the commodity planner (if there is no District pharmacy-in-charge) receives the R&R Forms and completes the request section of the form. According to the data that the facility staff members have completed on the R&R Form, the District pharmacy-in-charge completes the quantity to order and sends the forms to MSL for order fulfillment.

Central Level

At the central level, data from the R &R Forms are received by the Ministry of Health (MOH) Logistics Management Unit (LMU). The LMU is physically located at MSL. Data specialists from the LMU enter the R&R data into a software application called Supply Chain Manager. MSL picks and packs orders for each facility, and orders are sent to the district. The district level then distributes individual facilities' orders. A diagram of the flow of LMIS data and commodities can be seen in figure 2.

Figure 2. Movement of Commodities and LMIS Reports



Health Management Information System

The current HMIS in Zambia was designed in 1996, and it is in line with the national health strategic plan and other health sector reform efforts. The HMIS covers routine service activities and integrates some epidemiological surveillance. In 2005, Heywood, Nielson, and Orzenszyna conducted an assessment of the HMIS. This assessment concluded that the system was fragmented, and there was little confidence in the data of the system. The Zambian MOH undertook a revision of the HMIS, and a new procedures manual was developed in December 2008.

The HMIS collects information on child health, reproductive health, HIV and AIDS, tuberculosis, outpatient use, inpatient care, drugs and supplies management, human resources, environmental health services, and selected diseases (including malaria).

The HMIS is both paper-based and computerized; at the facility level, primarily paper-based tools are used, while at the district level, these data are entered into the District Health Information System (DHIS), which is the core software of the HMIS.

Facility Level

At the facility level, data are collected through patient record cards, tally sheets, and registers. These data are all paper-based forms. Data are collected on both outpatients and inpatients. Most of the data collected are disaggregated in three age ranges: under 1 year, 1 to under 5 years, and over 5 years. A full list of the data collected as part of the HMIS is included in Appendix B. The following types of data are collected as part of the HMIS:

- malaria cases provided with antimalarial treatment
- deaths of malaria cases provided with antimalarial treatment
- clinical cases of malaria
- deaths from clinical cases of malaria
- confirmed cases of malaria
- deaths from confirmed malaria
- clinical malaria in pregnancy
- confirmed malaria in pregnancy
- deaths from confirmed malaria in pregnancy
- deaths from clinical malaria in pregnancy
- malaria laboratory tests (slides/RDTs)

The data collected on the tally sheets, activity sheets, and/or collation sheets are used to complete a monthly HMIS report—the HIA (Health Information Aggregation), which is sent to the District Health Information Office (DHIO). There are three main HIA reports: service, disease, and hospital.

District Level

The DHIO receives the HIA reports from the facilities, validates the data, and captures the data in the DHIS. The DHIO uses DHIS to produce standardized quarterly reports that are then submitted to the provincial-level office.

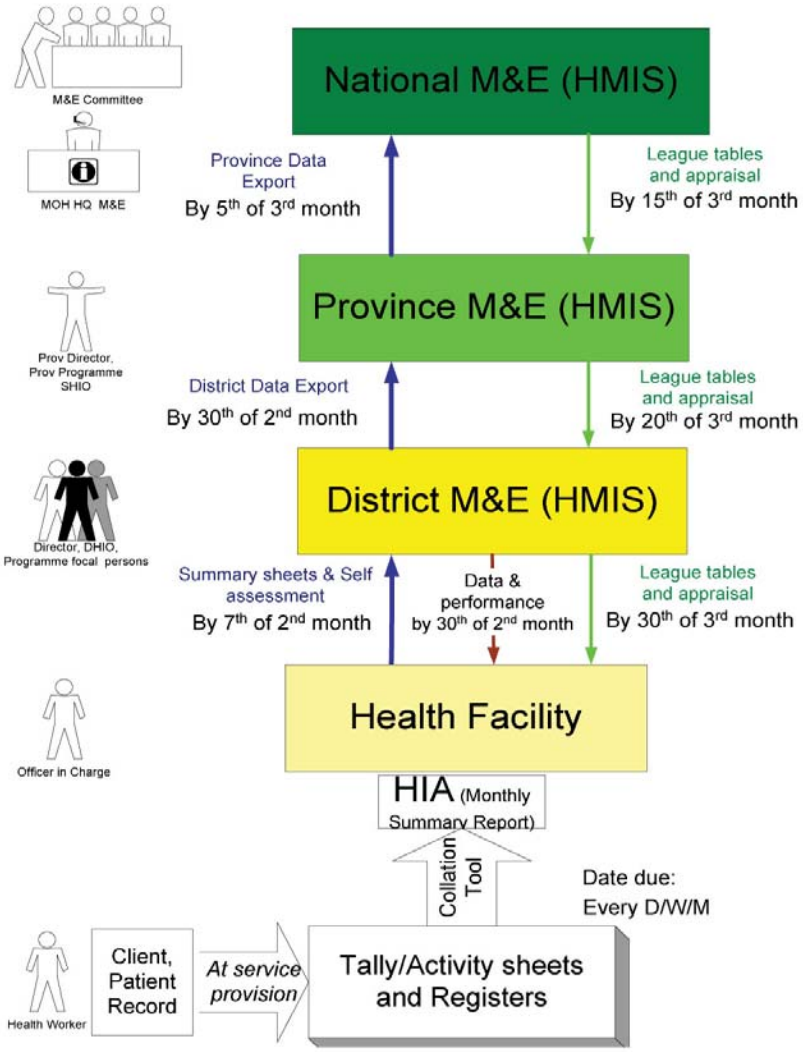
Provincial Level

The provincial health office receives the district-level data from the DHIO and then sends the data to the HMIS national office for consolidation by the 5th day of the third month after submission of the report.

Central Level

At the central level, selected quarterly HMIS indicator reports are produced regularly for dissemination to stakeholders. An essential set of indicators has been identified by the relevant program managers and other stakeholders. A diagram of the flow of HMIS data is seen in figure 3.

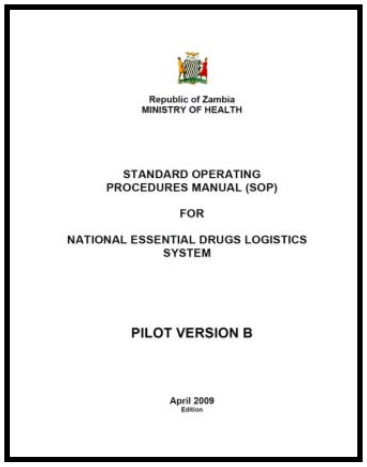
Figure 3. Movement of HMIS Data



Methodology

Two types of analysis were done. The first considered the defined procedures on the data collection, reporting, flow of data, and human resources across the LMIS and the HMIS. The second type of analysis was quantitative, comparing HMIS and LMIS data at the facility level.

Analysis of Documented Procedures and Process


Republic of Zambia
MINISTRY OF HEALTH

STANDARD OPERATING
PROCEDURES MANUAL (SOP)

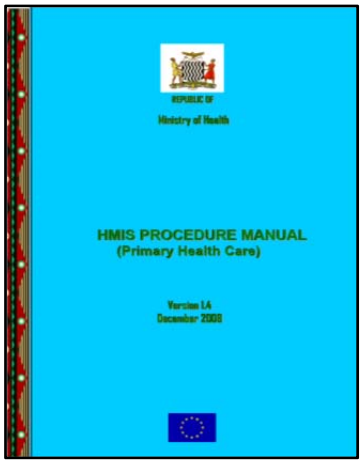
FOR

NATIONAL ESSENTIAL DRUGS LOGISTICS
SYSTEM

PILOT VERSION B

April 2009
Edition

The project obtained the MOH's *Standard Operating Procedures Manual for the National Essential Drugs Logistics System* (2009) and its *HMIS Procedure Manual (Primary Health Care)* (2008). The data collected, the flow of data, the human resources that manage that data, and the use of data were reviewed.


REPUBLIC OF
Ministry of Health

HMIS PROCEDURE MANUAL
(Primary Health Care)

Version 1A
December 2008

Quantitative Analysis of Data

Data and Data Sources

The HMIS data were obtained from the project office in Zambia, specifically from the DHIS. Those data were in the form of Excel sheets that contained all HMIS data items by facility, by month, and by district. For the HMIS, monthly data were available for the 2010 calendar year for the following five of the nine provinces: Central, Eastern, Lusaka, Northern, and Western. Data were not received for the Northwestern province, and data from Luapula were not disaggregated by facility and, therefore, were not used.

