COOPER/SMITH

Logistics Management Information Systems Landscape Analysis

Thailand National Malaria Control Program

Prepared for the Global Health Supply Chain – Partnership for Supply Chain Management (Washington DC)

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ACRONYMS AND ABBREVIATIONS

App – Application
BI – Business Intelligence
BIOPHICS - Center of Excellence for Biomedical and Public Health Informatics
BOE – Bureau of Epidemiology
BVBD – Bureau of Vector Borne Diseases
CHAI – Clinton Health Access Initiative
COTS – Commercial Off-the-Shelf
DHO – District Health Office
EDI – Enterprise Data Interchange
FDA – Federal Drug Administration
FGD – Focus Group Discussion
GF – Global Fund
GHSC-PSM – Global Health Supply Chain Procurement and Supply Management
GOT – Government of Thailand
GPO – Government Pharmaceutical Office
HIS – Health Information System
HPH – Health Promotion Hospital
LLIHN – Long Lasting Insecticide Treated Hammock Net
LLIN - Long Lasting Insecticide Treated Net
LMIS – Logistics Management Information System
LogHealth - Healthcare Supply Chain Excellence Centre
M&E – Monitoring and Evaluation
MIS – Malaria Information System
MMIS – Material Management Information System
MOPH – Ministry of Public Health
NMCP – National Malaria Control Program
ODPC – Office of Disease Prevention and Control
PAL - Pharmaceutical Administration and Logistics
PHO – Provincial Health Office
PMI – President's Malaria Initiative
PSO – Permanent Secretary Office
RDT – Rapid Diagnostic Test
USAID – United States Agency for International Development
VBDC – Vector Borne Disease Control Center
VBDU – Vector Borne Disease Unit
VHV – Village Health Worker
VMI – Vendor Managed Inventory
WHO – World Health Organization

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GHSC-PSM MALARIA LMIS LANDSCAPE ANALYSIS

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EXECUTIVE SUMMARY

Background

The Ministry of Public Health (MOPH) of Thailand has adopted a National Malaria Elimination Strategy (2017-2026) aiming to eliminate the malaria epidemic in country by 2024. The National Malaria Control Program (NMCP) was instituted to oversee the malaria response in Thailand. NMCP is currently implementing a rapid response approach ("1-3-7") by closely monitoring and responding to malaria cases. Currently there is a surveillance system – Malaria Information System (MIS) – that allows Vector Borne Disease Control Centers (VBDC) to enter data that will sync to a dashboard (Malaria Online). However, there is no stock status information from health facilities for NMCP to efficiently respond and adapt to malaria incidence or outbreak. Mainstream public hospitals are decentralized and have disparate logistic management systems. Hospitals report malaria cases to The Bureau of Epidemiology (BOE), but are not required to report malaria commodity information to BOE or NMCP. The use of multiple electronic systems instead of one streamlined system has resulted in gaps in commodity data and duplication of data. The NMCP needs a comprehensive Logistics Management Information System (LMIS) to effectively implement the rapid response approach for achieving the goal of malaria elimination by 2024.

The Global Health Supply Chain Procurement and Supply Management (GHSC-PSM) commissioned this analysis to assess current gaps in logistics management and develop a roadmap to develop or configure a new LMIS to assist the MOPH to adaptively manage the malaria epidemic and evolving commodity needs.

Methods

A Landscape Analysis was conducted to frame recommendations for developing or configuring a high-functioning LMIS. Specific objectives of the Landscape Analysis included:

- **Inventory major supply chain information systems** in Thailand and assess system capabilities
- **Validate data flows**, reporting processes, procurement and approval processes and roles and responsibilities
- **Assess opportunities for interoperability** and data exchange across systems
- **Document user perspectives** and requirements for a future-state LMIS
- **Identify current gaps,** data needs and system requirements
- **Provide recommendations** to address existing gaps

Information for this report was gathered through desk review of prior reports, presentations, databases and policy documents; stakeholder interviews and focus group discussions (FGD); facility visits; direct review of data systems, elements and collection forms; and a stakeholder workshop.

This analysis report is structured to present current **malaria governance structures, supply chain systems, data collection and reporting, data flows** and **forecasting and procurement processes**, followed by the identification of LMIS **gaps and recommendations** to address gaps. A roadmap will be developed as a companion to this Landscape Analysis.

Current LMIS Gaps

Key findings from this analysis are grouped and listed below.

Supply Chain Systems

- There is **no comprehensive digital platform** to easily collect, review, and analyze stock data in the vertical or general health system programs
- Hospitals have their own, **fragmented data systems** (service, lab, warehouse), which are also difficult to access
- Malaria commodities are likely not captured in **hospital material management systems** because they are procured with external resources
- With no existing central LMIS, there is **very little visibility** of stock levels, distribution, or consumption at province level and below
- MIS / Malaria Online is **widely adopted** and data from the system is widely utilized within BVBD
- The **data architecture** of MIS will need to be assessed before supply chain data can be added to the data hierarchy

Data Elements

- Key data from the general health system is currently reported at various intervals in a standard format to the health data center (**HDC**), but currently **malaria commodities are not included**
- Currently no system captures malaria data from **private, university or military hospitals**
- **Data elements are not standardized** across the vertical and general health systems. IT-MOPH is trying to address this by moving to **interoperability with hospital systems** through the HL7 service

Forecasting, Procurement and Allocations

- Most malaria commodities are procured centrally through **multiple channels**
- Drug and commodity **allocations are not optimized**. There is evidence of stock outs and drug expiry; however, little data are available about commodities below provincial level, limiting the ability to identify sources and drivers of poor performance.
- Drug distribution is based on **request and validation** against historical case data, not current stock levels and consumption
- There is no central standard for **commodity storage**, packing and distribution procedures to distribute malaria commodities to health facilities and sub-districts

Capacity Building

- IT staff have not been **fully trained on Tableau** functionalities – the data visualization software used for Malaria Online.

Advocacy and Communication

- Politics and siloed roles have not allowed BVBD to fully establish relationships with MOPH-IT and LogHealth and effectively **advocate for malaria commodities** being included in national databases

Recommendations to Address Gaps

- A commercial off-the-shelf (COTS) mobile application (app) can be adapted and integrated with the MIS to fit the LMIS needs of the country in the short term. In the long term, the LMIS can interoperate with the HL7 and be connected to public hospital data

- Identify malaria relevant metadata that can be included in MOPH managed systems
- Advocate for the inclusion of malaria related data and indicators in the HL7
- Review the existing data architecture of the MIS and update to ensure additional data, such as malaria commodity data, can be added and that data analysis can be automated through Tableau
- Automate routine processes that support decisions, such as automating drug request approval and forecasting processes

BACKGROUND

The purpose of the United States Agency for International Development (USAID) Global Health Supply Chain Procurement and Supply Management Program is to ensure uninterrupted supplies of health commodities in support of U.S. government-funded public health initiatives around the world. The program provides direct procurement and supply chain management support to the President's Emergency Plan for AIDS Relief, President's Malaria Initiative (PMI), and USAID's family planning and reproductive health program. In Thailand, the GHSC-PSM project supports PMI through two primary objectives:

- Assistance with logistics and tracking for malaria commodities purchased by partners
- Global and country collaboration to improve long-term availability of health commodities by strengthening supply chain management and reducing commodity gaps

The National Malaria Control Program (NMCP) in Thailand is one of the programs within the Bureau of Vector Borne Diseases (BVBD). NMCP oversees malaria clinics and manages supply of malaria commodities to these clinics and to the mainstream public hospital system.

The MOPH has developed its National Malaria Elimination Strategy 2017-2026 which aims at eliminating malaria by 2024. The strategy includes gradually integrating malaria services to the main stream public hospital system. The NMCP is implementing a rapid response approach ("1-3-7") by closely monitoring and responding to malaria cases. Currently there is a surveillance system – Malaria Information System (MIS) – that allows Vector Borne Disease Control Centers (VBDC) to enter data that will sync to a dashboard (Malaria Online). However, there is no stock status information from health facilities for NMCP to efficiently respond to malaria incidences or outbreak. Furthermore, the mainstream public hospitals are decentralized. Hospitals adopted or developed their own electronic systems for hospital management which includes management of logistics information for medical products. They also procure malaria commodities using their own budgets. Hospitals report malaria cases to The Bureau of Epidemiology (BOE), but are not required to report malaria commodities' logistics information to BOE or NMCP. The use of multiple electronic systems instead of one streamlined system has resulted in gaps in commodity data and in other cases duplication of data.

The MOPH developed the eHealth Strategy 2017-2026 which aims at automating the health information system. The strategy includes a plan to develop a drug and pharmaceutical database, pharmacy management system, finance management system, drug information system, and an electronic drug store system in collaboration with the Healthcare Supply Chain Excellence Centre (LogHealth), Faculty of Engineering of Mahidol University. The NMCP is in need of a Logistics Management Information System (LMIS) to effectively implement the rapid response approach to achieve malaria elimination by 2024.

PURPOSE AND OBJECTIVES

This Landscape Analysis frames recommendations to assist with logistics and tracking of malaria commodities for the NMCP and to develop or configure a new LMIS. The purpose of this analysis is to assess the current LMIS landscape in Thailand; map existing processes, data flows and stakeholder's requirements; evaluate the current state and capabilities of existing LMIS systems; identify current gaps and make recommendations for an overarching roadmap for the adoption of an LMIS.

The specific objectives of this analysis include the following:

- **Inventory major supply chain information systems** in Thailand and assess system capabilities
- **Validate data flows**, reporting processes, procurement and approval processes and roles and responsibilities
- **Assess opportunities for interoperability** and data exchange across systems
- **Document user perspectives** and requirements for a future state LMIS
- **Identify current gaps,** data needs and system requirements
- **Provide recommendations** to address existing gaps

Methods for the Landscape Analysis are outlined below, followed by findings from the objectives listed. Research for and findings of the Landscape Analysis allowed for identification of primary gaps in the national supply chain information system and the development of a roadmap for the adoption of a contextually appropriate, fit-for-purpose LMIS.

