

Understanding Challenges in HIV and Malaria Supply Chains in Lao People's
Democratic Republic

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Thesis submitted in partial fulfillment of
the requirements for the degree of Master of Science
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ABSTRACT

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Abstract

Lao People's Democratic Republic (Laos) faces a unique set of supply chain challenges for HIV and malaria control. Although the HIV and malaria prevalence rates are relatively low, the country has struggled to maintain an adequate supply of HIV and malaria commodities throughout the country, resulting in delays or stock outs of key commodities for both diseases. Supply chains in developing countries are often strained and weak, but creating sustainable procurement and supply chain management (PSM) processes is vital to the overall success of a country's health system. Poor PSM practices are reflective of and reinforced by a weak health system, and Laos, like other low-income countries, is confronting many PSM challenges. The Global Fund to Fight AIDS, Tuberculosis, and Malaria heavily supports both the HIV and malaria programs in Laos and is now placing increased emphasis on improving PSM processes in grant recipient countries. Research on supply chains in developing countries is scarce and in-depth, country-level analysis of challenges and barriers to successful PSM is essential to improving the long-term sustainability of health systems. The aim of this research is to improve supply chain management for HIV and malaria control programs. The specific objectives are:

1. To identify barriers and bottlenecks through a situation analysis of Laos' supply chains for national HIV/AIDS and malaria control programs.
2. To analyze factors affecting HIV/AIDS and malaria supply chains in Laos.

3. To suggest policy recommendations for the WHO, the Global Fund to Fight AIDS, Tuberculosis and Malaria, the Lao Ministry of Health, and other institutional or organizational stakeholders for improved supply chain management and function.

Qualitative research was conducted in Vientiane Capital and Savannakhet Province in May-July 2012 and included 41 key-informant interviews, document review, and informal observations. Data collection and analysis were primarily guided by the USAID|DELIVER integrated supply chains framework, as well as WHO frameworks on health information.

The research findings show four main thematic areas of barriers to successful PSM activities in Laos: data collection and reporting of PSM information, management and leadership of PSM activities, procurement processes, and human resources and capacity with the PSM system. Based on these findings, policy recommendations have been drawn for Laos' Ministry of Health and other key stakeholders to address these issues and challenges.

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List of Acronyms

ACT	Artemisinin-combination therapies
ART	Antiretroviral Therapy
CHAS	Center for HIV, AIDS, and STIs
CMPE	Center for Malariaology, Parasitology, and Entomology
GDP	Gross domestic product
GMR	Greater Mekong Region
HIV	Human immunodeficiency virus
HMIS	Health Management Information System
JICA	Japan International Cooperation Agency
LFA	Local Fund Agent
LMIS	Logistics Management Information System
M&E	Monitoring and evaluation
MoH	Ministry of Health
MPSC	Medical Product Supply Center
MSM	Men who have sex with men
NGO	Non-governmental organization
PR	Principal Recipient Office
PSM	Procurement and supply chain management
RDT	Rapid diagnostic test
SR	Sub-Recipient Office
UN	United Nations
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
VCT	Voluntary counseling and testing
VHV	Village Health Volunteer
VPP	Voluntary Pooled Procurement
WHO	World Health Organization

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1. Introduction

Despite their essential role, public health supply chains in developing countries are an under-researched and often under-prioritized component of all health programs. While gaining some recognition in this respect, a significant gap exists in academic and specialist literature on the topic.¹⁻⁵ Overall, successful program implementation is dependent on a reliable, consistent supply of health commodities, especially in commodity-heavy interventions for HIV, tuberculosis, and malaria. Public health supply chains are closely related to the World Health Organization's (WHO) key building blocks for health systems strengthening, particularly in terms of increasing access to health services and commodities.⁶ The genesis of this research began when WHO country office in Vientiane, Lao People's Democratic Republic (Laos) identified public health supply chains as a serious public health concern. This concern derived from two ongoing events in 2012: a national HIV test kit stock-out, and a three-fold increase in malaria rates from 2011. Both events are tied directly to failures in procurement and supply chain management (PSM), and both present tangible evidence that poor supply chain management contributes significantly to an overall weak health system and poor health outcomes.

This introductory chapter provides context, methodology, key findings, and suggestions. The Global Fund to Fight AIDS, Tuberculosis, and Malaria (Global Fund) provides extensive support to Laos' HIV, malaria, and tuberculosis programs and

understanding its role in PSM processes in Laos' health programming ecosystem in vital. This research did not set out to evaluate the role of the Global Fund in Laos, but many of the findings are linked directly to Global Fund processes. Mounier-Jack et al.'s 2010 critical review of the Global Fund's role in overall health systems strengthening in Laos begins to look at the larger systemic issues of the Global Fund's influence on the country's health system, but does not explicitly evaluate the Global Fund's role in PSM activities.⁷ Their findings complement the 2011 High-Level Independent Review Panel's report on fiduciary controls and oversight mechanisms of the Global Fund.⁸ The High-Level Independent Review Panel's report investigates all elements of the Global Fund's operations and mechanisms, but does not go into depth about challenges faced in specific countries. While both sources touch on issues relevant to PSM activities in Laos, neither look at how enhancing PSM capabilities can strengthen the overall health system. This research is at the intersection of these two works and strives to reduce the literature gap about public health supply chains in developing countries.

The results of this research are presented in two manuscripts, each of which will be submitted for publication to peer-reviewed or subject specialty journals. The first manuscript, "An Analysis of HIV and Malaria Procurement and Supply Chain Management Challenges in Lao People's Democratic Republic," examines systemic and management challenges within the Ministry of Health's HIV and malaria programs. The second manuscript, "Data Management and Supply Chain Barriers in HIV and Malaria

Programs in Lao People's Democratic Republic," focuses on data management challenges within Laos' HIV and malaria supply chains. These two manuscripts are presented in full as part of this thesis.

1.1 Background

Laos is a small, landlocked country in Southeast Asia that shares borders with Thailand, Myanmar (Burma), China, Vietnam, and Cambodia. These six countries comprise the Greater Mekong Region (GMR). Laos' population is estimated at 6.2 million, with 32% of the population living in urban areas; however, the number of people living in rural areas has decreased from 72.9% to 66.8% between 2005 and 2010.^{9,10} Although Laos is a low-income country, the gross domestic product (GDP) has been growing steadily at around 8% over the last five years, and the government has allowed vast swaths of the country to be developed in efforts to achieve its ambitious goal of graduating from Least Developed Country status by 2020. In recent years, Laos has exploited its natural resources to provide the GMR with resources and electricity, which results in direct foreign investments that fuel high growth rates and the promise of economic opportunity for the Laotian population.¹¹

Laos' healthcare programs are dominated by the public health system implemented by the Ministry of Health (MoH), which has four administrative levels: national, provincial, district, and health center. A Village Health Volunteer (VHV) program is loosely integrated into formalized MoH activities.⁹ All hospital staff are MoH

employees and health centers are mainly staffed by volunteers hoping to get on the government payroll. VHVs are supposed to be involved in outreach programs for multiple health areas, including malaria, antenatal and postnatal care, and community monitoring, but not for HIV.¹² In 2009, the average total health expenditure in Laos was 4.1% of the GDP, equivalent to US\$36 per capita. That same year, the general government expenditure on health accounted for 19.4% of the total expenditure on health, or just 0.8% of GDP, a very low level of public expenditure on health. Funding for health from external donors comprised 16% of the total health expenditure in 2008.⁹