The LMIS data were also obtained from the project office in Zambia. Those data were from the Supply Chain Manager (SCMgr) database. The data were monthly for 2010 and for all facilities in Model B and Model A districts. November LMIS data were not available.

For the analysis in this paper and drawing on the HMIS procedures manual definitions, we defined the HMIS data used as follows:

- Outpatient department (OPD) first attendance malaria cases provided with antimalarial treatment (total) = all cases of malaria that were provided with an ACT.
- OPD first attendance clinical case of malaria (total) = all malaria cases that were clinically diagnosed (i.e., neither a rapid diagnostic test [RDT] nor a microscopy was used for the diagnosis).
- OPD first attendance confirmed case of malaria (total) = all malaria cases that were confirmed with either an RDT or a microscopy.

The HMIS procedures manual does not define the distinction between OPD and inpatients, and it does not mention how to record first attendance as opposed to other types of cases.

Comparison of Data

Three key relationships between variables were tested. Two of them compared HMIS and LMIS data, and one compared two different types of HMIS data. The relationships were calculated as ratios to allow for comparison across months and within and across facilities.

1. The number of OPD malaria cases that received a treatment (HMIS data) versus the quantities of ACTs dispensed (LMIS data),
2. The number of confirmed plus clinical cases of malaria (HMIS data) versus the quantities of ACTs dispensed (LMIS data), and
3. The number of OPD malaria cases that received a treatment (HMIS data) versus the number of confirmed plus clinical cases of malaria (HMIS data).

Ideally, the ratios for each of the comparisons would be 1. That is, the number of malaria cases that received a treatment would equal the number of cases of malaria, the number of malaria cases would equal the quantities of ACTs dispensed, and the number of malaria cases that received an ACT would equal the quantities of ACTs dispensed.

To explain what the ratios mean, we compare the number of cases of malaria to the quantities of ACTs dispensed as follows:

- A ratio of less than 1 means that the number of malaria cases is *less than* the quantities of ACTs dispensed.
- A ratio of 1 means that the number of malaria cases *equals* the quantities of ACTs dispensed.
- A ratio of more than 1 means that the number of malaria cases is *more than* the number of ACTs dispensed.

Selection of Facilities to Compare

Selected districts were determined by the parameters of the EMLIP, which targeted 24 out of the total 72 districts in the country. For this initial analysis, we selected only the facilities of the pilot's "Model B" districts for potential analysis, and those districts included 218 facilities. Model B districts, theoretically, should all be capturing information in the same way, should have the same standard operating procedures, and should have the same access to training. Additionally, because Model B was determined to be the more effective model and is planned to be rolled out nationally, the analysis was limited to facilities in Model B districts.

The next step was to choose the facilities that would be included. For the facilities in the Model B districts, the HMIS and LMIS databases were then joined by matching health facility codes of the HMIS with the health facility codes of the LMIS. The Northern province was selected for the initial analysis because it has a relatively high percentage of facility codes that (42 out of 48, or about 88 percent) and because it has a relatively large total number of facilities compared to the other provinces. Figure 4 shows the two model B districts in the Northern province that were included in the analysis.

To control for data quality challenges, we selected for further analysis those individual facilities that had at least five months of data over time (because limited availability of data points was a challenge). Ratios were analyzed to allow (a) for comparison across months and within and across facilities by controlling for different total quantities and (b) for the issue of malaria seasonality.

Figure 4. EMLIP Districts Included in Analysis

For two of the relationships examined—those comparing HMIS and LMIS data (i.e., the number of cases that received treatments versus quantities of ACTs dispensed and the number of cases versus quantities of ACTs dispensed)—facility selection was also limited to those facilities that had relatively consistent ratios over time. For the ratio of the number of cases that received treatments versus the quantities of ACTs dispensed, a consistent ratio was defined as having less than a 0.2 standard deviation from a given facility's average ratio. For the number of cases versus quantities of ACTs dispensed ratio, a consistent ratio was defined as when a given facility's standard deviation was less than half of its average ratio. For both of the HMIS and LMIS comparison ratios, the variability among facilities below those cut-off points was substantially lower as compared to their peer facilities and, thus, was relatively more consistent. For the relationship between the two HMIS data points (number of cases that received treatments versus number of cases), all 27 facilities with available data were analyzed to examine the consistency and quality of HMIS data alone.

For this initial assessment, age totals and AL totals were used for all three ratios. This method was done to control for the fact that a patient may not receive the treatment pack size intended for his or her age and weight group, but he or she may still receive treatment. For example, an adult with malaria should receive the 4 × 6 packaging; if the 4 × 6 is not in stock, the patient may receive four of the 1 × 6 packs or two of the 2 × 6 packs.

Assumptions, Constraints, and Considerations

- **We assumed that all malaria patients who are receiving treatment are receiving AL, which is the standard treatment for uncomplicated malaria in Zambia.** This statement also assumes that providers at facilities are adhering to standard treatment guidelines. Providers may dispense other types of treatment to malaria patients, such as sulphadoxine-pyrimethamine, quinine, or other products. Those other treatments are not accounted for in this analysis.
- **The different presentations of AL complicate comparing quantities of ACTs dispensed with the number of cases of malaria.** AL comes in four presentations that are intended for patients of different age and weight bands. Although the presentations should be managed separately (often during a stockout), the presentations may be cut or combined to provide treatment. An adult who needs one 6 × 4 treatment, for example, may instead receive four of the 6 × 1 treatments. This practice also points to the broader issue of how "treatment received" was actually defined and of our assumption that it is approved AL patients who are receiving treatment at facilities.
- **Data analysis is limited to only outpatient data.** Inpatient data variables were not used. Because the HMIS did not distinguish between uncomplicated and severe malaria cases, we assumed that inpatients may be severe malaria cases and are less likely to have received treatment with AL and are more likely to be treated with quinine.
- **LMIS data were not available for the month of November, which is the start of the malaria season.** No LMIS data were available for the Northern province for the month of November. Because for many provinces of Zambia, November marks the start of malaria season, these data represent a significant gap in ACT commodity distribution.
- **In the EMLIP, consumption data are recorded and reported as issues from the facility store.** In EMLIP, consumption data are not obtained from consumption records at the facility. Rather, on the R&R Form, facility staff members report the issues from the facility store. Those issues could be sent to the dispensary, wards, or to a community health worker. Issues from the facility store are rounded up to the nearest pack size. In the case of each AL presentation (1 × 6, 2 × 6, 3 × 6, and 4 × 6), the packs consist of 30 blisters. Therefore, the "consumption" data are always in multiples of 30. Some quantities of products would remain in the dispensary, within the wards, or with the community health workers. We consider that once something has been issued from the storeroom, it has been consumed. Because of how consumption data are considered in this system, the quantities of products consumed will almost never match the quantities of ACTs dispensed.

Findings

Process and Procedures

- **The names of data and definitions of data are not uniform in the HMIS procedures manual and the HMIS DHIS outputs.** The data items listed in the HMIS procedures manual do not exactly match the data items in the DHIS outputs that the project obtained from the provincial level. For example, the procedures manual lists and describes six data elements. In the DHIS outputs, 55 unique data items are captured for each facility. However, all of those data items are not listed and described in the procedures manual. The data items that we used from the DHIS outputs are compared to the HMIS procedures manual in table 1.

Table 1. Data from the DHIS and the HMIS Procedures Manual

Data from DHIS Outputs	Data and Source of Data from HMIS Procedures Manual	Considerations
OPD first attendance clinical case of malaria (total)	Clinical malaria: number of cases with clinical symptoms of malaria—not confirmed by laboratory test. Source of data: OPD tally sheet	The HMIS procedures manual does not make a distinction between OPD and inpatients, nor does it mention how to record first attendance, as opposed to other types, of cases.
OPD first attendance confirmed case of malaria (total)	Confirmed malaria: number of malaria cases confirmed by a laboratory test (usually rapid diagnostic test or smear) Source of data: OPD tally sheet	
OPD first attendance malaria cases provided with antimalarial treatment (total)	Malaria case provided with antimalarial treatment: Malaria case provided with antimalarial treatment. Guide for use: If any of the above patients, confirmed or clinical, are provided with antimalarial treatment, one should record it, and the data should be similar in value to the sum of the confirmed and clinical cases. Source of data: calculated.	