METHODOLOGY

Information for this report was gathered through desk review of prior reports, presentations, databases and policy documents; stakeholder interviews and focus group discussions (FGD); facility visits; direct review of data systems, elements and collection forms; and a stakeholder workshop.

Stakeholder interviews and FGDs were completed during a field visit to Thailand from 29 April - 10 May 2019. Over the course of the visit, 37 individuals participated in interviews and focus groups, representing 7 departments, bureaus or offices within the Government of Thailand (GOT); 2 external donors; 3 technical partners; and 2 universities. **Table 1** summarizes the full list of organizations interviewed and their role in malaria control within Thailand.

Table 1. Organizations Interviewed for Landscape Analysis, by Level of Health System and Affiliation

Level	Affiliation	Organization, Department, or Office
Central	GOT	Bureau of Vector Borne Diseases Principal Recipient Office (PR-DDC) BVBD-IT Department of Disease Control (DDC) - IT MOPH-IT
	TECHNICAL PARTNERS	RTI Clinton Health Access Initiative (CHAI) GHSC World Health Organization (WHO)
	DONORS	USAID
	UNIVERSITIES	Center of Excellence for Biomedical and Public Health Informatics (BIOPHICS) LogHealth
Regional	GOT	VBDC Office of Disease Prevention and Control (ODPC)

Twenty-two individuals were interviewed across BVBD, two health promotion hospitals (HPH), three provincial health offices (PHO), one VBDC and one Vector Borne Disease Unit (VBDU) within three

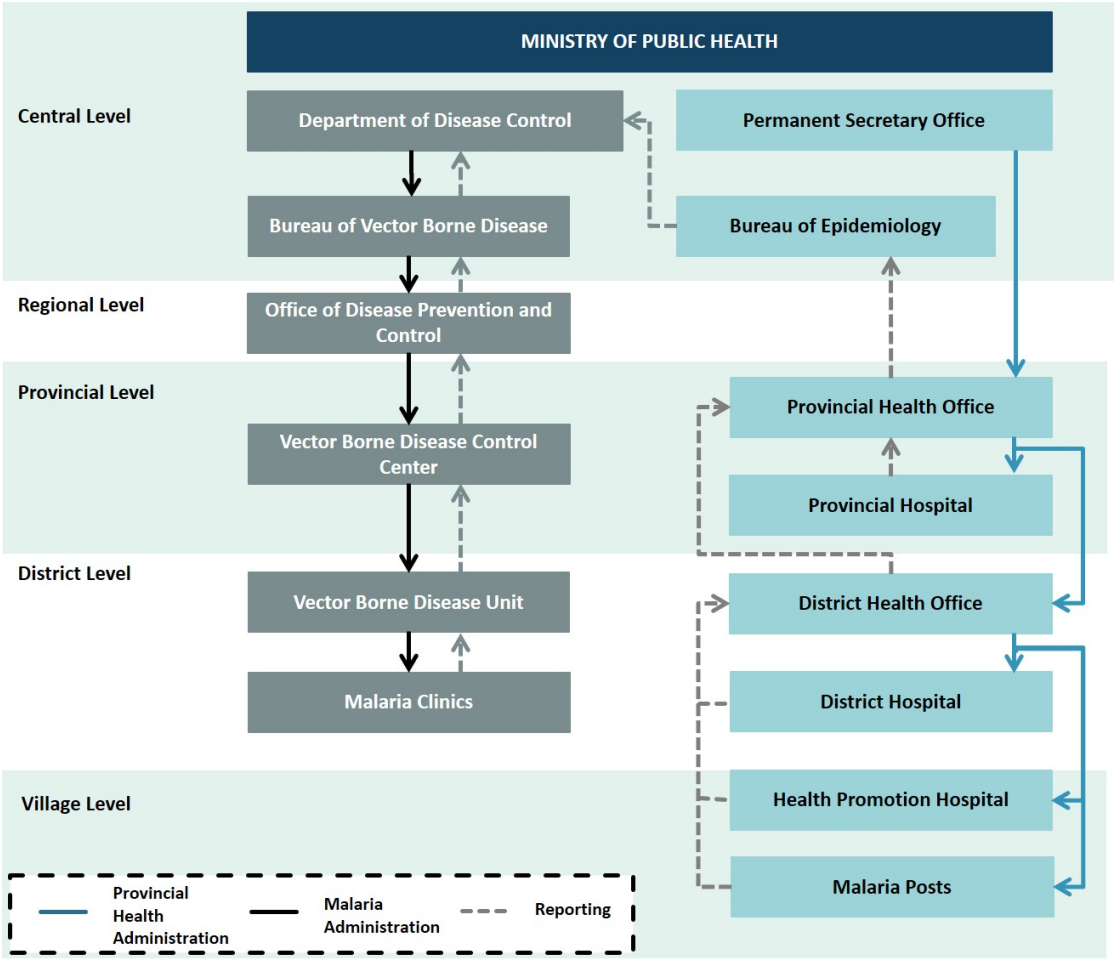
provinces: Mae Hong Son, Nonthaburi and Chiang Mai. Sites were not randomly chosen or sampled; rather, they were selected by GSCM-PSM counterparts to include facilities in high, medium and low malaria burden areas.

Nineteen individuals participated in the LMIS Workshop, including individuals from BVBD, ODPC, VBDC, PR-DDC, BIOPHICS, USAID, GHSC and USCF.

MALARIA GOVERNANCE STRUCTURES

Under the DDC, BVBD is the custodian for malaria programming in Thailand. BVBD oversees malaria clinics and manages the procurement and supply of commodities to the health facilities. Malaria administration underneath the DDC is sometimes referred to as the "vertical program" as it was established parallel to the general health system. Malaria is also treated at malaria posts and hospitals within the general health system, overseen by the Permanent Secretary Office (PSO). Malaria posts were previously under the responsibility of BVBD but have recently changed administrative lines from BVBD to PSO. **Figure 1** shows the structure of malaria administration and reporting within the DDC and the PSO.

Figure 1 - Malaria Administration and Reporting



Facilities

The Government of Thailand is in process of integrating the treatment of malaria back into general health services under the administration of the PSO. Most malaria posts now report to PSO. Malaria clinics report to the BVBD. The following include the types of facilities and offices in the NMCP and in general health services that test for, treat or support malaria programming.

Bureau of Vector Borne Diseases

Bureau of Vector Borne Diseases

BVBD oversees the National Malaria Control Program at the central level and holds many different roles, including procurement, monitoring and evaluation (M&E), program management, case management and stock quantification and management. Procurement and supply officers are responsible for quantifying and procuring malaria commodities and drugs. M&E officers track program related data and develop M&E frameworks. Public health technical officers supervise case management, stock management and procurement.

Office of Disease Prevention and Control

ODPC is located at the regional level. ODPC requests compiled stock information from VBDCs and shares with BVBD. They also assist in distributing malaria commodities.

Vector Borne Disease Control Center

VBDCs are located at the provincial level and oversee VBDUs. They request and compile stock levels from VBDU and send to ODPC. They also distribute commodities and drugs to VBDUs and PHOs for further distribution.

Vector Borne Disease Unit

VBDUs are located at the district level and oversee malaria clinics. They report to and provide information from their districts to VBDC. They also distribute commodities and drugs to the malaria clinics and approve requests for additional supplies.

Malaria Clinics

Malaria clinics are clinics at the district level under the authority of BVBD. Staff at malaria clinics can test, diagnose and treat malaria. Microscopy is used for malaria testing and diagnosis. Malaria clinics report directly to their relevant VBDU. Each clinic maintains a listing of their current stock levels.

Permanent Secretary Office

Bureau of Epidemiology

The Bureau of Epidemiology collects all malaria patient-related data from each individual hospital. However, they do not collect any stock information for malaria commodities.

Provincial Health Office

PHOs oversee provincial hospitals and district health offices (DHO). They are also responsible for distributing malaria commodities and drugs received from the vertical program, and report malaria stock information to BVBD on a quarterly basis.

Provincial Hospital

Provincial hospitals are provincial level facilities under the authority of PSO. Staff at provincial hospitals can test and diagnose for malaria using rapid diagnostic test (RDTs) and treat for malaria. They report directly to the PHO and can procure malaria drugs and commodities directly from the vendor. Stock levels are recorded in separate non-linked databases at each hospital.

District Health Office

DHOs oversee and manage district hospitals, HPHs and malaria posts. They are also responsible for distributing malaria commodities and drugs received from the PHO and reporting malaria stock information to PHOs on a quarterly basis.

District Hospital

District Hospitals are district level facilities under the authority of PSO. Staff at district hospitals can test and diagnose for malaria using RDTs and treat for malaria. District hospitals can directly procure malaria commodities and drugs from the vendor and record stock levels in non-linked databases or systems at each hospital. They report directly to the DHO.

Health Promotion Hospital

Health Promotion Hospitals are village level facilities under the authority of PSO. Staff at HPHs can test and diagnose for malaria using RDTs and provide treatment. They report directly to the District Health Office. HPHs can procure malaria commodities and drugs from the vendor and record stock levels in non-linked databases or systems at each HPH.

Malaria Posts

Malaria Posts are village-level facilities under the authority of PSO. Staff at Malaria Posts can test and diagnose for malaria using RDTs, and in some cases provide treatment. When they are unable to provide treatment, they refer patients to district or provincial hospitals. While malaria posts reported to BVBD administratively, they now report directly to the DHO under general health services.

Other

Non-Government Supported Facilities

Privately owned and military supported facilities may also treat malaria. However, they do not have to report their malaria related programming or stock data to BVBD or PSO. They privately procure malaria drugs and commodities, though on occasion will request drugs and commodities from BVBD.