1.1.1 Global Fund Operational Structure

The Global Fund operational structure is complex and the Lao MoH has struggled at times to meet grant requirements and work in effective partnership. The Global Fund operates from Geneva, Switzerland, where a country portfolio manager oversees the larger grant and country-level decisions and funding pertaining to a country's programs. The Global Fund issues grants to a country-level Principal Recipient (PR) office, and the PR office is responsible for overseeing the day-to-day activities and decisions related to all Global Fund supported programs. The PR in Laos is the MoH, and the MoH has established a team of people who work exclusively on managing Global Fund projects. The PR office in Laos outsources program implementation to Sub-Recipients (SRs) who facilitate the HIV, malaria, and TB programs. CHAS and CMPE (among others) act as SRs and report to the PR office. Laos,

as well as other Global Fund-supported countries, has two bodies that help guide programmatic decisions and grant proposals. The Country Coordinating Mechanism is supposed to be representative of all parties involved with Global Fund projects in Laos and includes a wide range of representatives from the government, charitable groups, the private sector, donors, UN agencies, and affected populations. The Country Coordinating Mechanism submits grant proposals to the Global Fund and a smaller, more nimble Oversight Committee is supposed to follow the implementation of the grant and troubleshoot problems as they arise. After grants are submitted to the Global Fund, the Technical Review Panel, a team of independent experts, assesses grants based on technical merit and makes suggestions to the Global Fund Board of Directors, who then decide whether or not to fund country proposals.⁸

The Global Fund compensates for the distance between Geneva and recipient countries by establishing a Local Fund Agent (LFA), which serves as an auditing body and fiduciary agent that ensures performance and funding allocation align with a country's proposed program plan. The Swiss Tropical and Public Health Institute is the LFA in Laos and has an office in Vientiane, in addition to working as the LFA for other countries in the GMR. The LFA does not, however, act on behalf of the Global Fund, nor can it offer any direct assistance to countries during the proposal, implementation, or follow-up processes. The Global Fund created a Voluntary Pooled Procurement (VPP) mechanism in 2007 that provides procurement services for grant recipient countries that

have low procurement volumes or limited PSM capacity. VPP is a bulk-purchasing scheme that pools countries' procurement requests to get lower prices from suppliers and manufacturers. VPP is designed to:

- Increase the speed and delivery of health commodities to countries
- Ensure the supply availability and reliability of these products
- Ensure that procured products are of assured quality
- Secure attractive prices for essential health products
- Help strength local procurement and supply management capacity

Laos was required to enter VPP in 2009 after failing to execute PSM activities successfully.¹³⁻¹⁵ See Figure 1 for a visual representation of the Global Fund structure.

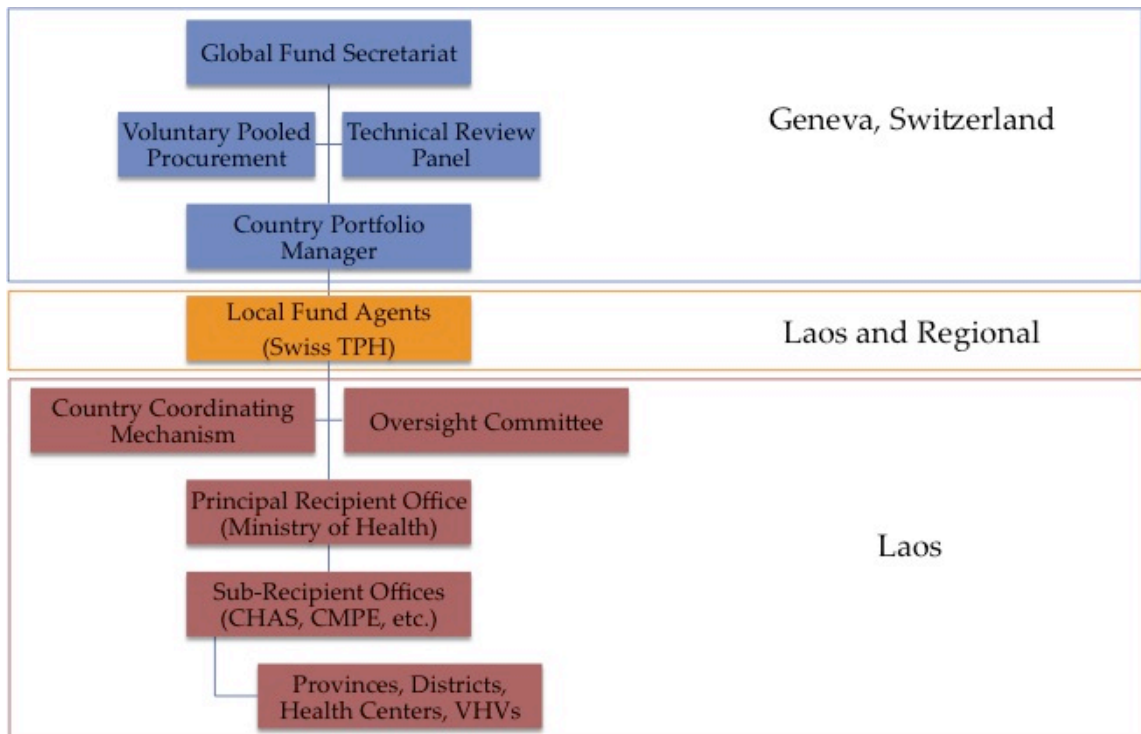


Figure 1: The Global Fund operational structure in Laos

1.1.2 The Global Fund in Laos

The Global Fund has heavily supported HIV, malaria, and tuberculosis programs in Laos since 2003, and has played an important role in the scale up of prevention and treatment activities. Laos has a low HIV prevalence (0.3% of 15-49 year olds), which is driven primarily by the most at-risk populations of female sex workers, men who have sex with men (MSM), and injectable drug users.¹⁶ The national HIV program is administered through the MoH via the Center for HIV, AIDS, and STIs (CHAS), and remains vertical and weakly integrated into the general health system.⁷ The malaria program is administered through the Center for Malariology, Parasitology and Entomology (CMPE) and the disease continues to represent a significant public health

problem in Laos, though epidemiological patterns have shifted throughout the past decade. Approximately 40,000 cases were reported in 2000 and that number had decreased to 3,837 cases in 2011.¹⁷ 2012 (through May) has seen a three-fold increase in cases to 11,221, which is attributed to delays in bed net distribution and substantial land clearing activities for the Nam Kong 2 and 3 hydro-dams. The outbreak began in the southern province of Attapeu, but Savannakhet, Saravane, Sekong and Champassack provinces are also at risk due to their proximity to Attapeu and other large scale, planned development projects.^{18,19}

As in most developing countries, PSM and monitoring and evaluation (M&E) historically have not been high priorities, but the Global Fund has recently expressed concern over the lack of progress in PSM and M&E capabilities and is stressing the need to increase in-country capacity in both areas.²⁰ M&E mechanisms can enable or facilitate improved PSM activities, and also help identify weaknesses in overall health programing. Global Fund financing and grant requirements guide all levels of the public health system and influence the PSM goals and objectives for the HIV and malaria programs. To date, the Global Fund has approved US\$41.8M (US\$29.3M dispersed) for HIV and US\$54.1M (US\$46.2M dispersed) for malaria. HIV received funding in Global Fund rounds 1, 4, 6, and 8, as well as a separate funding stream for health systems strengthening, and malaria received funding in Global Fund rounds 1, 4, 6, and 7.²¹ Mounier-Jack et al. state that the wider effects of the Global Fund on the Lao

health system are evidenced by improved access to services at lower levels of care, improved equity, and greater affordability.⁷