- **At most facilities, the HMIS records and reports are completed by a different person than the LMIS records and reports.** With different staff members collecting the different types of data, there may be more disconnect between the data collected. The records and reports used in the LMIS are completed by the Pharmacy in-charge or Facility-in-charge. For the HMIS, those data are collected and reported by other staff members—often, clinical staff members (e.g., a nurse or a registration clerk who captures information at the point of entry to the health facility). If the patient is admitted to the hospital (perhaps for a case of severe malaria), this diagnosis and treatment, which is recorded in the inpatient department (IPD) register, can be completed only by the service provider. For the smallest health facilities, with limited human resources, the same individual can possibly complete both the HMIS and LMIS records and reports. For facilities that have a separate staff for the dispensary or storeroom or both and for those facilities that register patients or see patients, different staff members collect the data. Furthermore, at very large facilities, several people may be collecting data for the HMIS, and several people may be collecting data for the LMIS. There could be different understandings about how data are to be captured and reported.

- **At most facilities, the HMIS records and reports are completed at a facility location that is different from where the LMIS records and reports are completed.** This difference, again, would lead to discrepancies between the data. The HMIS records that collect data on malaria cases—primarily through the outpatient department (OPD) attendance register and OPD Register – may be kept at various locations in the facility, depending on the facility's patient flow. The HMIS procedures manual highly recommends that these data be kept at the point of entry for the health facility, which may be called the "registry" at the facility. However, the LMIS record, which collects data on quantities of ACTs dispensed or issued using the Stock Control Card – is kept in the storeroom of the facility.
- **Throughout the flow of the LMIS data and HMIS data, different stakeholders use the data at each level.** As mentioned earlier, at the facility level, different types of staff members work on HMIS data compared to those members who work on the LMIS data. The differences are replicated through the whole flow of data in the system. At the district level, the district health information office manages and reviews the HMIS data, while the District pharmacy-in-charge manages and reviews the LMIS data. At the central level, the MOH Monitoring and Evaluation department receives, reviews, and analyzes the HMIS data and produces reports with selected indicators. For the LMIS at the central level, LMU at Medical Stores Limited receives and reviews the data. From a review of the procedures manuals, one cannot determine when and if the data converge for cross-analysis. However, the project office in Zambia does use both types of data for quantifying malaria needs and for monitoring programs.
- **The HMIS data and LMIS data are not set up for easy or routine comparison.** Before the analysis of HMIS and LMIS data could begin, we needed to complete several steps, because the information systems themselves did not align for quick comparison.
  - Different facility names were found between the HMIS and the LMIS (table 2). There were significant discrepancies between the names of the facilities, from 65 percent for the Western province to up to 95 percent for the Eastern province.

Table 2. Percentage of Facility Names Matching between the HMIS and LMIS

Province	Percentage of Facility Names That Match between the HMIS and LMIS
Eastern	21/22 = 95%
Northern	42/48 = 88%
Central	20/29 = 69%
Western	49/75 = 65%

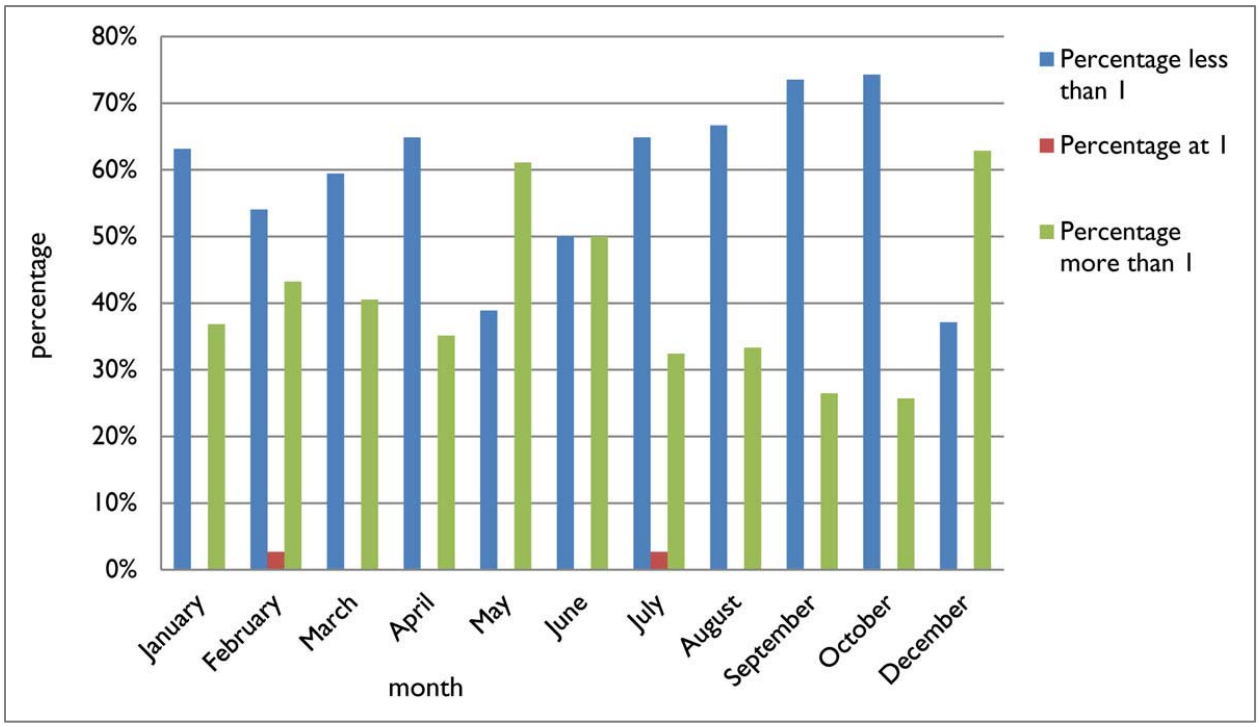
  - There was no standard coding of facilities across the HMIS and LMIS, which was necessary to do for this analysis. The Supply Chain Manager database containing LMIS data has a unique code for every facility. The DHIS outputs did not contain the unique codes for each facility, so the LMIS and HMIS needed to be matched by facility name first and then joined using the code.
  - There is no standard tool for comparing the data. The analysis presented in the next section was done through Access and Excel and was designed by the DC-based project staff. The project office in Zambia does consult HMIS data when conducting quantifications for malaria products; this comparison is challenging without a standard method and tool to routinely compare HMIS and LMIS data.

Overall Quantitative Data Findings

A central, overriding challenge of this analysis was the issue of data quality. Most data records from facilities were lacking in availability (with months of data not recorded) and in consistency (with ratios showing high levels of variation). In addition, one cannot assume that consistent data are necessarily valid in the relatively few cases in which data were consistent. Overall, this analysis points to a real need to improve the collection and use of facility-level data. These data are central to our understanding of how the supply of commodities meets demand and how to ultimately strengthen the supply chain to improve malaria control efforts. The following findings present many of the questions the current data raises as well as opportunities to move forward.

- **More frequently, facilities report that more quantities of ACTs are dispensed compared to the number of cases of malaria seen.** A ratio of less than 1 means that more quantities of ACTs are dispensed than the number of malaria cases seen. In every month except for May and December, more facilities reported more ACTs dispensed than malaria cases seen. (In June, about 50 percent of facilities reported more ACTs dispensed than malaria cases seen.) See figure 5 for more information.

Figure 5. Percentage of Facilities Where the Ratio of Number of Cases of Malaria vs. Quantities of ACTs Dispensed Are Less Than 1, Equal to 1, or More Than 1



There are several reasons why more quantities of ACTs may be reported as dispensed compared to the number of cases of malaria seen, including the following:

- In EMLIP, quantities dispensed are actually issues from the store to the dispensary. In the LMIS, once ACTs are issued from the store, they are counted as dispensed. However, there are most often stocks of ACTs held at the dispensary or in the ward. Those quantities could

potentially be higher in larger facilities where stocks may be issued to the dispensary, the ante-natal clinic, the inpatient wards, and other locations.

- The number of cases of malaria (confirmed + clinical) is, theoretically, coming from both OPDs and IPDs. For this analysis, only outpatient data were considered.
- There is no guidance in the *HMIS Procedure Manual* as to where to capture the number of cases of malaria seen by community health workers. The LMIS manual specifies that issues to community health workers should be made from the facility store and captured and reported as consumption information. Therefore, there may be cases of malaria that are treated with ACTs from the facility but that are not captured in the HMIS.
- There may be differences in the clarity of procedures between the HMIS and LMIS. If procedures are unclear, inconsistent data may be reported, because different facility staff members may have different understandings of how certain data should be collected, aggregated, or reported.
- There may be differences in training of staff members between the HMIS and LMIS. The facility staff undergoes a five-day training on EMLIP procedures. The authors were unable to obtain training materials that specify how facility staff members are trained on the HMIS forms and procedures. So, even if procedures are clear, a lack of proper facility staff training could account for some difference.
- Health workers at facilities may not trust results of RDTs and, therefore, may dispense ACTs to patients whose RDT result is negative. Similarly, health workers may dispense ACTs if malaria is suspected but not confirmed.
- Leakage could be another reason; quantities of ACTs have left the health facility but have not been dispensed to patients. However, comparing those data would generally not be an indication of leakage. A better measure of leakage at the facility level would be a comparison of the physical inventory of products in stock with the quantities recorded on the Stock Control Card.