USERS, KEY STAKEHOLDERS AND ROLES AND RESPONSIBILITIES

While BVBD and the National Malaria Control Program are central to malaria programming and supply chain in Thailand, there are many other key actors:

- The **PR-DDC Office** reports on select Global Fund indicators related to stock-outs, long lasting insecticide treated bed nets (LLINs), long lasting insecticide treated hammock nets (LLIHN) and RDTs. Additionally, PR-DDC has procurement officers to assist in the procurement of select malaria commodities and drugs.
- The **MOPH-IT Office** maintains the Health Data Center (HDC) – a data center warehouse that houses all health data reported in the general health facilities. MOPH-IT has undertaken to integrate all government and private hospital data into a cloud-based server by creating an HL7 integration layer between the HDC and all facilities within Thailand.
- **LogHealth** is partnered with the MOPH on projects to track and trace medicines and standardize healthcare product codes across Thailand. They are piloting the Material Management Information System (MMIS) and the Electronic Data Interchange (EDI) systems.
- The **Government Pharmaceutical Organization (GPO)** manufactures, sells and supplies pharmaceutical products and medical supplies in Thailand. GPO supports the Bureau of General Communicable disease to develop the Vendor Managed Inventory (VMI) for vaccine and related medicine for influenza.
- The **DDC-IT Office** maintains local and cloud-based servers that BVBD and Malaria Online are able to utilize.
- **BIOPHICS** developed the MIS and provides support as requested to Malaria Online for business intelligence (BI) for malaria related data, including the integration of data from BOE. They have created an algorithm to de-duplicate data from the 506 report that BVBD receives from BOE.

SYSTEMS FOR DATA COLLECTION, REPORTING AND ANALYSIS

Supply Chain Information Systems

This section explores the various information systems or data warehouses that have or can collect malaria case management and commodity information in Thailand. The Malaria Information System (MIS) is the sole system available for use in the vertical program and data is entered at the provincial level and higher. Systems for stock information are largely paper and excel based at malaria clinics and VBDUs. At VBDCs, procurement staff, public health technical officers, nurses and facility management have access to maintain data in the systems. In the general health services, each hospital maintains stock levels in various databases or excel. During the site visits, most facilities highlighted some level of data verification that takes place, often with the procurement staff both entering and verifying the data. VBDUs also conduct data quality and verification checks on collected data, though the frequency of data quality checks appears to be inconsistent and sporadic.

Malaria Information System

The MIS was developed by BIOPHICS as the main system to collect malaria data for the vertical program and is widely used across BVBD. The village and district levels collect data using paper forms and send to VBDCs for offline entry into the MIS. The data entry will sync with the local server and update the dashboards in Malaria Online – the web-based BI component of MIS. The database is currently housed on a local server at BVBD. While malaria stock information is not included in the MIS, other data elements are used to verify the number of malaria cases and quantify amount of stock

needed across different facilities and areas. General health system information is not included in the MIS, with the exception of the 506 Report that is uploaded into MIS on a monthly basis.

BVBD-IT programmers and IT Officer currently maintain the MIS. Changes and updates to the MIS are made on an ad hoc basis. Requests are made during team meetings and BVBD-IT prioritizes the requests according to level of effort and time needed to complete the request.

Malaria Online is the dashboard section of MIS and configured on Tableau. Global Fund funding currently supports the Tableau license for two more years. After the license expires, the cost of Tableau will need to be considered in the national budget if GF support does not continue. BVBD-IT uses the calculation tool built in to Tableau to produce the dashboards, but the data architecture is set up in such a way that data is not easily analyzed or visualized and the team has had only basic training on Tableau functionality. BVBD-IT reported that some data analysis and visualization requests require the download of two or three data tables and manual tabulation to produce. At the moment, Malaria Online contains ten different canned dashboards:

- **Malaria Situation**: Number of cases by time, location, patient (age, sex, nationality occupation), species, health facility, risk stratification area, data sources
- **Weekly Epidemic Detection**
- **Active foci response (sub-village level)**: source sites, reactive case detection, net distribution, area stratification, % RACD, % net coverage
- **1-3-7 strategy**: # of cases, target, result
- **Financial**: Expenditures report under each budget plan, by intervention, by organization, timeline
- **Malaria Death**: map, sex, age, location
- **GMS**: Map, # of cases by calendar year, case stratification, country, patient type (IPD/OPD), # cases by month, species, gender, age groups
- **Vector control additional with IRS**
- **Entomology**: Map for entomology activities (mosquito trap) by sub-village, mosquito type, risk stratification area, timeline, details by village
- **Number of Cases of Each Province**: graph for # of cases, occupation, age, active foci area, and 1-3-7 measure by the following filters -
    - Monthly
    - Yearly
    - Organization (e.g., BOE, ODPC, NGO)
    - Species
    - Nationality

MIS also includes two different modules and sets of indicators. Module 1 indicators include:

- Total malaria cases reported to the database
- Total malaria cases recorded in the health facility patient log books
- Percentage of malaria cases reported to the malaria database from examined health facilities

Module 2 indicators include:

- Number of malaria cases reported to the malaria database
- Number of malaria cases reported to the malaria database that were investigated
- Number of case investigations completed within three days

- Percentage of malaria cases reported to the malaria database that were investigated
- Percentage of malaria cases reported to the malaria database completed within three days

For vector control activities, the number of nets distributed can be displayed by:

- Fiscal Year
- Number of households, number of persons
- Net type
- Funding
- Activity (survey and distribution)
- Organization (NGO, PHO, BVBD)
- Risk stratification (A1, A2, B1, B2)
- Location by cluster

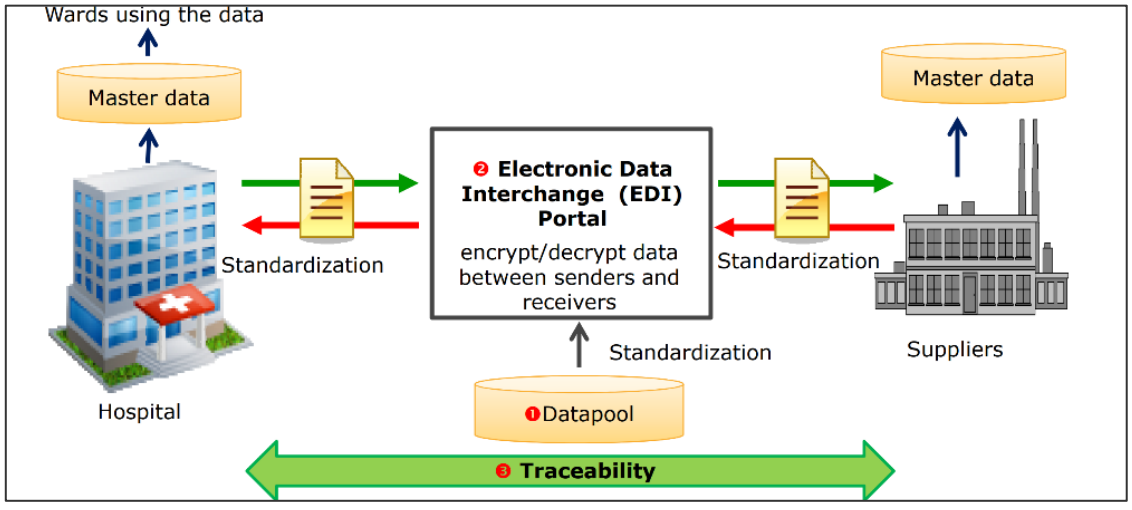
Vendor Managed Inventory

VMI is a traceability system that is currently being developed by Pharmaceutical Administration and Logistics (PAL) and outsourced to an IT company. VMI allows healthcare products to be tracked to the patient and traced back to the manufacturer. It also supports information on product recalls. Through the VMI, hospitals in the general health service can directly request drug replenishment through GPO to ensure that the hospital maintains the required level of drug inventory for medicines that are included in the nationally approved list of medicines. As this system currently focuses on drug requests, it does not allow for the procurement of RDTs or other malaria commodities.

Electronic Data Interchange

The EDI is a portal developed by LogHealth that allows for the sharing and exchange of information between hospitals and suppliers. It is currently being piloted in 20 facilities in the general health sector. LogHealth is creating a product catalogue and unique codes for drugs and commodities to allow a standard database on the manufacture, movement and use of healthcare products to be created. The standardization allows all hospitals and vendors to be able to enter and exchange data, even when using different systems and ultimately leads to greater visibility in the supply chain. **Figure 2** shows an overview of the exchange between hospitals, EDI and suppliers. Only drugs that are

Figure 2: EDI Overview



approved by the Thailand Food and Administration (FDA) are included in the standardized code book, which currently excludes malaria commodities and drugs.

The EDI contains the following:

- Standardized healthcare product identification (e.g., batch number, expiry date, Thailand FDA registration code, trade name, manufacturer name, etc.);
- Clinical information (e.g., active ingredient, strength, dosage, adverse drug reaction, drug interaction, etc.);
- Logistics information (e.g., presentation unit, product dimension, product weight, etc.); and
- Dynamic product information (e.g., manufacturing lot number, expiry date and manufacturing date).

Material Management Information System

The MMIS is a system being piloted in 20 general health service facilities by LogHealth. The purpose of the system is to track and record stock movement from the manufacturer to the warehouse. However, this system does not track current stock levels at the warehouse. The MMIS will interface with EDI and will also be used as an Enterprise Resource Planning (ERP) tool.