1.1.3 Supply Chains in Developing Countries

Supply chains in developing countries are often strained and weak. Because a supply chain consists of separate, yet interdependent, entities, creating coordinated and sustainable PSM processes is vital to the overall success of a country's health system.²²⁻²⁴ Health systems sustainability is a serious challenge in many low-income countries, particularly where donor aid is the primary source of funding for health programs. Creating systems that allow in-country MoH units to take over PSM activities as donor aid is phased out is necessary for long-term sustainability.^{7,23,25} Global sourcing of commodities causes extended lead times and the potential for delays in procurement; however, life-saving commodities must reach those who need them in order to meet national health targets.^{4,26} Any movement of products, services, information, and money between any tier can be considered supply chain activity, and a complication in one area of the supply chain can disrupt activity at all levels.^{4,27} Opportunities for conflict between tiers of the supply chain are common, particularly in social service settings.¹ PSM activities are highly complex and well-functioning supply chains require that each link of the chain be synchronized with and supportive of the operation of the chain as a whole.²⁸ Supply chains should be fully integrated into health programming to ensure the most effective means of delivering commodities to patients.^{4,28}

According to the USAID|DELIVER Project (DELIVER), integrated supply chains share common characteristics including clarity of roles and responsibilities, agility, streamlined processes, visibility of information, trust and collaboration, and alignment of objectives.^{29,30} Figure 2 is based on DELIVER's logistics cycle, but is updated to reflect PSM activities in Laos.²⁰ The cycle visualizes the four main areas of logistics and PSM activities including serving customers (patients), product selection, quantification and forecasting, and inventory management, storage and distribution. These four areas must function interdependently in order to maximize efficiency, and if one area of the cycle is performing weakly, all other areas are also affected. Larger systemic functions including system organization, staffing, budgets, supervision, M&E, and quality monitoring influence the cycle. While the entire PSM cycle is data-driven, product selection and quantification and forecasting are particularly sensitive to accurate data collection and analysis.

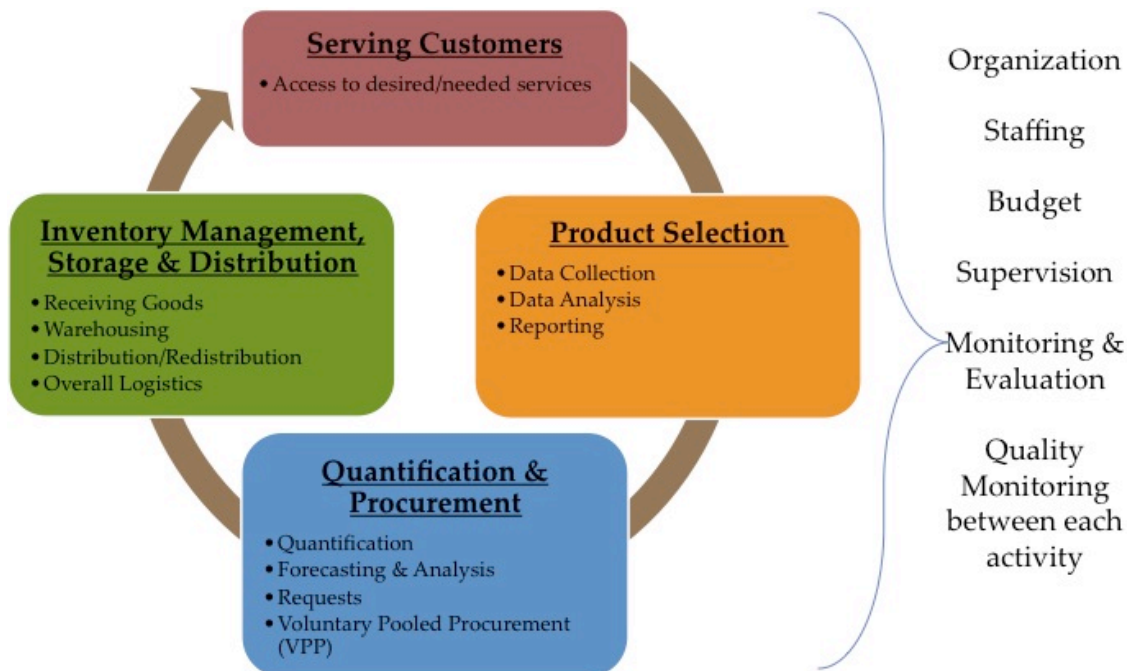


Figure 2: The procurement and logistics cycle (based on USAID | DELIVER Project, but adapted for the Laotian country context). The four main points of the cycle are all interconnected, and larger management and systemic issue influence overall functionality.

1.1.4 Health Management Information Systems

Implementing a Health Management Information System (HMIS) can help countries integrate data collection, reporting, and data use to improve health service effectiveness and efficiency through better management of health services at all levels.³¹ Krishnan et al. found that a computerized HMIS system in rural India improved program effectiveness, efficiency, and saved resources, all while reducing time spent by healthcare workers in record keeping and report generation.³² The literature explicitly states that poor data management can have serious repercussions for health programs, and increased access to accurate data through a HMIS can benefit PSM activities by

improving quantification and forecasting estimates and reducing errors or stock-outs. In addition, improved access to data can reduce costs, delays, bottlenecks, and time spent by health workers, as well as streamline logistics operations, limiting the need for expansive buffer stocks. Improving PSM functionality ultimately improves patient care and health outcomes.^{2,5,23,26,28,33-42}

The Lao MoH recognizes the importance and value of an integrated HMIS and has designed a National Information System Strategic Plan for 2009-2015, with the support of the WHO country office. This plan aims to unite health departments and national programs in Laos in an effort to increase evidence-based decision-making, planning, and M&E, all of which will result in better health for the population. While this plan is not specific to public health supply chains, it does include plans for both population-based and facility-based information, the latter of which is directly pertinent to PSM activities. The plan revolves around five goals for Laos, of which three are directly relevant to PSM: rationalize and integrate, where appropriate, all stakeholders' and programs' data and information on mortality, morbidity, disability, social determinants and health systems, into one national health information system; revitalize and strengthen current data management to develop one unified national HIS data base; to develop and implement population and institution based data sources, especially the vital registration system, and improve health and disease recording.³⁵

1.1.5 Data Management in Public Health Supply Chains

Access to timely and reliable health data is critical for ensuring patients have access to health commodities that they both want and need. Supply chains and logistics management rely heavily on facility and patient data, and an absence of quality data has direct negative impacts on the overall health system and health outcomes. However, developing effective data management systems in resource-poor countries has proven challenging, particularly in vertical health systems that have multiple fragmented funding streams for specific diseases.⁴³ Lack of access to data for forecasting, supply planning, and delivery of health commodities has been cited as a key impediment to countries' ability to support health programs and meet targets.⁴⁴ Developing countries often struggle to effectively manage health data, including an absence of data, unreliable data, poor data analysis, and linking data between and across programs. Braa, Heywood, and Sahay found that data use and data quality are interrelated in developing countries, whereby poor quality data will not be used, and because they are not used, the data will remain of poor quality.⁴⁵ This is this case in Laos, where the country has experienced difficulties with a successful uptake of a data management system and ensuring access to consistent, timely data.^{4,15,23,28,46} A lack of dependable evidence and analytic methods for identifying program options makes priority setting and planning in developing countries challenging and uncertain.^{47,48}