- **However, there are still a significant number of facilities where the cases of malaria seen are higher than the quantities of ACTs dispensed**. As shown in figure 5, a significant percentage of facilities have a ratio is more than 1, which means more cases of malaria are seen than quantities of ACTs dispensed. The percentage of those facilities ranges from 26 percent to 61 percent over the year. There are several reasons for more cases of malaria than quantities of dispensed ACTs:
  - Supplies may be insufficient to meet the requirements of all malaria patients.
  - As mentioned earlier, differences in the clarity of procedures may exist between the HMIS and LMIS. There may also be differences in training of staff members between the HMIS and LMIS.
- **Ratios vary widely across facilities.** For every relationship compared, there was no consistent trend. For example, when one looks at the number of cases of malaria compared to the quantities of ACTs dispensed, there are a wide range of ratios: from almost 10 cases of malaria seen to 1 treatment dispensed, to 0.01 cases of malaria seen to 1 treatment dispensed. Figures 6, 7, and 8 show the range of ratios for each of the relationships compared. A variety of reasons exist for this range of ratios, including (a) poor understanding of the procedures for collecting and reporting the HMIS or LMIS data, (b) unclear procedures themselves, (c) different staff members collecting data, or (d) inadequate resources or tools for collecting and reporting data.

Figure 6. Range of Ratios: Number of Malaria Cases Receiving Treatment vs. Number of Cases of Malaria

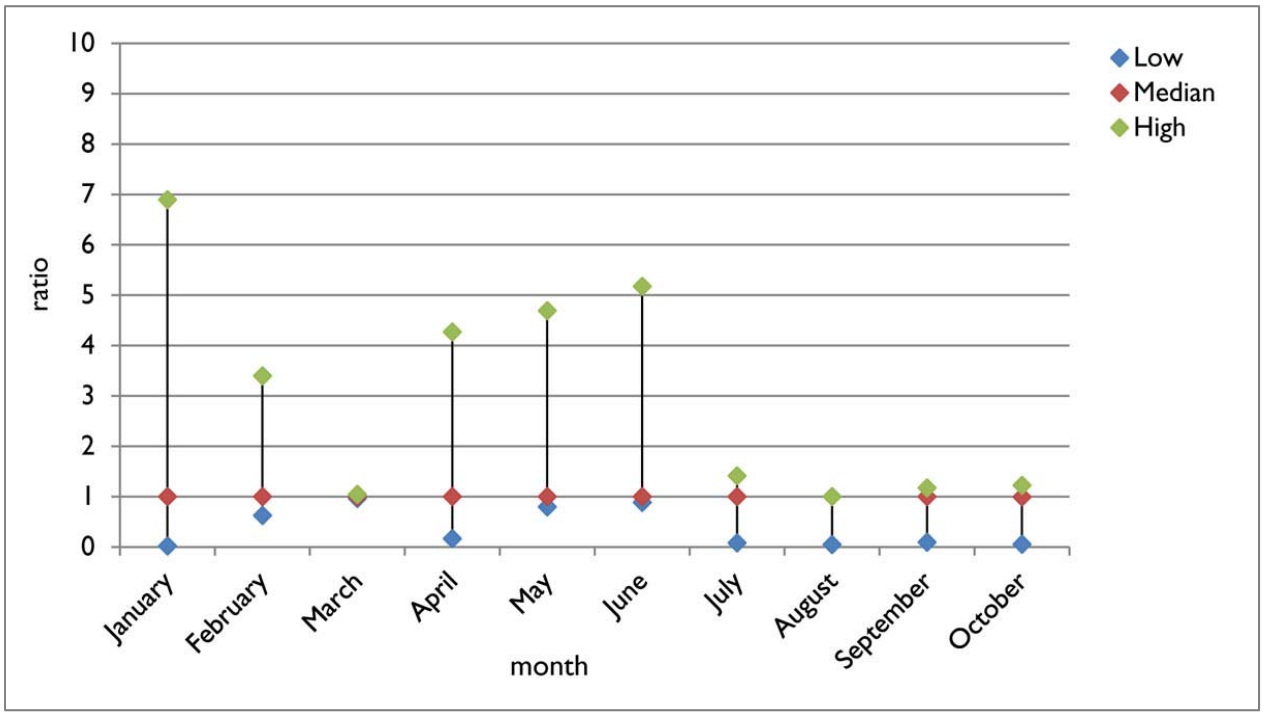


Figure 7. Range of Ratios: Number of Malaria Cases Receiving Treatment vs. Quantities of ACTs Dispensed

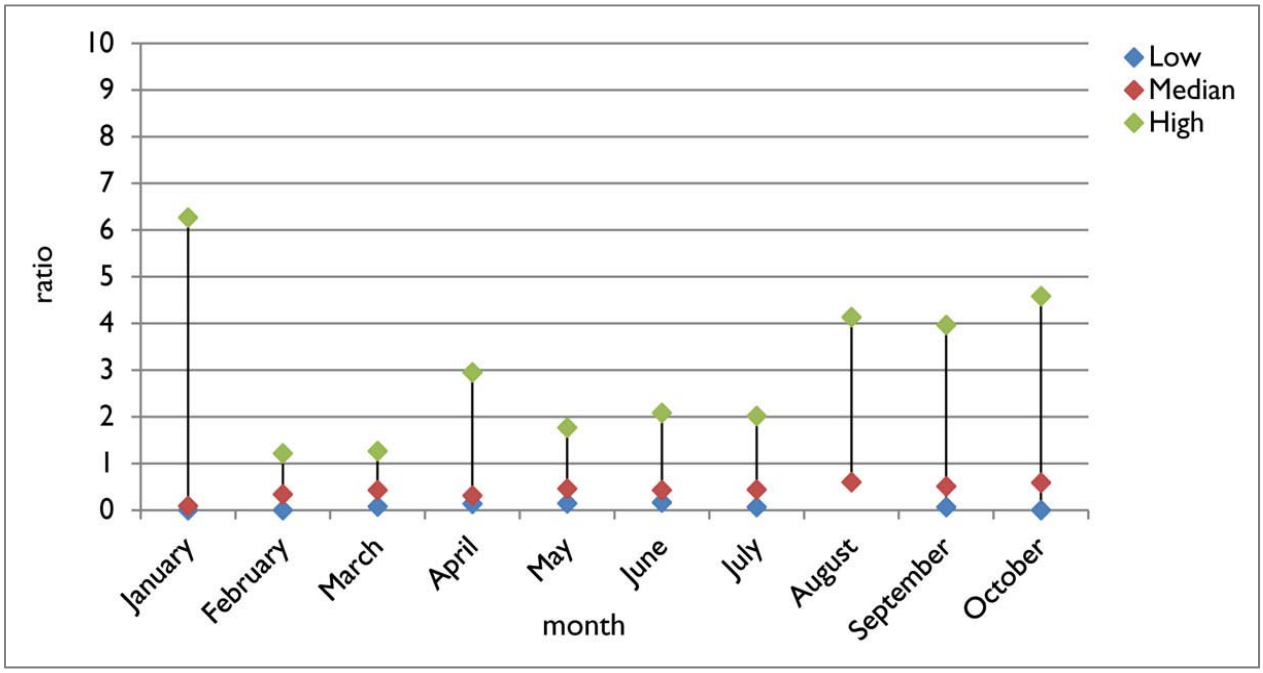
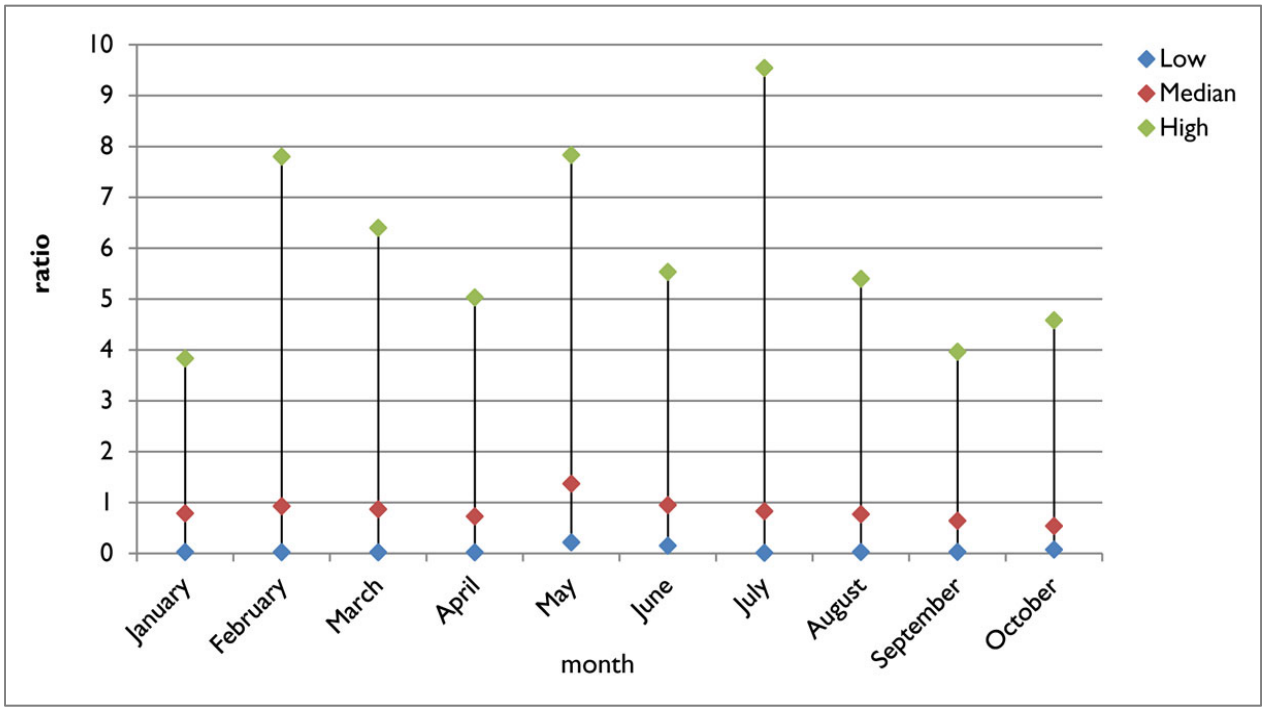