Health Data Center

Information and Communication Technology Center developed a cloud-based provincial medical and health data warehouse, called the Health Data Center. Since hospitals are using many different health information systems, the HDC was developed to house data from the 43 folders. The 43 folders are data sets that are pre-established and include standard data that each PSO supported facility is to report on. The HDC has a dashboard (**Figure 3**) to display data from the 43 folders. Each hospital can utilize their own Pentaho, JSP, or MySQL database to collect program data and then export to reports to be uploaded into the HDC. The HDC uses SQL, SQOOP and Hadoop for data visualization and utilizes Yii Frameworks for its PHP framework.

Figure 3: HDC Dashboard

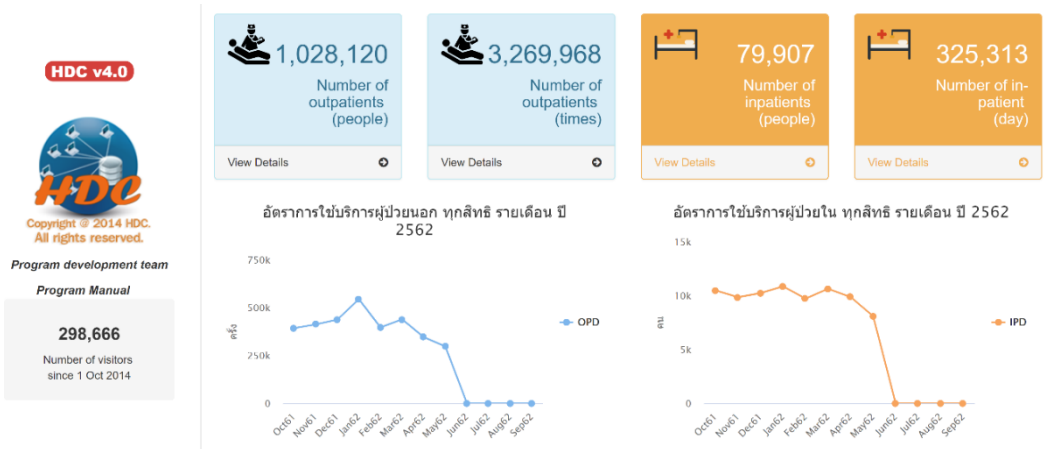
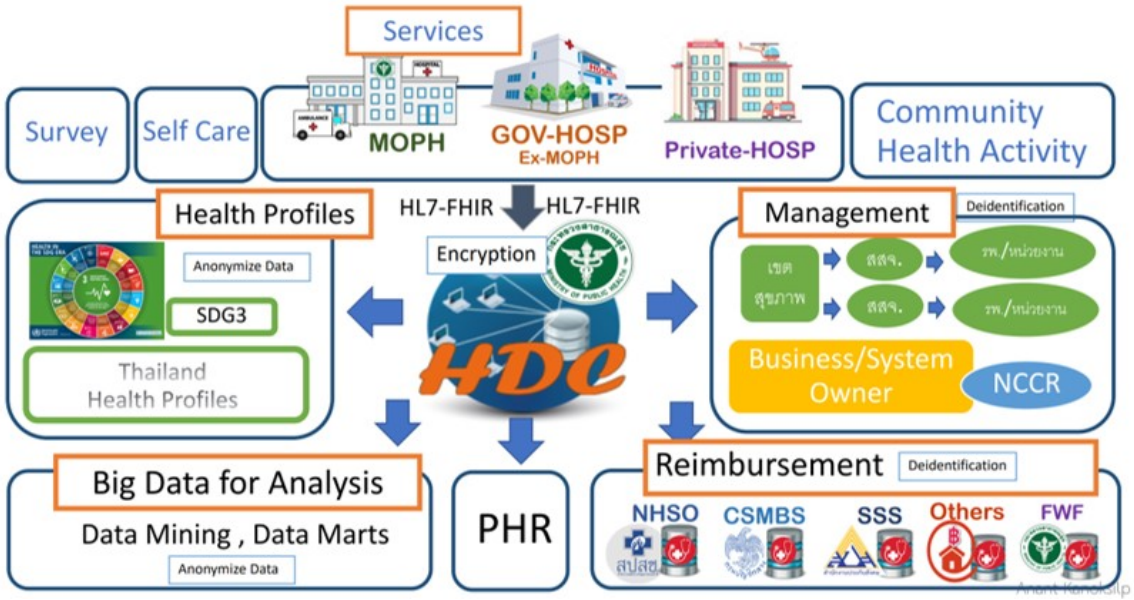


Figure 4 – MOPH One Health Data Platform



The HDC currently does not capture information from private hospitals or non-government supported hospitals. Because hospital systems are disparate and not all hospitals are represented in the HDC, the MOPH-IT has undertaken a project called the One Health Data Platform. Through this project, MOPH-IT is developing an interface level to gather data from all types of facilities and HIS, called the HL7. The data will ultimately reside in the HDC. Together with LogHealth, the MOPH-IT is developing a product catalog and coding to standardize language across the HISs. **Figure 4** shows the One Health Data Platform projected vision.

JHOS / JHCIS / HOSxP / Hospital Software

Figure 5 – 43 Folder Malaria Data

แฟ้มสะสม	แฟ้มบริการ	แฟ้มบริการกึ่งสำรวจ
1.PERSON	1.FUNCTIONAL	1.REHABILITATION
2.ADDRESS	2.ICF	2.NCDSCREEN
3.DEATH	3.SERVICE	3.ANC
4.CHRONIC	4.DIAGNOSIS_OPD	4.LABOR
5.CARD	5.DRUG_OPD	5.POSTNATAL
6.HOME	6.PROCEDURE_OPD	6.NEWBORN
7.VILLAGE	7.CHARGE_OPD	7.NEWBORNCARE
8.DISABILITY	8.SURVEILLANCE	8.EPI
9.PROVIDER	9.ACCIDENT	9.NUTRITION
10.WOMEN	10.LABFU	10.SPECIALPP
11. DRUGALLERGY	11.CHRONICFU	
12. PRENATAL	12.ADMISSION	
	13.DIAGNOSIS_IPD	
	14.DRUG_IPD	
	15.PROCEDURE_IPD	
	16.CHARGE_IPD	
	17.APPOINTMENT*	
	18.DENTAL	
	19.FP	
	20.COMMUNITY_ACTIVITY	
	21.COMMUNITY_SERVICE	
การส่งต่อ	22.CARE_REFER	
	23.CLINICAL_REFER	
	24.DRUG_REFER	
	25.INVESTIGATION_REFER	
	26.PROCEDURE_REFER	
	27.REFER_HISTORY	
	28.REFER_RESULT	

PSO supported health facilities utilize many software and freeware platforms to manage malaria data and drug supplies. All the data recorded about the patient and on the ID card needs to be reported to the PHO and ultimately to the HDC. The various software provided to hospitals is open source and hospitals can choose to use them or use their own systems. The software and freeware have multi-function modules to control and monitor both on the front operations and back office operations (i.e screening, registration, historical taking, pharmacy, stock allocation, balance stock). The systems, such as HOSxP, JHOS and JHCIS collect data from the 43 folders and push it to the HDC. The software can be exported, run through OP/PP to ensure data cleanliness, and sent to the HDC. The data elements collected are highlighted in red in **Figure 5**. The 43

folders include malaria clinical data, but does not include stock levels. Stock is kept in separate databases, excel, etc. and is not standardized across facilities.

DATA COLLECTION AND REPORTING

Hospitals and facilities report stock-related data for annual implementation planning, confirming available medical supplies, determining the next allocation of supplies and producing epidemiologic reports. Those surveyed at the facilities highlighted the following data elements used to make those decisions:

- # of LLITNs
- # of tests
- Morbidity rate
- # of medical supplies available
- Consumption rates
- Incidence rate
- # of malaria patients
- Population data
- Drug expiry date
- Fever rate
- # of public health services available

Table 2 shows the epidemiological reporting forms used in the Bureau of Vector Borne Diseases to collect this information and malaria-related data elements. Very little malaria commodity data is collected. Stock is expected to be recorded at each facility, both in the vertical and general health service programs; however, each facility can choose how to record and track stock levels and are not required to use a standardized template.

Table 2: Forms used to collect malaria data

FORM	DESCRIPTION	DATA ELEMENTS
EP-1	Blood Record Form	Patient ID Malaria Type Case Number Test Result
EP-3	Investigation and Radical Treatment of Malaria Cases	Patient ID Malaria Type Treatment Period Malaria Treatment
VC-3	Vector Control Activity	Household sprayed
VC-4	Net Survey and Distribution Form	# of LLIN / LLIHN distributed
VIVO	Patient Follow-Up Form	Case Number Malaria Treatment and quantity # of drugs given

Table 3 shows the reports produced by BVBD. Data used to produce the reports comes from the data collection forms described in Table 2.

Table 3: Reports Produced by BVBD

FORM	DESCRIPTION	RELATED FORMS
EP-2	Monthly Report of Malaria Case Detection	Compilation of EP-1
EP-4	Summary of Malaria Species	Compilation of EP-3
EP-6	Malaria Registration	Compilation of EP-1 and EP-3
EP-7	Summary by ODPC	N/A
Stock Request	Excel sheet requesting stock levels	N/A
Donor Reports	Donor reporting requirements (e.g., GF quarterly report)	N/A
Stock Reports	Monthly Medical Supply Inventory	N/A
Stock Reports	Yearly Procurement Plan	N/A
Stock Reports	Monthly Chemical Report	N/A
Stock Reports	Monthly Inventory and Distribution Report	N/A

DATA FLOW

The current malaria data flow is described in **Figure 6**. The data flow begins when a patient presents themselves to a health facility (e.g., Malaria Post, Malaria Clinic, HPH, District Hospital, or Provincial Hospital).