1.1.6 HIV and Malaria Data Collection in Laos

All levels of the health system contribute data to PSM activities. Laos' HIV and malaria programs are structured differently, and therefore capture and handle data differently. CHAS currently uses two software systems to track the HIV epidemic in Laos. HIVcam is a facility-based software used for antiretroviral therapy (ART) case management and the national M&E software, MERS, is used to track prevention activities. MERS does not incorporate traditional M&E indicators, but rather looks at the broad strokes of prevention and outreach operations across the country. Both HIVcam and MERS operate in parallel and are not automatically synchronized to reflect current HIV trends.⁴⁹ Primary data is collected and compiled via a paper reporting system at community-based service providers such as voluntary counseling and testing (VCT) sites, drop-in centers for sex workers and men who have sex with men, and district hospitals. These data, together with reports from ART sites, are compiled with provincial-level data and reported to CHAS. In all, there are 149 sites throughout the country that are supposed to report monthly on HIV indicators (see Figure 3 for reporting structure and Table 1 for reporting sites).

The Malaria Information System is based on passive case detection data, much of which is identified at the village and health center levels. The first level of malaria surveillance is the VHVs who are required to report the number of confirmed *P. falciparum* malaria cases (alongside other indicators) each month to the health center or

district malaria office in their area. A health center aggregates data from all villages in its catchment area by sex and age-group and reports this information to their district malaria office. The district malaria office is responsible for summarizing the data from all health centers (including village data) in the district as well as collecting data from district hospitals. This synthesis happens again at the provincial level and is reported to the national program overseen by CMPE, whose role is to validate and collect data from provincial, military, and police malaria sites.⁵⁰ In all, there are 6,064 malaria sites in Laos, all of which are supposed to report monthly on malaria indicators (see Figure 4 for reporting structure and Table 2 for reporting sites). As with HIV, most malaria sites collect and report data via a paper reporting system.

Monda, Keipeer, and Were cite that the quality of a system's data is directly proportional to the length of time workers spend on the database, and Laos' malaria data is particularly susceptible to bottlenecks in data collection and analysis because of the emphasis placed on village and health center-level data.⁵¹ VHVs are community members trained as lay health workers who provide primary healthcare services including diagnosis and management of basic diseases (respiratory diseases, diarrhea, and uncomplicated malaria); they also participate in health education activities, assist in vaccination and insecticide treated bed net campaigns, and report morbidity and mortality data to health centers or district offices.^{50,52} The village committee and villagers determine VHV selection in consultation with the Community and District Health

Offices. While there are pre-determined criteria for VHV selection, the criteria often cannot be met. Literacy is a major barrier for recruiting VHVs, and often selected VHVs will be one of a few community members who can read and write. VHVs are not paid employees; rather, their incentives for working are an exemption from medical expenses and an irregular allowance paid by vertical programs (usually donor-supported) when they attend a training or help conduct an outreach activity.⁵²

VHVs were integrated into malaria care seven years ago and play a pivotal role in malaria control through data collection, monthly reporting, education, diagnosis and treatment, and distribution and retreatment of insecticide treated bed nets. VHVs are given one week of training and supplied with rapid diagnostic tests (RDTs) and treatment through CMPE's distribution channels, although most VHVs receive very few quantities of each. VHVs have had mixed success with diagnosing and treating malaria, and their low level of training often presents a significant challenge to effective malaria data collection. Village-level data is crucial to overall malaria PSM planning, yet VHVs do not provide reliable, timely reports or feedback.⁵⁰

Despite these barriers, high-quality data can be obtained in developing countries if practical quality assurance procedures are in place.⁵³ Braa, Heywood, and Sahay found that data-use workshops on Zanzibar Island in the United Republic of Tanzania significantly helped improve overall data management including data quality, analysis and interpretation, integration across programs, problem solving skills, teamwork, and

practical computer skills.⁴⁵ Improving these functions within PSM activities can help overall health programming, as can selecting valid PSM indicators that reflect the overall quality of the program. PSM activities require a minimum level of reliable indicators to run successful programs.^{20,54} Both CHAS and CMPE designate key data indicators based on what the Global Fund requires for reporting, and those indicators are incorporated into PSM activities and planning.

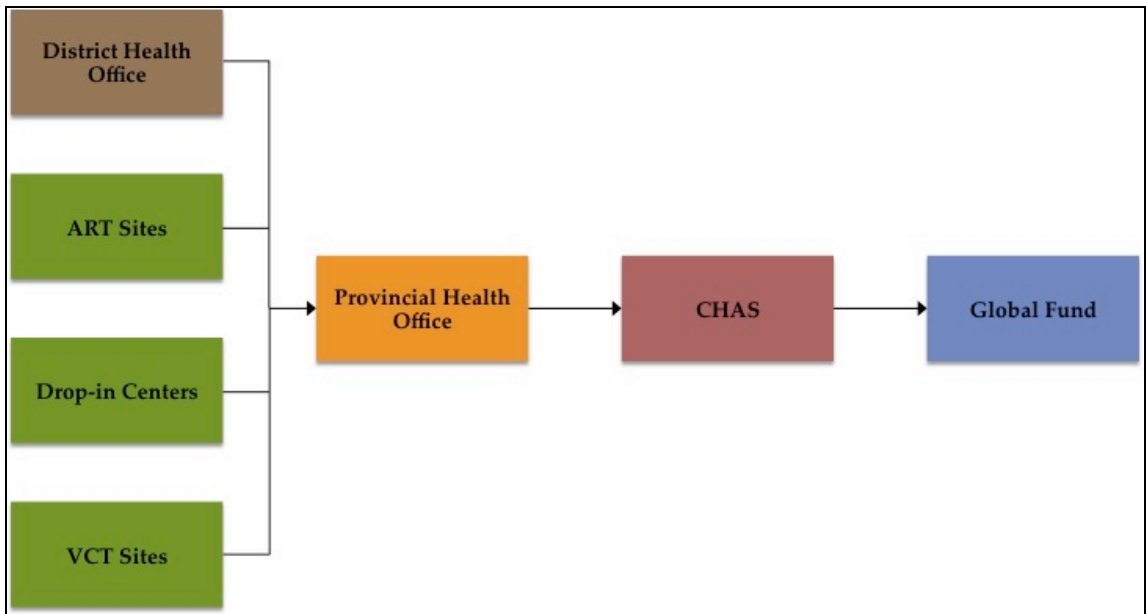


Figure 3: HIV reporting structure

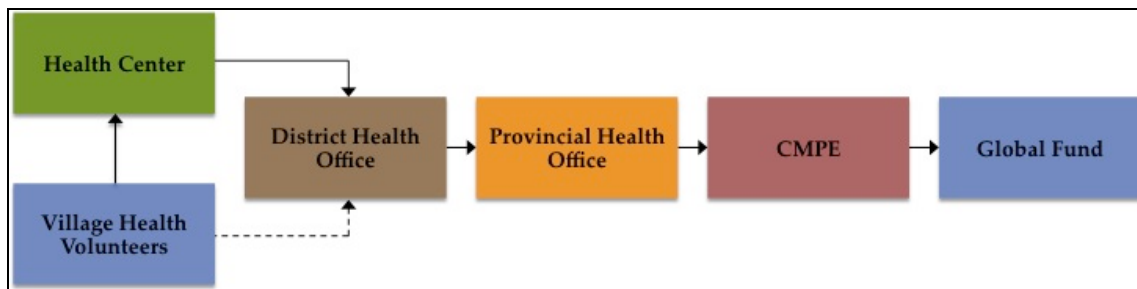


Figure 4: Malaria reporting structure

Table 1: HIV Reporting Sites

HIV Site Level	Number of Reporting Sites
Central	7
Provincial Hospitals	18
Military/Police Hospitals	19
District Hospitals	89
Drop-In/Health centers	16
Total	149