Figure 8. Range of Ratios: Number of Cases of Malaria vs. Quantities of ACTs Dispensed



- **Very few facilities had consistent ratios.** For this analysis, the authors defined consistent facilities as those facilities whose ratios were less than 0.2 standard deviations from the median. For the northern region, the following number of facilities had consistent ratios for the following data relationships:
  - Number of patients receiving malaria treatment versus number of cases of malaria: 7 of 16 facilities (44 percent),
  - Number of cases of malaria versus quantities of ACTs dispensed: 11 of 40 facilities (28 percent), and
  - Number of patients receiving malaria treatment versus quantities of ACTs dispensed: 7.

  Figure 9 shows the facilities that had consistent ratios for the comparison between the number of malaria cases and the quantities of ACTs dispensed. Figure 10 shows the facilities that had consistent ratios for the comparison between the number of malaria cases that received treatment and the quantities of ACTs dispensed.

Figure 9. Facilities with Consistent Ratios of the Number of Malaria Cases and the Quantities of ACTs Dispensed

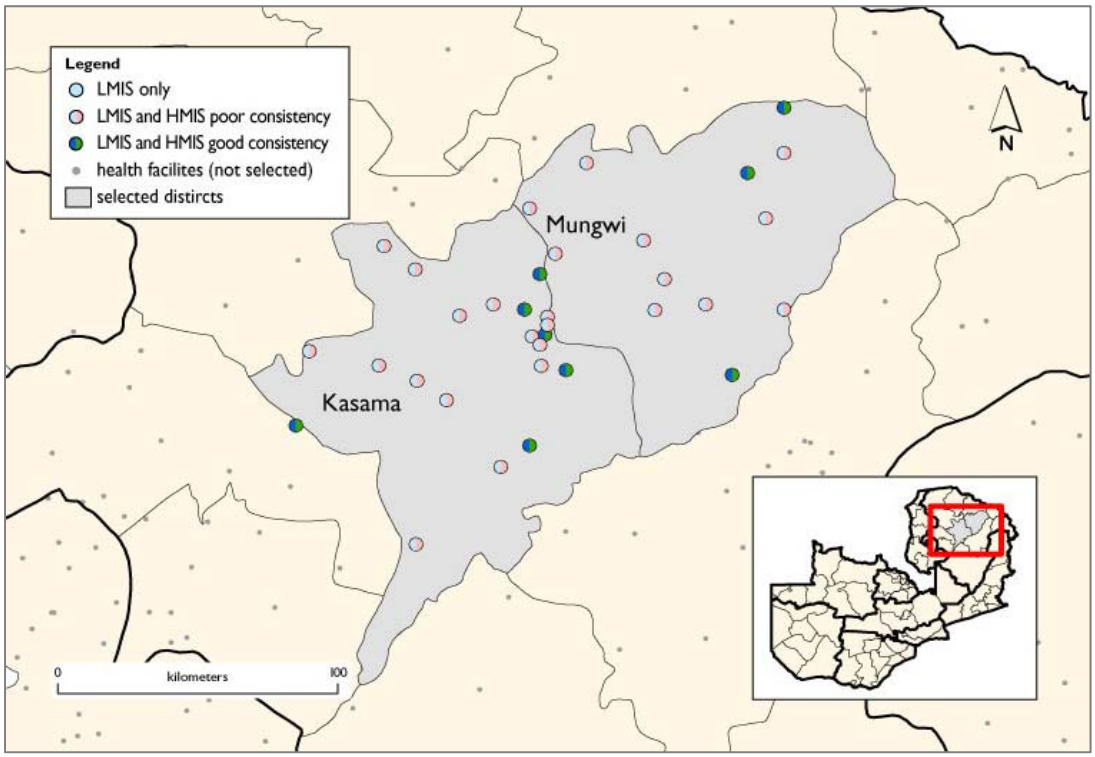
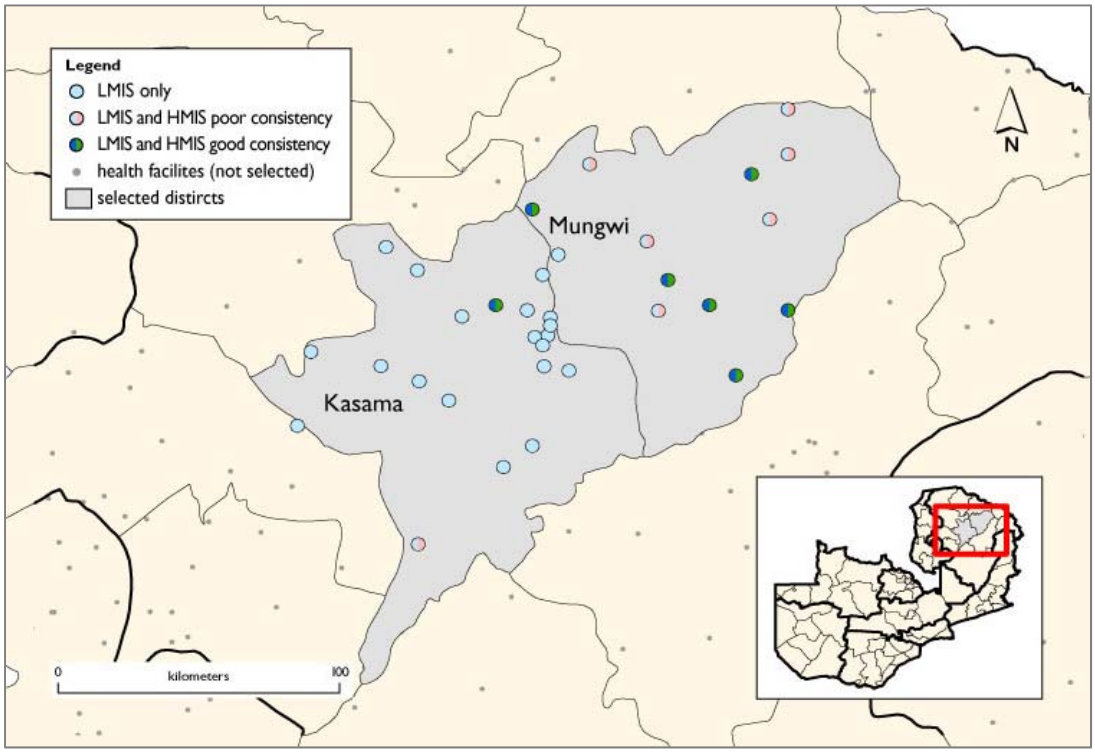
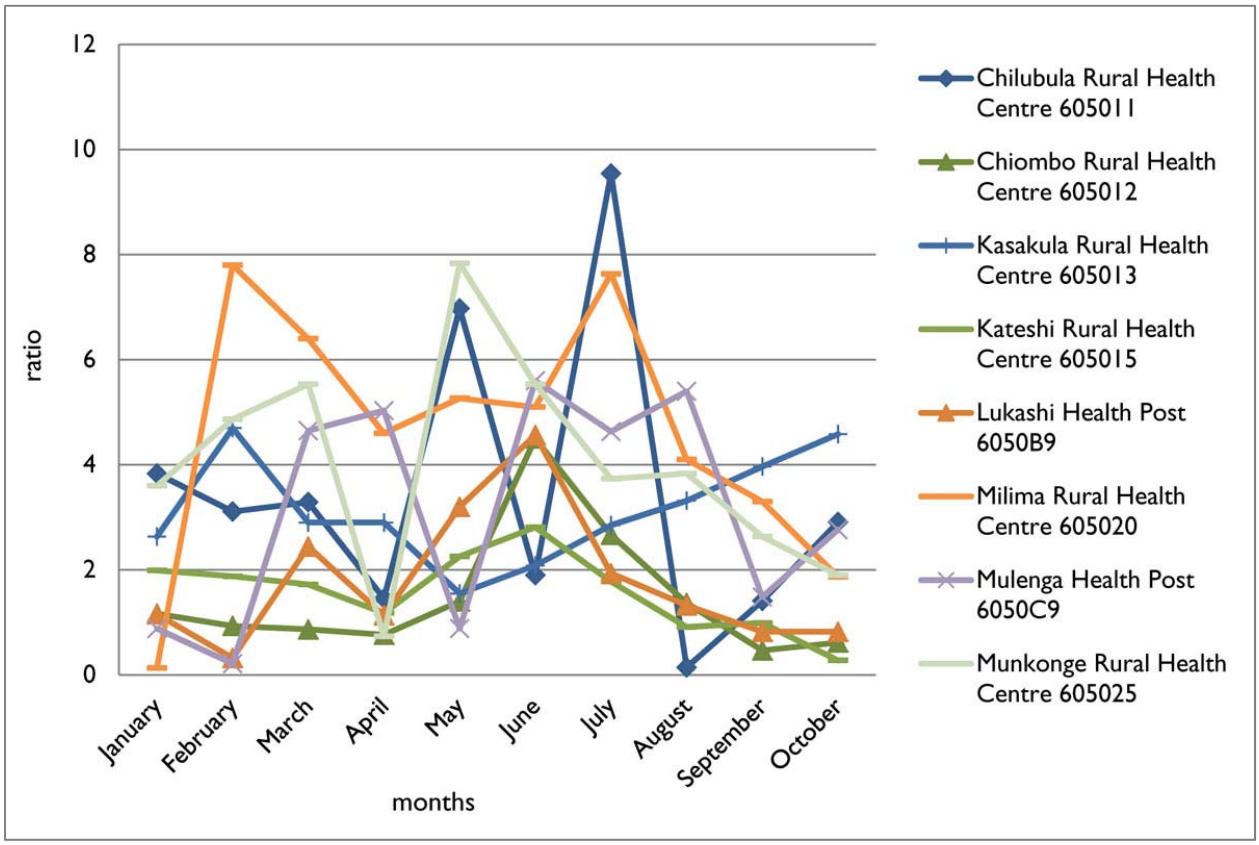