National Malaria Control Program

If a patient presents to a Malaria Post or Malaria Clinic, their information will be recorded in the EP-1 Form and they will be tested for malaria. If the Malaria Post cannot provide treatment, they will refer the patient to a HPH or District Hospital. Otherwise, treatment will begin and the information will be recorded in the EP-3 Form. Information will also be recorded on the VIVO Form to ensure follow-up. The paper-based forms are sent to the VBDU for compilation and offline data entry into the MIS. The data is synced to the server and will be available for display in Malaria Online. If VBDUs are part of LLIN or LLIHN distribution activities, they will fill out the paper VC-3 and VC-4 forms, and enter the data into the MIS. The data will also be synced to the server, uploaded and available for display in Malaria Online.

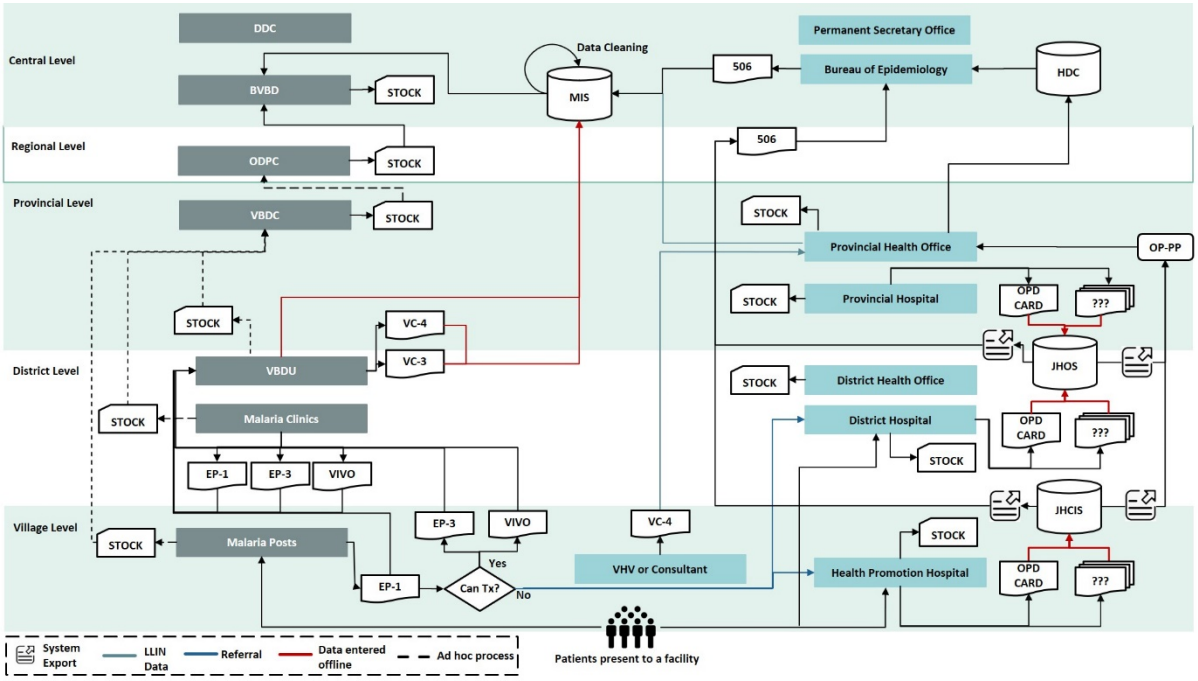
General Health Services Program

If a patient presents themselves to a HPH, District Hospital or Provincial Hospital, their information is recorded on the OPD Card and entered into the hospital's HIS. Data is exported from the HIS, run through the online OP/PP to check data quality and sent to the PHO electronically. The PHO reviews the data before it is added to the HDC; however, the upload automatically happens without a confirmation from the PHO. The 506 Report is completed separately by each facility and sent to BOE. BOE will compile and send to BVBD on a monthly basis. The data from the 506 Report is uploaded into the MIS and BVBD completes a de-duplication process.

LLIN / LLIHN distribution takes place at the village levels. Often Village Health Volunteers (VHV) or consultants are hired for the distribution. These individuals record the distribution information in the

VC-4 Form and will send the paper form to the PHO. The PHO is responsible to review and enter the data into the MIS.

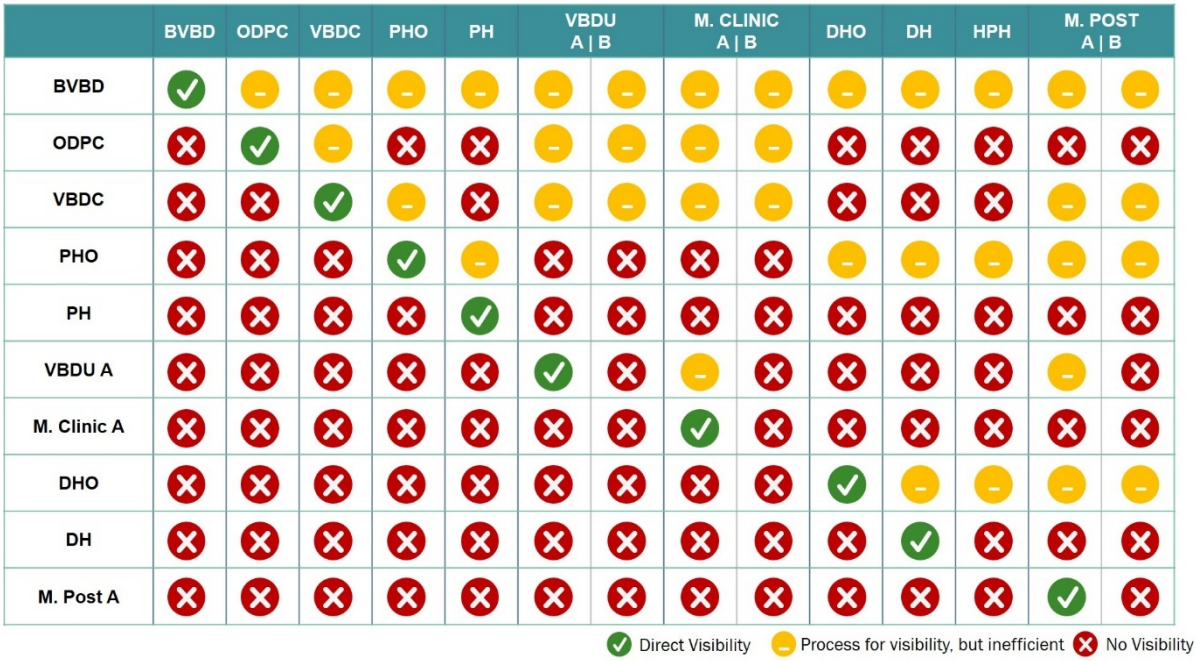
Figure 6 – Current Malaria Data Flow



Stock Levels

Each facility maintains their malaria stock data in separate databases. For the vertical program, stock levels are sent directly to the VBDC on a monthly basis for compilation. VBDC will add their stock levels to the compilation and send to ODPC when requested. ODPC will send a stock report to BVBD on a quarterly basis, including all stock within their region of the vertical program. Much like the vertical program, each PSO supported facility maintains their malaria stock in a separate database. Stock levels are sent from hospitals to health offices as requested in an excel template. On a quarterly basis, BVBD requests stock levels from PHOs to be able to report stock out levels to Global Fund. Because each facility uses their own system or database for stock management, there is little visibility of stock levels, distribution or consumption below the provincial level. **Figure 7** shows the visibility at each level.

Figure 7: Malaria Commodity Visibility by Level



There is no visibility into stock expiration dates, and there are reported cases of having to throw away drugs because of expiration. Additionally, the lack of visibility between facilities hinders district and province ability to reallocate commodities between health facilities locally.

PROCUREMENT AND FORECASTING PROCESSES

Forecasting Methodology

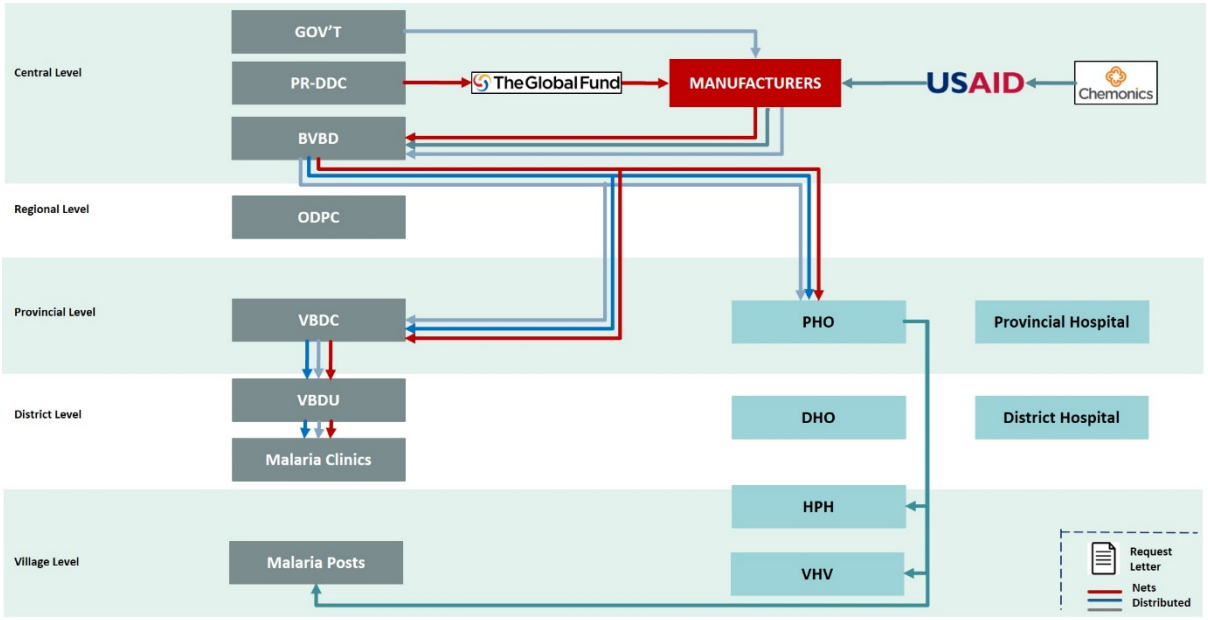
There is no standard methodology used in health facilities to forecast supply needs. There is also no inventory data network to allow sharing among facilities and provincial health offices in terms of stock monitoring and allocation. Some health facilities reported forecasting their supply needs based on their budget. Other health facilities reported looking at historical trends to determine what patient load might be. Multiple health facilities mentioned they try to maintain a 20% buffer stock of malarial commodities to avoid stock-outs.