Table 2: Malaria reporting sites (Strata 3 is most at risk for malaria, Strata 1 is least at risk for malaria)

Malaria Site Level	Number of Reporting Sites
Provincial	17
District	135
Health Centers	61 (Strata 3)
	218 (Strata 2)
	415 (Strata 1)
Villages	649 (Strata 3)
	694 (Strata 2)
	3875 (Strata 1)
Total	6064

1.1.7 Research Aims and Objectives

Laos is confronting many of the same PSM challenges other low-income countries face. Poor PSM practices are reflective of and reinforced by a weak health system at all levels and include problems of governance, human resources and capacity, information flow, and data management.^{5,7,23-25} Laos also faces additional PSM challenges due specifically to its landlocked status, which negatively affects delivery times and in-country infrastructure.³³ The direct correlation between supply chain management and health is increasingly a concern among health workers, donors, and academics, yet the scarcity of information regarding the structure, functions, and performance of public health supply chains in developing countries hampers informed decision making and capacity transfer. In-depth, country-level analysis of the challenges and barriers to successful PSM in developing and low-income countries is essential to improving long-term sustainability of health systems.¹⁻⁵ For Laos, the substantial investment by the Global Fund and other donors in the country's health system, as well as the Global Fund's focus on PSM capacity and the lack of detailed understanding about the supply chain system, necessitates an in-depth country-level assessment of Laos' PSM activities.²⁴ The aim of this research is to improve supply chain management for HIV and malaria control programs. The specific objectives are:

1. To identify barriers and bottlenecks through a situation analysis of Laos' supply chains for national HIV/AIDS and malaria control programs.
2. To analyze factors affecting HIV/AIDS and malaria supply chains in Laos.

3. To suggest policy recommendations for the WHO, the Global Fund to Fight AIDS, Tuberculosis and Malaria, the Lao Ministry of Health, and other institutional or organizational stakeholders for improved supply chain management and function.

1.2 Study Design

The study design uses a combination of different qualitative data collection methods to achieve the research objectives including key-informant interviews, document review, and informal observations (see Figure 5 for study design). The methods were developed according to what would produce the highest quality data, but also taking into account what was feasible for the scope of research. This research was conducted in collaboration with the WHO country office in Vientiane Capital. Research ran from February-September 2012, with three months (May-July) spent in country.

1.2.1 Key-informant Interviews

The researcher recruited 39 participants for key-informant interviews through purposeful and snowball sampling, and chose participants for level of involvement with supply chain or procurement issues. Two participants were interviewed twice (once at the beginning and once at the end of research), yielding 41 interviews in total. Interviews were conducted in Vientiane Capital, Savannakhet Province, and Phine and Xaybouly Districts (see Table 3 for participant demographic information). Selected interviewees were contacted to gauge participation interest and were interviewed at a mutually consented location, usually their office. Interviews were conducted in English

when possible and in Lao through a WHO local staff member when necessary.

Interviews lasted between 45 and 90 minutes and all interviews were transcribed within 48 hours of completion. Informed consent was obtained from all participants prior to the interview and participants were not compensated for their time. The Duke University Institutional Review Board deemed that this research was exempt from human subjects research ethical review [Protocol #B0045; approved 16 April 2012].

1.2.2 Document Review

The literature and document review began prior to arriving in country and continued throughout the research process. Articles relevant to the research were collected via PubMed and Google Scholar, and applicable documents were collected through the WHO, donors in Laos, the Lao MoH, and the Global Fund. Examples of documents reviewed include Global Fund grant proposals and related documentation, national program plans, third-party consultant reports, health information reports, and MoH and partner guidelines.

1.2.3 Informal Observations

Informal observations complemented the in-depth interviews and were conducted primarily during procurement and supply chain-related meetings with key stakeholders in Laos. Meeting types ranged from small staff meetings with individual units to the Global Fund Country Coordination Mechanism meeting on 8 July 2012. Attending meetings provided insight as to how the national-level programs handled

PSM issues as they arose, and also how tight deadlines and requests from the Global Fund were managed.

1.2.4 Frameworks for Analysis

Because all supply chains, regardless of the level of integration, can be strengthened, DELIVER developed a supply chain management evolution framework that identifies qualities of and necessary improvements to public health supply chains in developing countries. The DELIVER framework was designed to evaluate HIV supply chains, but DELIVER has found that many supply chain interventions and solutions are not unique to HIV commodities. Therefore this framework may be extrapolated to help strengthen other public health supply chains, specifically malaria in this context.²⁰

Both the WHO and DELIVER have established guidelines for looking at data in healthcare programs in developing countries. The data management component of this research is based on these guidelines, including: the WHO's "Developing Health Management Information Systems: A Practical Guide for Developing Countries" and "Framework and Standards for Country Health Information Systems," and USAID's "The Logistics Management Information System Assessment Guidelines" and "Measuring Supply Chain Performance" Guide to Key Performance Indicators for Public Health Managers."^{31,55-57} Data was entered into Nvivo 9, then coded and analyzed for themes identified by the research team (see Table 4).

1.2.5 Research Limitations

This research was restricted to Laos, thereby limiting the scope of extrapolation beyond the Lao content. Research was conducted for nine weeks in Vientiane Capital and one week in Savannakhet Province, and ideally would have allocated equal research time to all 17 provinces. The scope of investigated health commodities was purposefully narrowed to HIV test kits and malaria commodities including RDTs, artemisinin-combination therapies (ACTs), and bed nets; however, all HIV and malaria commodities follow relatively the same supply chain and procurement processes. Ideally, qualitative data would have been supplemented with quantitative analysis of stocks on hand and warehousing capabilities. Lastly, the coordination challenges identified, particularly with outside partners, would ideally be compared across the region and among similar countries in Africa, Eastern Europe, and South America. Unfortunately conducting similar research across different countries was not feasible as part of this study.