Figure 10. Facilities with Consistent Ratios of the Number of Malaria Cases That Received Treatment and the Quantities of ACTs Dispensed



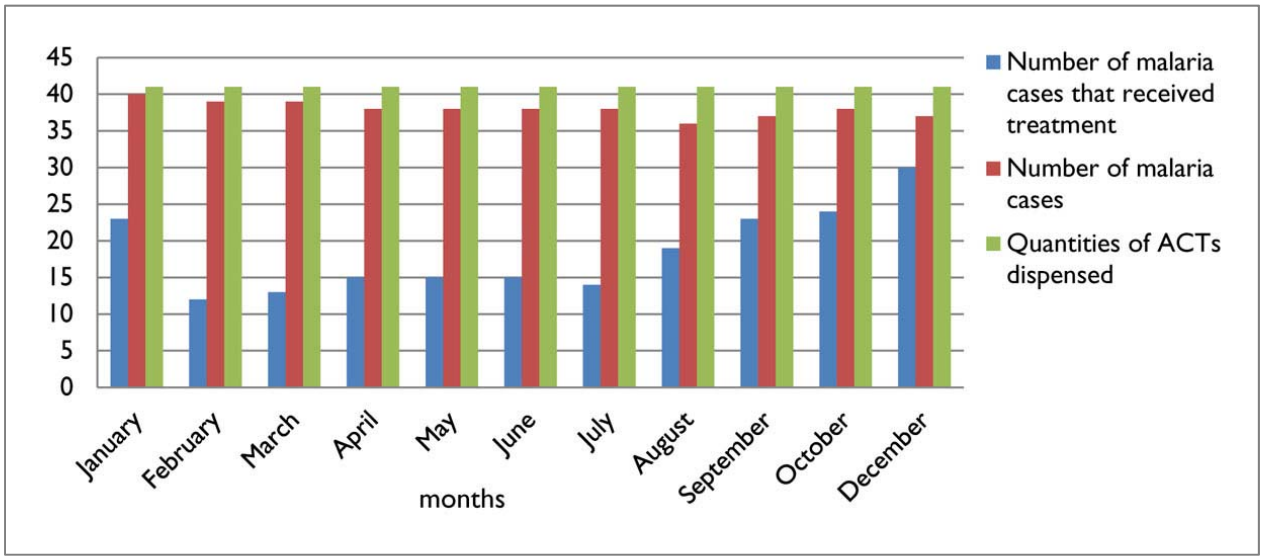
- **Ratios are not consistent across time for a single facility.** In addition to the wide range of ratios across all facilities, wide ranges of ratios exist across time for a single facility. This finding means that at a single facility vastly different data are reported each month: in one month, 10 cases of malaria are seen for every treatment dispensed; in another month, 5 cases of malaria seen for every treatment dispensed; and in yet another month,1 case of malaria is seen for 5 treatments dispensed. Figure 11 shows the range for ratios of the number of cases of malaria to the quantities of ACTs dispensed. For Chilubula Rural Health Centre, for example, the ratio runs from a high of 9.5 in July to a low of 0.14 in August.

Figure 11. Ratio of Number of Malaria Cases to Quantities of ACTs Dispensed: Inconsistent Facilities



Facilities consistently report on the number of cases but *not* on the number of cases that receive ACTs. Almost the same number of facilities report on the quantities of ACTs dispensed and the number of malaria cases. However, far fewer facilities report on the number of malaria cases that received treatment, as shown in figure 12. One possible reason for this finding is that in order to know whether a patient actually received treatment, the data would have to be collected at the dispensary; however, most of the HMIS records are kept at the registry or the OPD. Those staff members responsible for capturing the information on the number of malaria cases that received treatment may not actually have access to that information.