At the central level, BVBD uses an Excel-based quantification tool to plan shipment requests. BVBD looks at historical case numbers and species and then calculates the amount of medicines needed accordingly. For LLIN / LLIHN quantification, they survey communities on an annual basis to understand the gap in available LLINs. As the commodities and drugs are estimated at the central level, allocation of drugs and commodities is not optimized and is often done as blanket distributions. There is evidence of stock outs and drug expiry. Overall, drug distribution is based on request and validation against historical case data and not current stock levels and consumption.

Procurement and Approval Flows

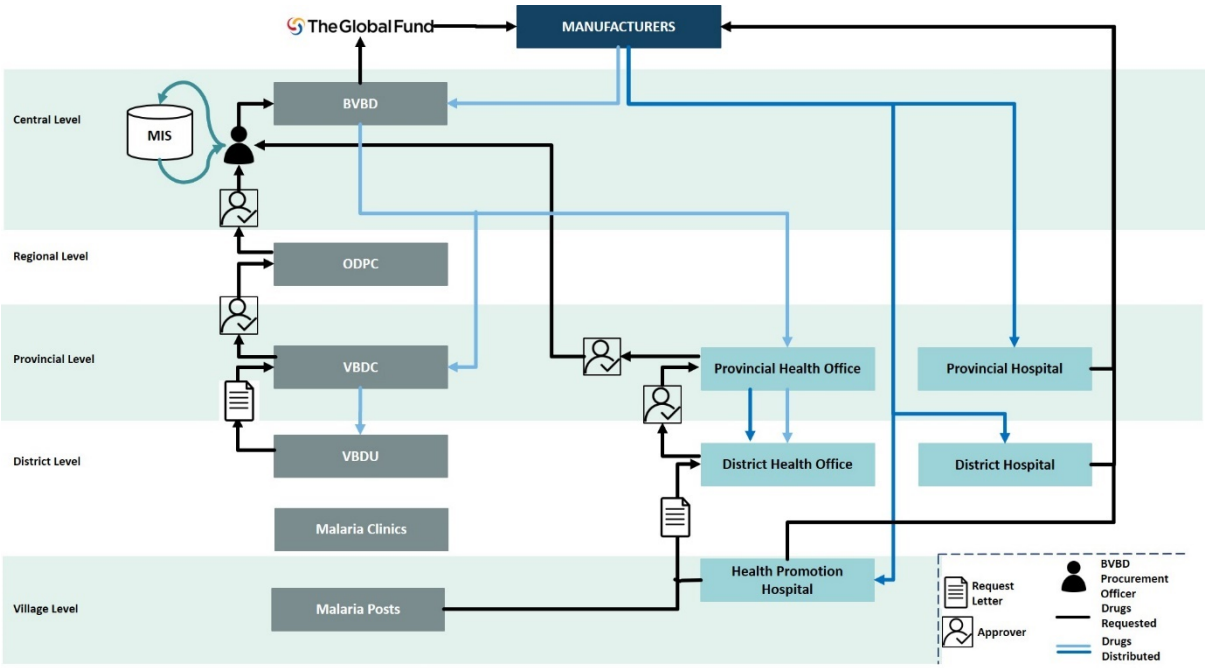
Most malaria commodities are procured centrally through multiple channels, as shown in **Figures 8-11.**

Figure 8 – Current LLIN / LLIHN Procurement and Approval Flow



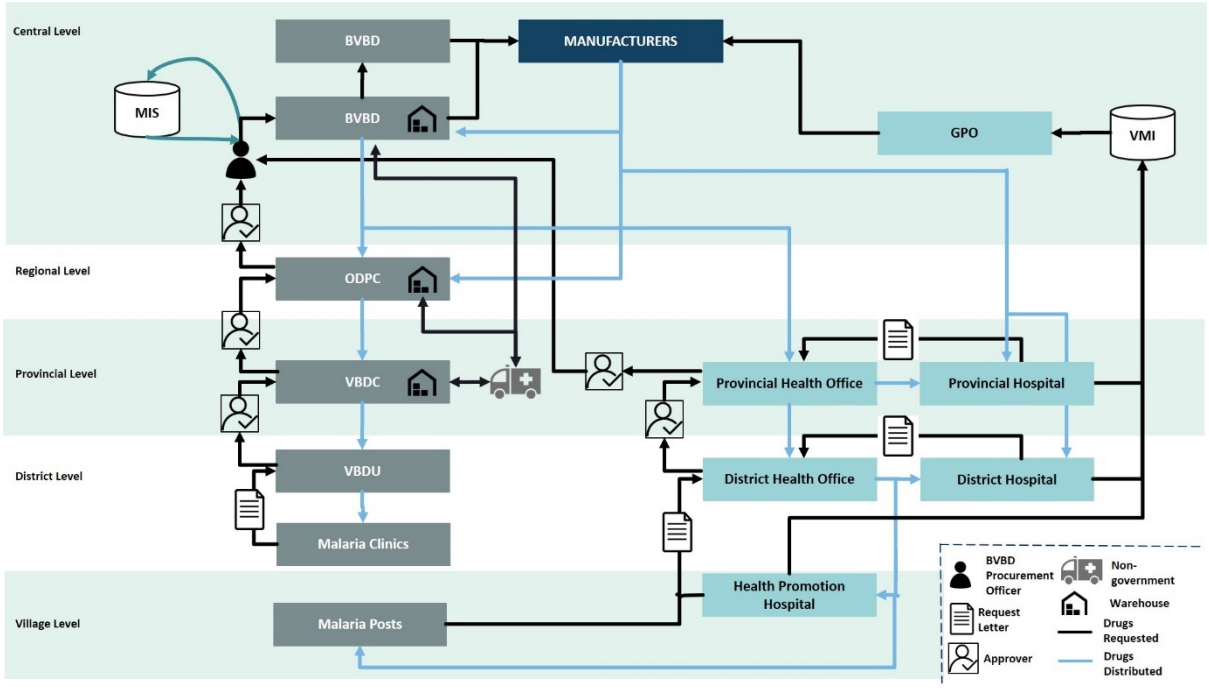
LLIN / LLIHNs are purchased with funds from USAID, Global Fund, and the Government of Thailand. Each donor interacts with the manufacturer to place the procurement order. The manufacturer distributes the nets to BVBD, who in turn is responsible to send to the PHOs and VBDC. VBDC will distribute the nets to VBDU and the Malaria Clinics. While Malaria Clinics are not part of the community outreach for LLINs / LLIHNs, they provide them to cross-border patients. Provincial health offices distribute the nets to HPHs, VHVs and malaria posts. LLIN / LLIHN are procured on an annual basis, and none are warehoused in a central location.

Figure 9 – Current Procurement and Approval Flow for RDTs



BVBD requests RDTs through Global Fund. Most RDTs are used in the general health services programming as BVBD does testing through microscopy. The manufacturer will send the RDTs to BVBD, who will distribute to PHOs and VBDC. VBDC distributes to VBDUs. PHOs will distribute to provincial hospitals, district hospitals and HPHs. The general health facilities can request additional supply of RDTs directly from the manufacturer, or can write a formal letter of request to the DHO. The DHO will approve and send the letter to the PHO for approval. Once approved, PHO will send the request to BVBD. BVBD review the letter, confirms the case load in the MIS, and will approve, adjust or reject the request to procure additional RDTs. If the VBDU needs additional RDTs, they will also send an official paper request to the VBDC, who approves and sends to ODPC. ODPC will review and once approved send to BVBD. BVBD will follow the same process and look at the case load in the MIS before approving the additional distribution of RDTs.

Figure 10 – Current Procurement and Approval Flow for Malaria Drugs

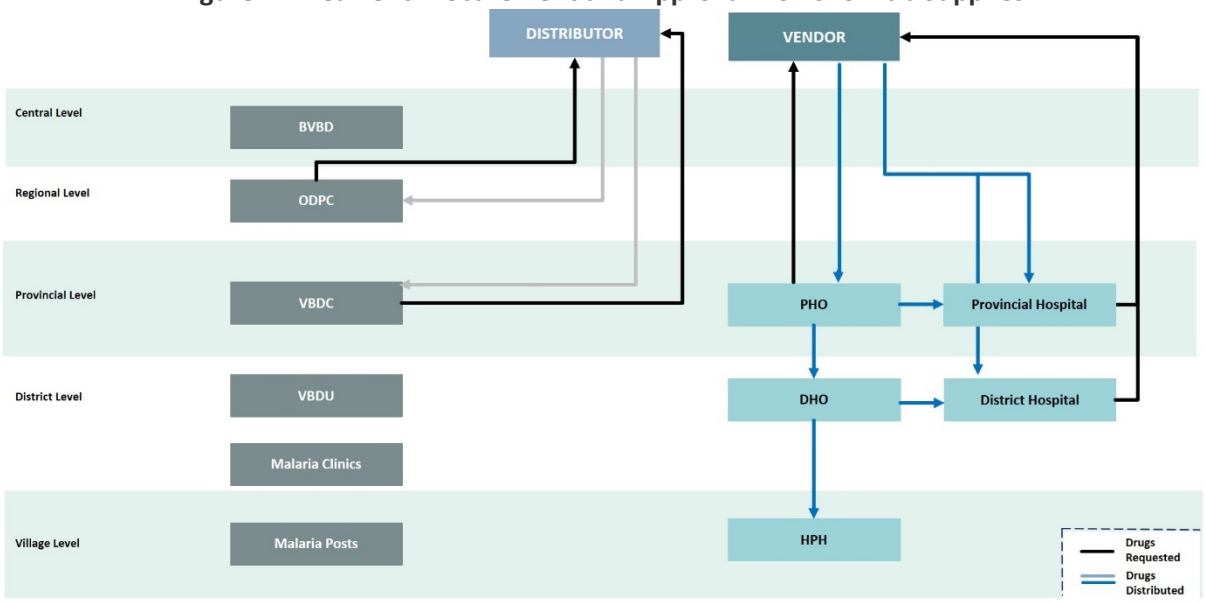


Malaria Drugs are procured multiple times per year. BVBD and DDC Procurement will directly request malaria drugs. The manufacturers distribute these drugs directly to the BVBD and ODPC warehouses. The distribution of malaria drugs in the vertical program follows the administrative lines. BVBD will also distribute malaria drugs to PHOs for further distribution.