Table 3: Participant demographic information

Region	Program Level	Number of Interviews	Interview Languages
Vientiane Capital	Global Fund	4	English: 4 Lao: 0
Vientiane Capital	Ministry of Health & National-level programs	13	English: 9 Lao: 3
Vientiane Capital	National-level partners (non-governmental)	9	English: 9 Lao: 0
Savannakhet Province (Capital)	Provincial	6	English: 1 Lao: 5
Savannakhet Province (Capital)	Provincial-level partners (non-governmental)	1	English: 0 Lao: 1
Phine District (Savannakhet Province)	District & Health Center	5	English: 0 Lao: 5
Xayboully District (Savannakhet Province)	District	3	English: 0 Lao: 3
	TOTAL	41	English: 24 Lao: 17

Table 4: Coded themes by focus area

Focus Area	Coded Theme	Number of Citations	Total Number of Citations
Data Collection and Reporting	Quantification	41	194
	Requesting	37	
	Data	36	
	Reporting	34	
	Monitoring & Evaluation	17	
	Data Analysis	13	
	Forecasting	9	
	Language Barriers	7	
Management and Leadership	Coordination	113	269
	Management	51	
	Guidelines and Strategies	33	
	Unnecessary Time	30	
	Oversight	27	
	Accountability	15	
Procurement	Procurement Processes	64	156
	Logistics	58	
	Planning	34	
Human Resources	Capacity	62	124
	Training	37	
	Lack of Understanding	18	
	Happiness with Job	7	

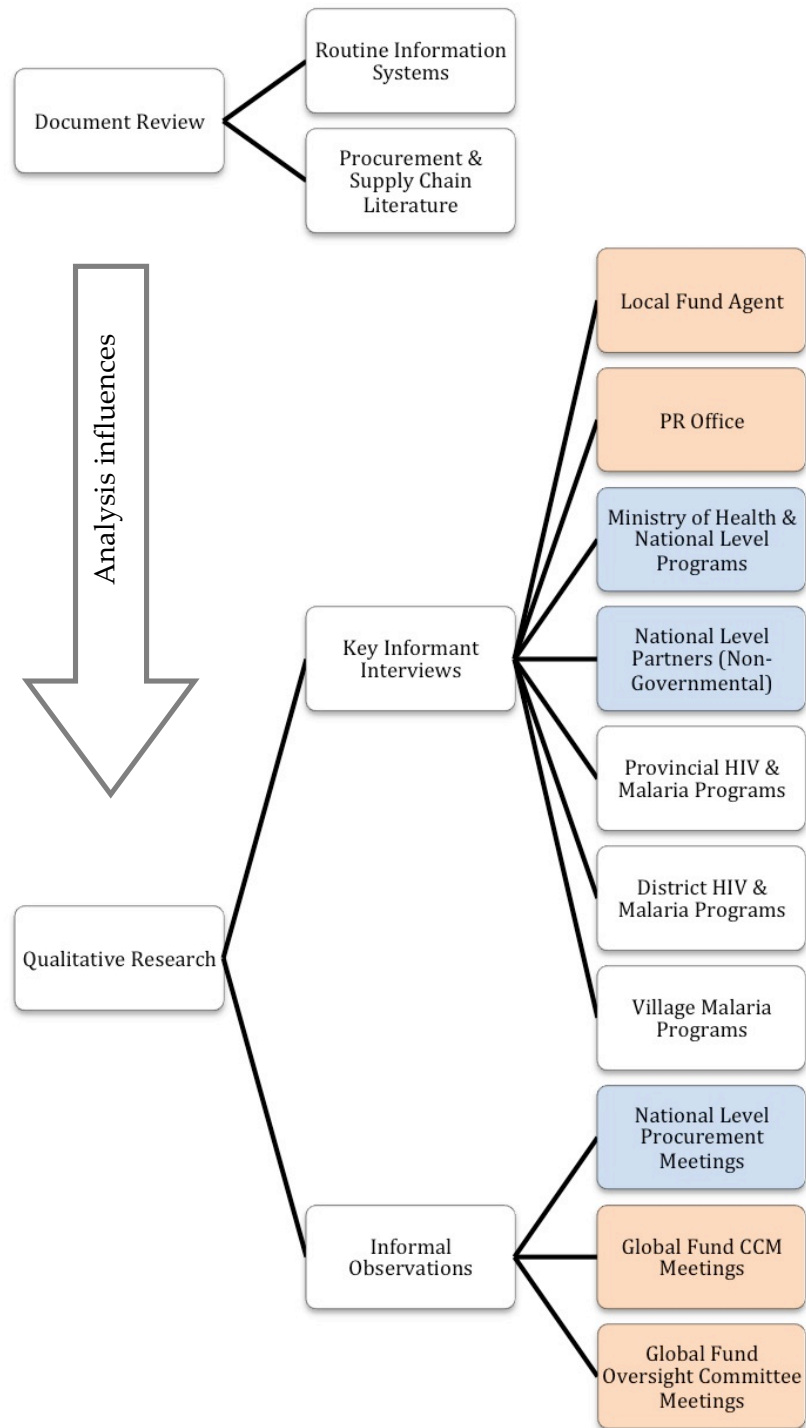


Figure 5: Study design and methodology (orange boxes indicate Global Fund level; blue boxes indicate national-level programs)

1.3 Key Findings

The data shows important trends related to Laos' overall supply chain and procurement functionality. The thematic analysis derived four thematic areas of key components for supply chain management and procurement activities: data collection and reporting of PSM information, management and leadership of PSM activities, procurement processes, and human resources and capacity within the PSM system. A brief synopsis of each area is provided in this chapter.

Coordination within the MoH and among partners is lacking, and communication breakdowns have acutely affected the health system. Information is not shared among units, departments, across the MoH or to partners, and confusion and misinformation is a direct result of poor information flow. Laos has struggled to maintain adequate data management systems, which has had a direct negative impact on the overall supply chain and healthcare system. Patients do not have access to commodities they need because people within the health system are not sharing pertinent information in a timely manner. System-wide guidelines and recommendations are not universally followed, and widely acknowledged procedures for logistics functionality and training are not in place. Perhaps most critical to overall supply chain function is the lack of a cohesive team in place to manage procurement and supply chain function. Neither HIV nor malaria has a team in place that represents interests across units and partnerships.

The long-term sustainability of the supply chain and procurement processes is directly tied to international funding and assistance, with minimal improvements having been made to bolster in-country capacity. This research suggests that successful planning and supply chain integration is rooted in the country's ability to have consistent, timely information and requires adaptability at both the national and Global Fund levels.

1.3.1 Data Collection and Reporting of PSM Information

Poor data collection and reporting are fundamental problems throughout Laos' health system. Deficiencies in the timeliness and quality of reporting at every level of the supply chain were indicative of the larger failure of effective supply chain management throughout the health system. Data collection and reporting is a major hurdle in supply chain management and procurement in Laos, but supply chains and procurement processes demand access to timely and accurate data. In addition to reporting problems, the information that is available is not analyzed at each level of the chain, which results in faulty data reported all the way to the national-level and PR offices. The PR office is then left to synthesize data, which causes undue work for the national programs and the PR office, and increases the likelihood of delayed or inaccurate reports to the LFA and Portfolio Manager. This research found that each program has developed its own data and reporting systems with limited success. Mounier-Jack et al. reported similar data challenges in their work on Laos.⁷

1.3.2 Management and Leadership of PSM Activities

This research found three main areas of management that are lacking and cause systemic weaknesses in Laos' PSM: accountability, communication, and relationship management, particularly between the Global Fund and country-level programs. The MoH has designed the HIV and malaria programs such that information and commodities flow in a top-down approach from Vientiane, thus necessitating strong leadership and clarity at the national level. In this context, it is necessary to look at management in two areas – national level management of provincial and district programs and national level management of the Global Fund.