Figure 12. Number of Facilities Reporting on Each Data Item



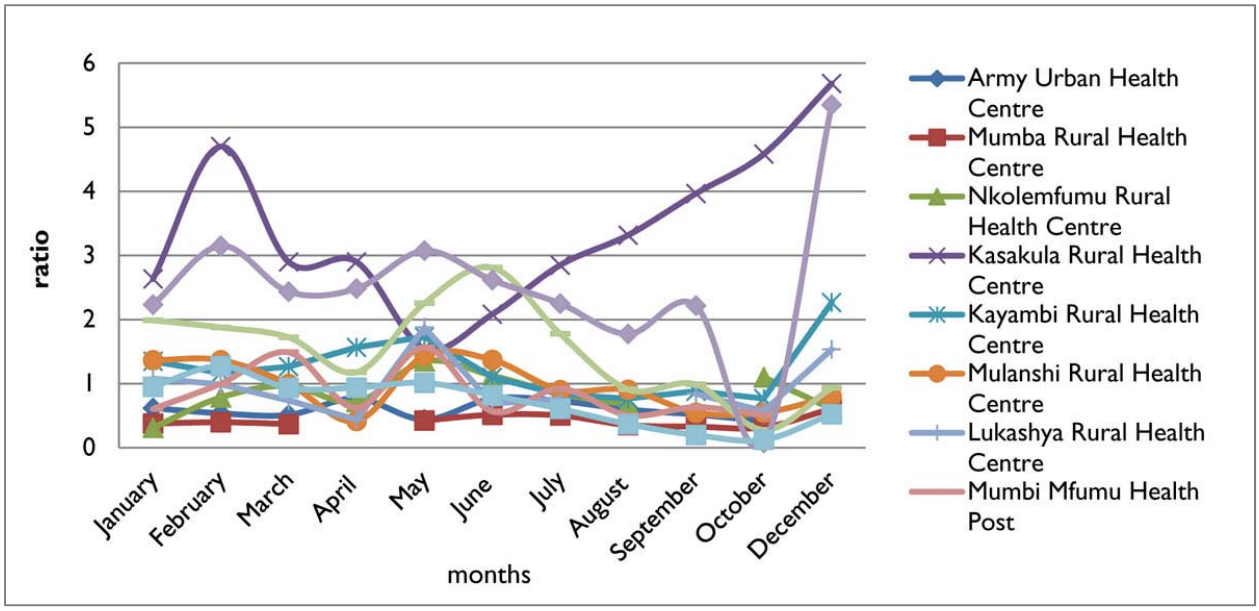
Findings on Facilities with Consistent Ratios

This component of the analysis focuses on those facilities that were relatively consistent, as compared to their peer facilities, over time. A "consistent" facility was defined as having less than 0.2 standard deviation from its average ratio of the number of malaria cases receiving treatment (HMIS) versus quantities of ACTs dispensed (LMIS). In addition, a "consistent" facility must have a standard deviation of less than half its average ratio of the number of confirmed plus clinical malaria cases versus quantities of ACTs dispensed. The facilities were chosen for more in-depth analysis because consistent ratios over time were considered more likely to have relatively higher quality data-reporting practices and were, therefore, more likely to be reliable sources of data (keeping in mind, however, that consistent data are not necessarily valid).

- **Even for the facilities that had consistent ratios, those ratios are not necessarily valid.** In this analysis, Army Urban Health Center was considered a facility with consistent ratios. However, in February 2010, **the** facility was stocked-out of all four presentations, but the facility still reported that twice as many treatments were dispensed as were cases of malaria seen. A facility that has a ratio of 0.05 every month would be consistent. If we consider the number of cases of malaria compared to the quantities of ACTs dispensed, this consistency would mean that every month the facility dispenses 20 treatments for every 1 case. This scenario could be true for a facility, but unlikely.
- **On average, the HMIS data variable reporting appears to be consistent.** Of all the facilities with available data regarding OPD versus confirmed plus clinical cases, most facilities had ratios averaging about 1 (with a range of 0.11 to 3.5 and a median of 1). However, there were instances in which the number of cases receiving treatment exceeded the number of total malaria cases reported, and there were other instances in which the number of total malaria cases reported exceeded the number of patients receiving treatment. Some facilities have ratios that are consistently higher than 1 over the course of the year, with the number of cases receiving treatment substantially exceeding the number of confirmed plus clinical cases of malaria.

- **During the malaria season, more cases of malaria occur than treatments being dispensed.** The 11 facilities where the standard deviation was less than half of the facility's average ratio were examined. Overall, during the approximate malaria season (of November through May), the ratio of total confirmed plus clinical cases to dispensed drugs is more than 1, with the implication that more cases were possibly seen than quantities consumed. (The fundamental limitation here is the issue of consumption, with data dispensed reported as issues from the facility store rather than as consumption records at the service delivery point.) Whereas data from November are not available, the data from December have consistently higher ratios than do other months, thereby coinciding with the start of the malaria season. Ratios also peak in May, which marks the end of the malaria season. After the malaria season, ratios are consistently below 1, with quantities dispensed less than the number of cases reported. See figure 13.

Figure 13. Cases of Malaria vs. Number of Treatments Dispensed: Consistent Facilities



These observations present several questions and a need for further analysis. Are product levels more likely to be depleted at the end of the malaria season? Or has the dispensed product already been distributed to nurses at facilities or community-based distributors? Without consumption records at facilities, it is difficult to determine when patients actually receive treatment. Alternatively, because of the increased number of patients during the malaria season, do facilities have the human resources available to continue to invest time in LMIS or HMIS monitoring? Or are resources largely occupied with malaria case management?

- **Fewer malaria cases receive treatment than quantities of ACTs dispensed.** Among the seven facilities with a standard deviation of less than 0.2 and with data available for this comparison, the ratio of the number cases of malaria that received treatment to the quantity of ACTs dispensed is less than 1. In nearly all cases, the ratios are less than 80 percent. This percentage could result from the fact that consumption data are considered as issues to the storeroom, that community-based distributors may be accounting for some of the consumption, or that some inpatients may be receiving ACTs. However, the sample size for this comparison is probably too small for us to draw any conclusions.

Recommendations

Most countries do not have robust HMIS and LMIS systems that have data that can be compared. Zambia is distinctive in this sense. The findings presented in this paper should be considered as a first step in analyzing the LMIS and HMIS data in Zambia. Because the analysis conducted was limited to only one province and sampled a relatively small selection of facilities, it does not portray a national picture of the relationships between the data. Therefore, general conclusions about the relationship between malaria case data and consumption data—at the national or international level—cannot be drawn. To better understand these relationships on a national level, it would be necessary to conduct these analyses for more provinces.

Conducting routine comparisons of HMIS and LMIS malaria data can (a) help one gain a more complete picture of malaria services and supplies in-country, (b) help ensure that supplies and services for malaria are better aligned with country needs, and (c) monitor and improve data quality. Specific programmatic benefits of such analysis include the following:

- *Improving the quantification process:* When conducting a quantification, it is important to collect and use a range of data sources to produce one or more forecasts, because each source of data has its own strengths and weaknesses. Forecast results from the various sources should be compared and synthesized to arrive at a final forecast. A well-functioning HMIS and LMIS are central to improving the accuracy of quantification.
- *Measuring adherence to policies and guidelines:* Comparing these two types of data can provide some insight as to whether health facility staff members are adhering to established policies and guidelines. For example, one of the reasons that consumption data do not match case data may be a lack of adherence to the guideline that every suspected case of malaria must be confirmed by RDT or microscopy before a patient receives an ACT. Another question of adherence is whether those cases of malaria that received treatment actually received an ACT rather than sulphadoxine-pyrimethamine or quinine.
- *Increasing understanding of the impact of stockouts and informing resupply:* The number of days out of stock is not currently captured in the LMIS; quantities resupplied are based on quantities that have been dispensed in the previous reporting period. However, if a facility reports that its stock on hand at the end of the reporting period is zero, there is a stockout. In these cases, to account for days out of stock when resupplying facilities or conducting national quantifications, managers could compare the periods of stockouts with the number of cases of malaria reported, particularly those cases of malaria that did not receive treatment. Capturing and reporting the number of cases of malaria would help to measure the impact of stockouts, and program managers could adjust resupply quantities appropriately.
- *Enhancing communication between the program staff and supply chain staff at all levels:* One set of findings conducted in this analysis was procedural; that is, different staff members at the same level manage and use different data. At larger health facilities, this occurrence would mean a difference between a nurse who may manage the malaria case data and a pharmacist who would manage the malaria product data. These differences in staff management of data are replicated

up the supply chain. At the central level, this replication may mean the NMCP (case data) and the LMU (product data) are managed by different staff members. Comparing and analyzing HMIS and LMIS data would require the participation of these two types of staff members. Formalizing and regularizing this analysis would enable these staff members to use both types of data to improve performance in their specific areas.

As mentioned previously, the analyses conducted in this paper should be expanded to other provinces in Zambia so that a national picture can be developed. To expand this analysis nationally, we would need to refine the methodology more. First, we would better define what we mean by a "consistent ratio" and the thresholds that would be used to determine consistency. After further defining this, we would apply this categorization to all facilities in the EMLIP districts to determine the total number of facilities where we could conduct further analyses.