If a malaria clinic needs additional drugs, they will send a written request to the VBDU, who approves and sends to VBDC. BVBD approves and sends to ODPC. ODPC approves and sends to the Procurement Officer at BVBD. The Procurement Officer checks the request against the case load and approves, adjusts or rejects the request. There is also occasion where non-government supported facilities or civil society organizations (CSOs) will reach out to VBDCs or BVBD to request additional malaria medicines. The drugs are provided on an ad hoc basis as a gap fill measure and are not included in the annual procurement planning process.

Hospitals can request drugs from the manufacturer via the VMI and GPO. The manufacturer directly distributes the drugs to the requesting hospital. If additional malaria medicines need to be requested from BVBD, DHOs and then PHOs field the written requests and send to BVBD to verify the request against case load data in the MIS and approve the request.

Figure 11 – Current Procurement and Approval Flows for Lab Supplies



Lab supplies are directly requested from vendors and distributors by ODPC, VBDC, PHOs and hospitals. Each facility will have a budget that can be used for the procurement. If additional funding is needed, the facility or office will follow financial protocols in requesting additional budget to procure lab supplies.

CURRENT LMIS GAPS

Supply Chain Information Systems

- There is no comprehensive digital platform to easily collect, review, and analyze stock data in the vertical or general health system program**.** Most stock systems are paper based or fragmented at the facility level and are difficult to access. Hospitals have their own, fragmented data systems (service, lab, warehouse), which are also difficult to access. Hospitals adopted or developed their own electronic systems for hospital management which includes management of logistics information for medical products. As a result, there is very little visibility of stock levels, distribution, or consumption at province level and below.
- Data from the general health side (506 Report) hasn't been fully integrated into MIS / Malaria Online and requires a manual upload and data de-duplication process. While commodity information is not included in the 506 Report, the case management data is needed to confirm trends and caseloads. Besides the 506 Report, no data is shared from the general health services programs with BVBD.
- MIS / Malaria Online is widely adopted and data utilized within BVBD. The process of updating the MIS is ad hoc. BVBD IT Programmers are given requests for data visualization or system updates during meetings, and prioritize based on time and level of effort. When data visualization requests have been added to Malaria Online, the data tables were added separately. As a result, the data architecture is not set up in a relational way to easily analyze and visualize new requests. The data architecture will need to be assessed before additional data can be added to the system (e.g., supply chain data).

Data Elements

- Currently no system captures malaria data from private, university or military hospitals. Only public hospitals provide information to BOE. MOPH-IT is developing an integration layer (HL7) to interoperate with all hospitals in Thailand over the next several years.
- Data elements are not standardized across the vertical and general health systems. Hospitals report malaria cases to BOE, but are not required to report malaria commodities' logistics information to BOE or NMCP. As a result, different data elements may be captured within each health system.
- Malaria commodities are likely not captured in hospital material management systems and only a few commodities have standard product codes in Thailand. LogHealth is currently creating a product code catalog for government approved medicines that can be utilized by the LMIS.

Forecasting, Procurement and Allocations

- Most malaria commodities are procured centrally through multiple channels; hospitals have the ability to directly procure commodities and BVBD has little visibility into the process.
- Drug and commodity allocations are not optimized. There is evidence of stock outs and drug expiry; however, little data are available about commodities below provincial level, limiting the ability to identify sources and drivers of poor performance. This also limits the ability to reallocate drugs between facilities.
- Drug distribution is based on request and validation against historical case data, not current stock levels and consumption.
- The health facility visits also flagged that there is no central standard for commodity storage, packing and distribution procedures to distribute malaria commodities to health facilities and sub-districts. For instance, poor packaging may result in direct exposure to sunlight, decreasing the quality of the commodity and making it more difficult to maintain a current stock of medicines.
- Requests for additional commodities and drugs is completed in paper form, which can delay the approval process as it moves between approvers.
- Drug stock data is not available in real-time, making the forecasting of additional drugs and commodities challenging.

Capacity Building

- Tableau is used for data visualization in Malaria Online. However, IT staff have not been fully trained on Tableau's functionalities and are not aware of the types of analysis that can be completed within the system. As a result, they may be tabling analysis that could be completed if they were trained in Tableau.

Advocacy and Communication

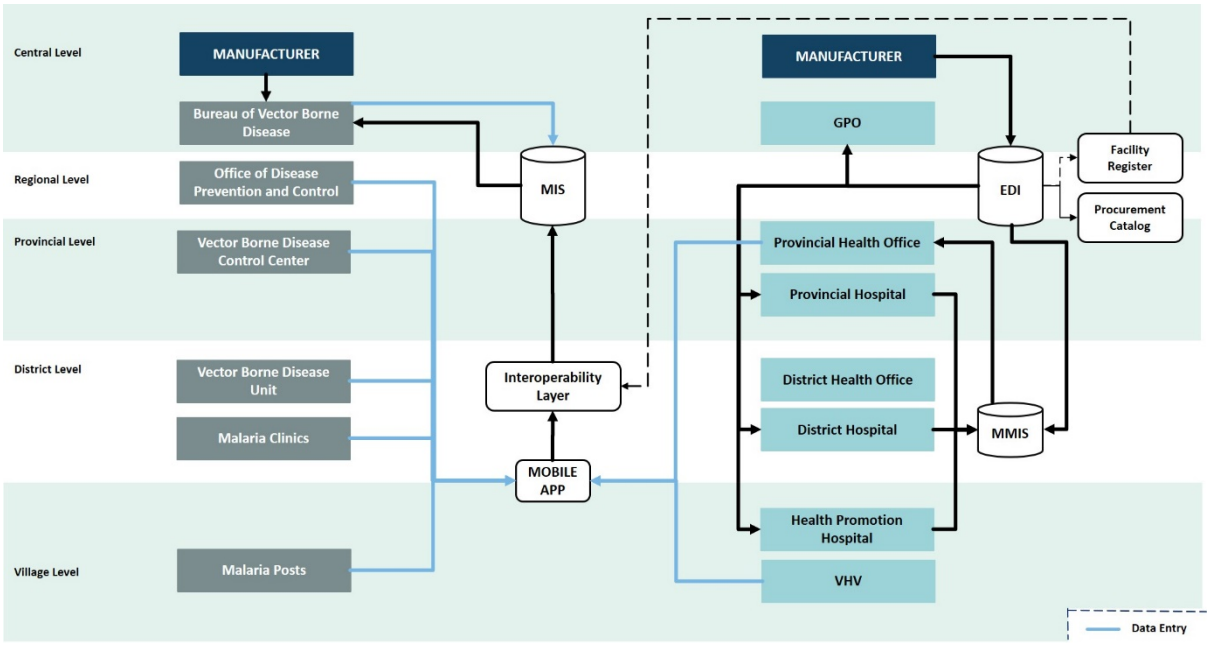
- MOPH-IT and LogHealth are working on multiple LMIS related approaches. Politics and siloed roles have not allowed BVBD to fully establish relationships with MOPH-IT and LogHealth and be a player to advocate for malaria commodities being included in national databases.

RECOMMENDATIONS TO ADDRESS GAPS

Short- and Medium-Term Recommendations

While there is no integrated digital platform to easily collect, review, and analyze stock data at facilities in Thailand, a commercial off the shelf (COTS) mobile application (app) can be adapted to fit the needs of the country in the short term. **Figure 12** shows the recommended data flow in the short term, where a mobile app would replace paper-based data collection within the vertical program. Should the structure of the vertical program change, BVBD can easily adapt the app to collect data from relevant actors within the vertical program. The general health program hospitals will continue to use their existing HIS. The inventory information will flow into the MMIS, being scaled by LogHealth. The Provincial Health Office will access the information and enter the data into the mobile app. VHVs can also directly enter LLIN/LLIHN distribution information in the app. The mobile application interacts with an interoperability layer. This interoperability layer utilizes the metadata being developed by LogHealth and MOPH-IT. By using the standardized hospital codes, product codes, etc., BVBD can ensure that the data in the MIS can be cross-walked to data in the general health services. The interoperability layer then pushes data into the MIS, where BVBD is able to access the data and dashboards as is done currently.