Well-integrated supply chains demand high levels of management and coordination, as well as good governance. Good governance requires one entity of the supply chain to influence or determine the activities of the supply chain and, in Laos' case, dictate how PSM activities fit into the larger programmatic plan for health.^{58,59} Windisch et al. state that good governance is a key driver of health systems performance.²³ The current situation in Laos demonstrates how weak management and leadership can have direct negative effects on the quality of supply chain management and, ultimately, on health outcomes.

1.3.3 Procurement Processes

Successful procurement is fundamental to any health program and is a vital component to any functioning supply chain. As one participant at the national level

said, “Procurement is not just buying and using, it’s also how commodities are being used and why.” Procurement and forecasting are challenging even in well-functioning supply chain systems and are particularly vulnerable to inefficiencies in the larger health system. About 34% of Global Fund support for the second commitment (2013-2015) in Laos is dedicated to procurement, and despite nine years of Global Fund financing, the national procurement system has only improved incrementally. Alemnji et al. noted that incorporating procurement into health programs is particularly challenging in developing countries because of the financial involvement and benefits derived from supply chain management.²⁵

Procurement of health commodities is more complex than other types of goods. Many partners in Laos contribute to the HIV and malaria procurement processes, and managing the process requires strong leadership and oversight. Any commodities procured with Global Fund monies must go through the VPP mechanism, instituted through the Global Fund headquarters in Geneva. VPP is intended to lower procurement costs by pooling orders for multiple countries, but VPP is not agile enough to process emergency procurements, forcing CMPE and CHAS to find alternative procurement mechanisms in emergency situations (i.e. the HIV test kit stock-out). Another foreseeable problem with VPP is the long-term sustainability of the program. Participants expressed concerns over what will happen when Global Fund money

inevitably lessens or disappears altogether, particularly given the weak procurement capacity at the local level.

1.3.4 Human Resources and Capacity within the PSM system

Laos has a severe shortage of procurement and supply chain management professionals. Very few people at the national level are in charge of managing the HIV and malaria programs, and even fewer people at the provincial and district levels are adequate managers with supply chain experience. Multiple participants at the Global Fund and national levels cited capacity and human resources at the district and provincial levels as a problem with overall supply chain management. Countrywide capacity and training were two reoccurring themes throughout the data.

The majority of supply chain and procurement capacity to date has come from international assistance through the Global Fund, UN agencies, and other non-Laotian partners. The MoH authorized the Medical Product Supply Center (MPSC) (housed within the MoH) to manage a one-warehouse system in August 2009 in an effort to begin transitioning capacity from outside experts to the national programs. While the MPSC is decreed to manage all MoH procurement, the actual role of the MPSC is unclear and concerns were raised over the MPSC's ability to management procurement for one disease, let alone all MoH programs.

1.4 Conclusions and Recommendations

Our research found that supply chain and procurement barriers exist at all levels of the supply chain. The countrywide HIV test kit stock-out and 2012's three-fold increase in malaria cases are poignant reminders that supply chain management is vital to public health outcomes. While all participants were quick to acknowledge that problems exist, very few people are working to improve overall supply chain function. It is essential that the MoH begin actively using resources available to make changes to the current system so that capacity, and hopefully financing, can be turned over to the country.

Until recently, Laos has sufficed with a substandard supply chain system. It is now imperative that the MoH takes measurable steps to improve procurement capabilities and supply chain management for HIV and malaria. Although making improvements to the supply chain management and procurement functionality nationwide seems daunting, Laos can make tangible actions to move the country's capabilities forward. Building lasting capacity at the national level will take time, but Laos must work aggressively to utilize resources currently available to the MoH via the Global Fund and other partners to make improvements. A summary of the suggestions provided in both manuscripts is presented here.

Suggestion 1: Develop a supply chain team at the national level

Procurement, logistics, and supply chain management is a fulltime job that necessitates a dedicated team of people to oversee activities. Multiple sources suggested creating dedicated teams to manage PSM activities.^{5,26,28} While there are people employed by both CHAS and CMPE who work on these issues, they are often done in parallel with other responsibilities. This team would oversee procurement, logistics, and supply chain functions at the provincial and district levels, and would also be responsible for coordinating supply chain-related events that happen outside of VPP (i.e. emergency procurement of antibiotics for opportunistic infections in HIV patients via UNICEF). The team would be responsible for having a firm grasp of supply chain operations at all levels and would be required to synthesize and report on supply chain functions as needed. The creation of a supply chain-focused team would ultimately reduce duplication of and conflicts between activities, and would facilitate work in liaison with the MPSC to ensure timely procurement and distribution of goods. Ultimately, the PSM team should transition over to become part of the MPSC.

Suggestion 2: Strengthen capacity and focus of the MPSC

Despite being endorsed by the MoH as the proprietor of procurement and logistics for the Lao health system, the MPSC has yet to develop a well-rooted place within Laos' national programs. Having multiple supply chains creates increased risks of failure and adds additional costs for countries, so bolstering the MPSC would directly

benefit all health programs.²⁸ The role of MPSC must be clearly defined among MPSC employees, within the MoH, and to partners outside of the Ministry. The MoH and the MPSC must be explicitly clear as to what their current capabilities are and how they plan to expand those capabilities (and when).

Suggestion 3: Streamline program-specific and national guidelines

Failures in the supply chain can be linked directly to confusion over guidelines and recommendations for specific diseases within the greater health system. It is essential to have cohesive, straightforward guidelines that are easy to interpret and follow. This is particularly relevant for the lower levels of the supply chain (i.e. the District level) that are not empowered to make decisions about health policies.

Guidelines and policies must be comprehensive and offer recommendations for when exact guidelines cannot be followed. It is also recommended that a national early-warning system is established to indicate when stocks are becoming low in certain regions. An early warning system would require setting minimum thresholds for commodity quantities and enact a redistribution plan to ensure equitable use of commodities across the country.

Suggestion 4: Employ a portion of people for data management at each level

It is imperative that a portion of staff and time are allocated to the data management process at each level of the supply chain. Effective oversight of data management is essential and should be built into every level of the supply chain.⁴⁵

Implementing Braa, Heywodd, and Sahay’s model of collaboration among healthcare workers involved in data management could help bolster Laos’ overall data management system as well.⁴⁵

Suggestion 5: Revise the VHV program and transition it to a Village Health Worker

The public health system depends on VHVs, but the systemic inadequacies of the VHV program are detrimental to the overall health of the country. VHVs are very valuable for data collection, particularly for malaria, but the program has not been successful at ensuring continued access to quality data. Because VHVs are unpaid and not incentivized correctly to participate in data collection and reporting, the program must be reworked so that valuable village-level data is incorporated into health planning. The MoH should transition away from the current VHV program to a paid and compensated Village Health Worker program. Village Health Workers should be given at least six months training and taught specifically how to collect and report data. The position must be desirable and offer workers a viable alternative to their current means of employment.