In addition to expanding the existing analysis to other provinces, a variety of other analyses are possible. The following are some illustrative comparisons of data that could be made:

- Number of deaths resulting from malaria (HMIS data) compared to the number of stockouts experienced at the facility (LMIS data);
- Number of outpatient malaria cases (HMIS data) compared to the number of inpatient cases of malaria (HMIS data);
- Number of malaria cases, disaggregated by age (HMIS data) compared to quantities of ACTs dispensed, which would be disaggregated by presentation (LMIS data);
- Number of tests performed (HMIS data) compared to the number of confirmed malaria cases (HMIS data);
- Number of confirmed malaria cases (HMIS data) compared to quantities of RDTs used (LMIS data);
- Number of tests performed (HMIS data) compared to quantities of RDTs used (LMIS data);
- Number of cases of malaria (HMIS data) compared to the number of deaths resulting from malaria (HMIS data); and
- Number of confirmed cases of malaria (HMIS data) compared to the number of clinical cases of malaria (HMIS data).

Performing those additional analyses would have both programmatic benefits (e.g., understanding the number of cases compared to the number of deaths or understanding the proportion of cases that are confirmed by RDTs) and supply chain benefits (e.g., quantification).

The National Malaria Control Committee of the Ministry of Health in Zambia could leverage the data through the different systems to help improve the malaria services offered at a facility and throughout the country. The following steps may assist in this improvement:

1. Develop a tool to allow for the data to be compared easily and routinely. As a first step to developing this tool, facility names and codes should be standardized. The tool should allow for outputs of the DHIS and SCMgr to be easily imported.
2. Determine criteria for a "well-performing" facility. For this analysis, we identified those facilities that had relatively consistent ratios as compared to their peer facilities; however, it is equally important to identify facilities that have both consistent and valid ratios. The criteria should apply to both the HMIS and the LMIS.

3. Use the criteria developed to identify those facilities that are performing well and those facilities that are most in need of technical assistance. It is important to identify the facilities that are collecting and reporting HMIS data and LMIS data according to the established procedures. Data quality was a significant challenge in conducting the analyses, and lessons may be learned from those facilities that are having measurable success in this area. To use the data for decisionmaking, one must be confident in the quality of the data being routinely submitted.
4. Involve staff members from both the Ministry of Health's Monitoring and Evaluation department and the LMU in analyzing and using the data presented in this publication as part of their decisionmaking. There is often a gap between staff members who are involved in program planning, monitoring, and management and those staff members who are involved in supply chain operations. Joining those HMIS and LMIS data in a deliberate, routine exercise would require the participation of both types of staff members.

Conclusion

HMIS data and LMIS data on malaria should be routinely compared to get a more complete picture of malaria services and supplies in-country. Often, to even conduct the comparison is very challenging because of having (a) systems that do not relate to each other, (b) differences in procedures and processes, and (c) different staff members who are involved in each of the systems. For this report, we could compare the two types of data, though issues with data quality, particularly for the HMIS, complicated the analysis and significantly limited the pool of facilities eligible for comparison.

There is a tendency to want a direct correlation between the HMIS data and the LMIS data, and theoretically, those data should match. In malaria, this matching would mean that the number of cases of malaria is equal to the quantities of ACTs dispensed, or at least that the number of cases of malaria that received treatment is equal to the quantities of ACTs dispensed. However, there are a multitude of reasons that those numbers will not match. Limited supplies, lack of adherence to standard treatment guidelines, unclear procedures, differences between the staff members who manage the data at the facility level, and knowledge of where those data are managed are some factors that contribute to discrepancies between HMIS and LMIS data.

In some sense, it is reasonable that the two types of data do not match. It is important to compare them, to see what the differences are and evaluate the magnitude of those differences, and to take specific actions that will help improve the data quality. If the strengths and weaknesses of each data source are well understood, the weaknesses can be targeted for improvement and the strengths can be used to improve decisionmaking, thereby improving overall malaria program management.

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Appendices

Appendix A. Report and Requisition Form

REPORT AND REQUISITION FOR ESSENTIAL DRUGS – Health Centre

Reporting period: from _____ to _____ Province: _____ Maximum stock level: 4 months
dd/mm/yyyy dd/mm/yyyy

Facility: _____ District: _____ Emergency order point: 0.5 months

Drug product	Unit	Beginning balance of stocks in storeroom	Total quantity received during the month	Total quantity issued during the month	Losses and adjustments	Physical count of stocks in the storeroom at the end of the month	Quantity on order but not yet received	(AMI) = (E + previous 2 months issues) ÷ 3	Maximum quantity	Order quantity
A	B	C	D	E	F	G	H	I	J = (I × 4)	K=(J-H-G)
Acetylsalicylic acid 300mg tabs	1,000s									
Paracetamol 100mg tabs	1,000s									
Paracetamol 500mg tabs	1,000s									
Lidocaine 1% vial, 10ml	Each									
Mebendazole 100mg tabs	100s									
Magnesium trisilicate compound tabs	500s									
Metronidazole 200mg tabs	1,000s									
Cephalexin 250 mg tabs	1,000s									
Cephalexin 125mg/5ml oral suspension, 100ml	each									
Ciprofloxacin injection, 2mg/ml, 100ml vial	each									
Amoxycillin 250mg tabs	1,000s									
Benzathine benzylpenicillin 2.4M IU, 10ml vial	20s									
Benzylpenicillin Sodium 1M IU, 10ml vial	10s									
Benzylpenicillin Sodium 5M IU, 10ml vial	10s									
Doxycycline 100mg cap	1,000s									

Explanation for losses/adjustments: _____

Discrepancies or remarks: _____

Appendix B. Health Management Information Systems Data

- OPD first attendance malaria cases provided with antimalarial treatment under 1 year
- OPD first attendance malaria cases provided with antimalarial treatment 1 to 5 years
- OPD first attendance malaria cases provided with antimalarial treatment over 5 years
- OPD first attendance malaria cases provided with antimalarial treatment (total)
- IP discharge malaria case provided with antimalarial treatment under 1 year
- IP discharge malaria case provided with antimalarial treatment 1 to 5 years
- IP discharge malaria case provided with antimalarial treatment over 5 years
- IP discharge malaria case provided with antimalarial treatment (total)
- Deaths of malaria case provided with antimalarial treatment under 1 year
- Deaths of malaria case provided with antimalarial treatment 1 to 5 Years
- Deaths of malaria case provided with antimalarial treatment over 5 years
- Deaths of malaria case provided with antimalarial treatment (total)
- OPD first attendance clinical case of malaria under 1 year
- OPD first attendance clinical case of malaria 1 to under 5 years
- OPD first attendance clinical case of malaria over 5 years
- OPD first attendance clinical case of malaria (total)
- IP discharge clinical case of malaria under 1 year
- IP discharge clinical case of malaria 1 to under 5 years
- IP discharge clinical case of malaria over 5 years
- IP discharge clinical case of malaria (total)
- Deaths clinical case of malaria under 1 year
- Deaths clinical case of malaria 1 to under 5 years
- Deaths clinical case of malaria (total)
- Deaths clinical case of malaria over 5 years
- OPD first attendance confirmed malaria under 1 year
- OPD first attendance confirmed malaria 1 to under 5 years
- OPD first attendance confirmed malaria over 5 years

- OPD first attendance confirmed malaria (total)
- IP discharge confirmed malaria under 1 year
- IP discharge confirmed malaria 1 to under 5 years
- IP discharge malaria laboratory tests (slide/RDT) (total)
- IP discharge confirmed malaria over 5 years
- IP discharge confirmed malaria (total)
- Deaths confirmed malaria under 1 year
- Deaths confirmed malaria 1 to under 5 years
- Deaths confirmed malaria over 5 years
- Deaths confirmed malaria (total)
- OPD first attendance clinical malaria in pregnancy
- OPD first attendance clinical malaria in pregnancy (total)
- IP discharge clinical malaria in pregnancy
- OPD first attendance confirmed malaria in pregnancy
- OPD first attendance confirmed malaria in pregnancy (total)
- IP discharge confirmed malaria in pregnancy
- IP discharge confirmed malaria in pregnancy (total)
- Deaths confirmed malaria in pregnancy
- Deaths clinical malaria in pregnancy
- OPD first attendance malaria laboratory tests (slide/RDT) under 1 year
- OPD first attendance malaria laboratory tests (slide/RDT) 1 to 5 years
- OPD first attendance malaria laboratory tests (slide/RDT) over 5 years
- OPD first attendance malaria laboratory tests (slide/RDT) (total)
- IP discharge malaria laboratory tests (slide/RDT) under 1 year
- IP discharge malaria laboratory tests (slide/RDT) 1 to 5 years
- IP discharge malaria laboratory tests (slide/RDT) over 5 years
- IP discharge clinical malaria in pregnancy (total)
- Deaths confirmed malaria in pregnancy (total)

For more information, please visit deliver.jsi.com.

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