Figure 12 – Recommended Short Term Data Flow



The following short-term recommendations were identified to implement the proposed data flow:

1. IDENTIFY MALARIA RELEVANT METADATA FOR SYSTEM INTEGRATION

The anticipated integration of the vertical program with general health services makes it important to consider how the data for each respective program can allow for integration. Little data is currently shared between the two programs and needs to be standardized before the data can be easily related and analyzed. Standard metadata will allow the data to be standardized and shared. MOPH-IT and LogHealth are in process of developing data cross-walks and standardized codes, presenting a good opportunity for BVBD to develop and provide malaria specific information. At a minimum, the

following metadata components need to be identified for interoperability between system hierarchies:

- Malaria Terminology List
- Data Dictionary
- Pharmaceutical Codes
- Master Facility Registry
- Patient identification number

2. UPDATE MIS / MALARIA ONLINE DATA ARCHITECTURE TO INCLUDE COMMODITY DATA

Steps must be taken to ensure MIS and Malaria Online can add data tables for commodity data for warehousing, data analysis and visualization. This includes reviewing and updating the existing data architecture for Malaria Online. BVBD identified that it is difficult to do ad hoc data analysis of the data as there does not appear to be a linking key between the various data tables in the system. Before adding additional data tables to the MIS, the data architecture should be updated in a way that allows for linking between tables and easier inclusion of new data sets. If not addressed, data analysis of may not fully address user needs. The following steps should be addressed:

- Review and update the existing data architecture to include a linking table and ensure the architecture provides a foundation that can be further built upon
- Create space in the MIS for commodity data and develop data tables for commodity data and any other data elements that will be included in the new data set
- Ensure the metadata identified in Recommendation 1 is implemented in the database

3. ESTABLISH STANDARD TIMEFRAME FOR MIS / MALARIA ONLINE UPDATES

A more formal requirements gathering and prioritization process should be put into place for MIS and Malaria Online. The current ad hoc process is reactive and inefficient, making it difficult to develop the system towards within a strategic approach. Requirements are received on a rolling basis during meetings, and prioritization is based on level of effort and time instead of MIS scope. By switching to design sprints, BVBD-IT can formalize when requirements are received, how they are prioritized and focus on addressing the sprints before focusing on additional requirements. A more strategic prioritization of requirements will also protect the foundational data architecture as changes in MIS will be more deliberate.

4. BUILD CAPACITY OF BVBD-IT STAFF IN TABLEAU

The data visualizations in Malaria Online are built in Tableau. However, Tableau's functionality is not utilized to its fullest extent as BVBD-IT staff only have basic training in the software. With additional training, the staff will be able to fully leverage Tableau, improve their ability to provide ad hoc analysis and expand the business intelligence functionality of MIS.

5. HOST THE MIS ON THE DDC-IT SERVER

Malaria Online is located on a local server with BVBD. The server has a lag time and there are times when Malaria Online isn't quickly available. DDC-IT has a newer, cloud-based server that is available to migrate the MIS to the new server. Migrating Malaria Online to the DDC-IT server would improve the time it takes for Malaria Online to download. If DDC-IT maintains the server, it will provide additional time for the BVBD-IT staff to focus their efforts on the MIS.

6. AUTOMATE ROUTINE PROCESSES THAT SUPPORT DECISIONS

Forecasting and quantification are currently manual processes that can be automated within a new system. Additionally, approvals (e.g., allocation plans, drug requests) are completed by sending paper requests between offices and can be incorporated as a work flow into a new system. Before implementing a new system, BVBD should explore what data elements will be needed to automate routine processes within the solution.

7. CONDUCT A USER-CENTERED DESIGN WORKSHOP

Before establishing the LMIS platform, BVBD should hold a user-centered design workshop to focus on the types of data products (dashboards, reports, key figures, etc.) users would like to see in Malaria Online. Users from different levels of the health system and across different roles should be represented. Based on the dashboard requirements, BVBD can drill down into data elements that should be included during data collection.

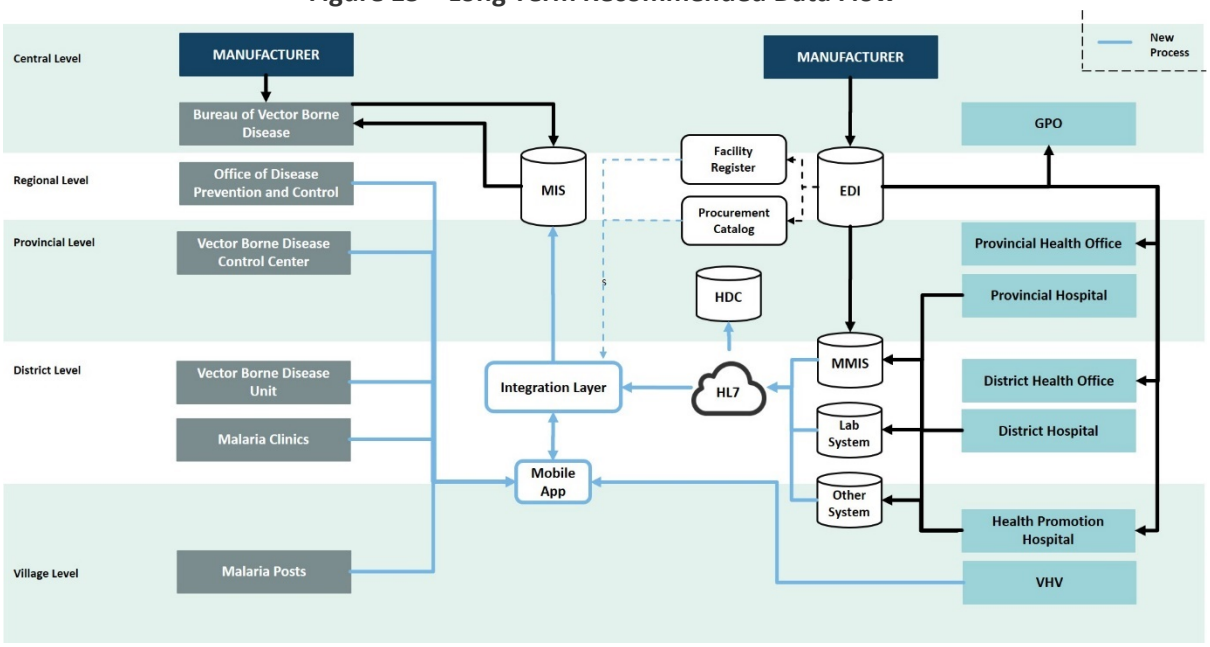
8. ESTABLISH LMIS PLATFORM AND SCALE UP

As a medium-term recommendation, BVBD should select and adapt a COTS mobile application software to collect malaria commodity data, as set forth in **Figure 12**. With the pending integration of the vertical program with the general health services, the COTS should be lightweight and not require a heavy investment in infrastructure (e.g., cell phones, additional servers, etc.) to allow for easier integration at a later time. Solution options are laid out in the forthcoming *Roadmap Document* and additional detail for the roll-out of a platform is included in the action plan. Business requirements gathered to date are listed in the *Summary of User Define Require*ments section. Once the platform is established, BVBD should test the application in two provinces for one month. Afterwards, the testers can provide feedback and additional adjustments made before scaling nationwide.

Long-Term Recommendations

The long-term recommendations further build on the successful implementation of the short- and medium-term recommendations. **Figure 13** demonstrates the long-term vision for a nation-wide LMIS.

Figure 13 – Long Term Recommended Data Flow



The vertical program will use the mobile application at all levels for data entry. The data will be pushed

through an integration layer and into the MIS for real time data analysis. Facilities in the general health services will enter data into their respective HISs. The HIS will push data into the HL7 integration layer and from there into the MIS integration layer and the HDC. The MIS integration layer will include standardized codes and data cross-walks necessary to feed into the data hierarchy in the MIS. The data will be pushed into the MIS where it will be available for data analysis.

Specific long-term recommendations include:

1. ADVOCATE FOR INCLUSION OF MALARIA DATA IN HDC

It would be beneficial for BVBD to develop direct communication lines and fully established relationships with the MOPH-IT and LogHealth to advocate for the inclusion of malaria data in national databases. The MMIS and EDI only report on medicines that are approved by the Thailand Federal and Drug Administration (FDA) or that are in the procurement catalogs. Additionally, many malaria related indicators are not included in the HDC or hospital HISs. With MOPH-IT developing the One Health Database, this presents a good opportunity for BVBD to advocate with the MOPH-IT and LogHealth for malaria related data and indicators to be included in the MMIS, EDI and HL7. If not included, some important malaria data may not be captured in hospitals.

2. ESTABLISH A DIRECT CONNECTION BETWEEN THE HDC AND MIS THROUGH AN INTEGRATION LAYER

The main difference between the short- and long-term recommended data flows is that the long-term data flow establishes a direct connection between the HDC and MIS. General health service data will go through the HL7 integration layer and be pushed into the MIS integration layer. Once the connection is established, the MIS and vertical NMCP will have visibility into the general health service data for malaria. Since HL7 will also include data from non-public hospitals, universities, CSOs, etc., the data captured should provide a full picture of malaria in Thailand. LogHealth is also researching the ability to pull in financial information from manufacturers, vendors and the Ministry of Finance (MOF) to allow for analysis of budget data as well. Building on Recommendation 1, BVBD should develop relationships with key stakeholders within the MOPH-IT and LogHealth.

CONCLUSION

This Landscape Analysis found that there is no integrated digital platform to collect, review and analyze stock data in Thailand. Hospitals have their own, fragmented data systems where they collect stock information. The vertical program does not have a digital LMIS and maintains stock information in Excel. Additionally, the vertical and general health systems do not collect similar data elements across their various systems. IT-MOPH and LogHealth are trying to address this in the general health system by moving to interoperability with hospitals systems through the HL7 layer. BVBD should identify relevant metadata that can be included in MOPH managed systems and advocate for the inclusion of malaria data and indicators in the HL7 layer. In the short term, a COTS mobile app can be adapted and integrated with the MIS to provide a digital platform to collect malaria commodity data for the vertical program. Once the HL7 layer is developed in the general health service, BVBD can coordinate with MOPH-IT to create an interoperability layer to push HL7 data to the MIS, creating a nationwide LMIS.

This document is a companion document to the LMIS Roadmap where analysis of mobile apps and additional recommendations for LMIS adaption are articulated.