Suggestion 6: In the long-term, simplify and streamline reporting forms amongst health programs

Data indicators and forms are inconsistent among Global Fund funding rounds and amongst different donors. Complicated forms and indicators are difficult for programs to capture, particularly at the health center and village levels where literacy is

a major concern. Although this would be very challenging and require coordination amongst different funding partners, the MoH should work towards streamlining forms and indicators, and making literacy adaptations to make completing reports easier. There are formidable challenges to doing this, namely that each donor organization has their own indicators that must get reported on, but it is something to move towards as Laos continues to improve its data management system.

Suggestion 7: Additional data management research is required

This research was not optimized to analyze Laos' data management challenges, so it is important to build on this research with additional studies looking specifically at how data is incorporated in the health system. Future studies would ideally look at all health programs and identify data harmonization opportunities across programs and sectors.

2. An Analysis of HIV and Malaria Procurement and Supply Chain Management Challenges in Lao People's Democratic Republic

2.1 Background

Lao People's Democratic Republic (Laos) is a small, landlocked country in Southeast Asia that shares borders with Thailand, Myanmar (Burma), China, Vietnam, and Cambodia. These six countries comprise the Greater Mekong Region (GMR). Laos' population is estimated at 6.2 million, with 32% of the population living in urban areas; however, the number of people living in rural areas has decreased from 72.9% to 66.8% between 2005 and 2010.^{9,10} Although Laos is a low-income country, the gross domestic product (GDP) has been growing steadily at around 8% over the last five years, and the government has allowed vast swaths of the country to be developed in efforts to achieve its ambitious goal of graduating from Least Developed Country status by 2020. In recent years, Laos has exploited its natural resources to provide the GMR with resources and electricity, which results in direct foreign investments that fuel high growth rates and the promise of economic opportunity for the Laotian population.¹¹

Laos' healthcare programs are dominated by the public health system implemented by the Ministry of Health (MoH), which has four administrative levels: national, provincial, district, and health center. There is also a Village Health Volunteer (VHV) program that is loosely integrated into formalized MoH activities. Outside of the central and specialized hospitals in Vientiane Capital, there are 4 regional hospitals, 16

provincial hospitals, 130 district hospitals, and 862 health centers.⁹ All hospital staff are MoH employees and health centers are mainly staffed by volunteers hoping to get on the government payroll. VHVs are supposed to be involved in outreach programs for multiple health areas, including malaria, antenatal and postnatal care, and community monitoring, but not for HIV.¹² In 2009, the average total health expenditure in Laos was 4.1% of the GDP, equivalent to US\$36 per capita. That same year, the general government expenditure on health accounted for 19.4% of the total expenditure on health, or just 0.8% of GDP, a very low level of public expenditure on health. Funding for health from external donors comprised 16% of the total health expenditure in 2008.⁹

The Global Fund to Fight AIDS, Tuberculosis, and Malaria (Global Fund) has heavily supported HIV/AIDS, malaria, and tuberculosis programs in Laos, and has played an important role in the scale up of prevention and treatment activities, although this research only looks at procurement and supply chain management (PSM) for HIV and malaria. Laos has a low HIV prevalence (0.3% of 15-49 year olds), which is driven primarily by the most at-risk populations of female sex workers, men who have sex with men (MSM), and injectable drug users.¹⁶ The national HIV program is administered through the MoH via the Center for HIV, AIDS, and STIs (CHAS), and remains vertical and weakly integrated into the general health system.⁷ The malaria program is administered through the Center for Malariology, Parasitology and Entomology (CMPE) and the disease continues to represent a significant public health problem in Laos,

though epidemiological patterns have shifted throughout the past decade.

Approximately 40,000 cases were reported in 2000 and that number had decreased to 3,837 cases in 2011.¹⁷ 2012 (through May) has seen a three-fold increase in cases to 11,221, which is attributed to delays in bed net distribution and substantial land clearing activities for the Nam Kong 2 and 3 hydro-dams. The outbreak began in the southern province of Attapeu, but Savannakhet, Saravane, Sekong and Champassack provinces are also at risk due to their proximity to Attapeu and other large scale, planned development projects.^{18,19}

As in most developing countries, PSM and monitoring and evaluation (M&E) historically have not been high priorities, but the Global Fund has recently expressed concern over the lack of progress in PSM and M&E capabilities and is stressing the need to increase in-country capacity in both areas.²⁰ M&E mechanisms can enable or facilitate improved PSM activities, and also help identify weaknesses in overall health programing. To date, the Global Fund has approved US\$41.8M (US\$29.3M dispersed) for HIV and US\$54.1M (US\$46.2M dispersed) for malaria. HIV received funding in Global Fund rounds 1, 4, 6, and 8, as well as a separate funding stream for health systems strengthening, and malaria received funding in Global Fund rounds 1, 4, 6, and 7.²¹ Mounier-Jack et al. state that the wider effects of the Global Fund on the Lao health system are evidenced by improved access to services at lower levels of care, improved equity, and greater affordability.⁷

2.2.1 Global Fund Operational Structure

The Global Fund operational structure is complex and the MoH has struggled at times to meet grant requirements and work in effective partnership. The Global Fund operates from Geneva, Switzerland, where a country portfolio manager oversees the larger grant and country-level decisions and funding pertaining to a country's programs. The Global Fund issues grants to a country-level Principal Recipient (PR) office, and the PR office is responsible for overseeing the day-to-day activities and decisions related to all Global Fund supported programs. The PR in Laos is the MoH, and the MoH has established a team of people who work exclusively on managing Global Fund projects. The PR office in Laos outsources program implementation to Sub-Recipients (SRs) who facilitate the HIV, malaria, and TB programs. CHAS and CMPE (among others) act as SRs and report to the PR office. Laos, as well as other Global Fund-supported countries, has two bodies that help guide programmatic decisions and grant proposals. The Country Coordinating Mechanism is supposed to be representative of all parties involved with Global Fund projects in Laos and includes a wide range of representatives from the government, charitable groups, the private sector, donors, UN agencies, and affected populations. The Country Coordinating Mechanism submits grant proposals to the Global Fund and a smaller, more nimble Oversight Committee is supposed to follow the implementation of the grant and troubleshoot problems as they arise. After grants are submitted to the Global Fund, the

Technical Review Panel, a team of independent experts, assesses grants based on technical merit and makes suggestions to the Global Fund Board of Directors, who then decide whether or not to fund country proposals.⁸

The Global Fund compensates for the distance between Geneva and recipient countries by establishing a Local Fund Agent (LFA), which serves as an auditing body and fiduciary agent that ensures performance and funding allocation align with a country's proposed program plan. The Swiss Tropical and Public Health Institute is the LFA in Laos and has an office in Vientiane, in addition to working as the LFA for other countries in the GMR. The LFA does not, however, act on behalf of the Global Fund, nor can it offer any direct assistance to countries during the proposal, implementation, or follow-up processes. The Global Fund created a Voluntary Pooled Procurement (VPP) mechanism in 2007 that provides procurement services for grant recipient countries that have low procurement volumes or limited PSM capacity. VPP is a bulk-purchasing scheme that pools countries' procurement requests to get lower prices from suppliers and manufacturers. VPP is designed to:

- Increase the speed and delivery of health commodities to countries
- Ensure the supply availability and reliability of these products
- Ensure that procured products are of assured quality
- Secure attractive prices for essential health products
- Help strength local procurement and supply management capacity

Laos was required to enter VPP in 2009 after failing to execute PSM activities successfully.¹³⁻¹⁵ See Figure 6 for a visual representation of the Global Fund structure.

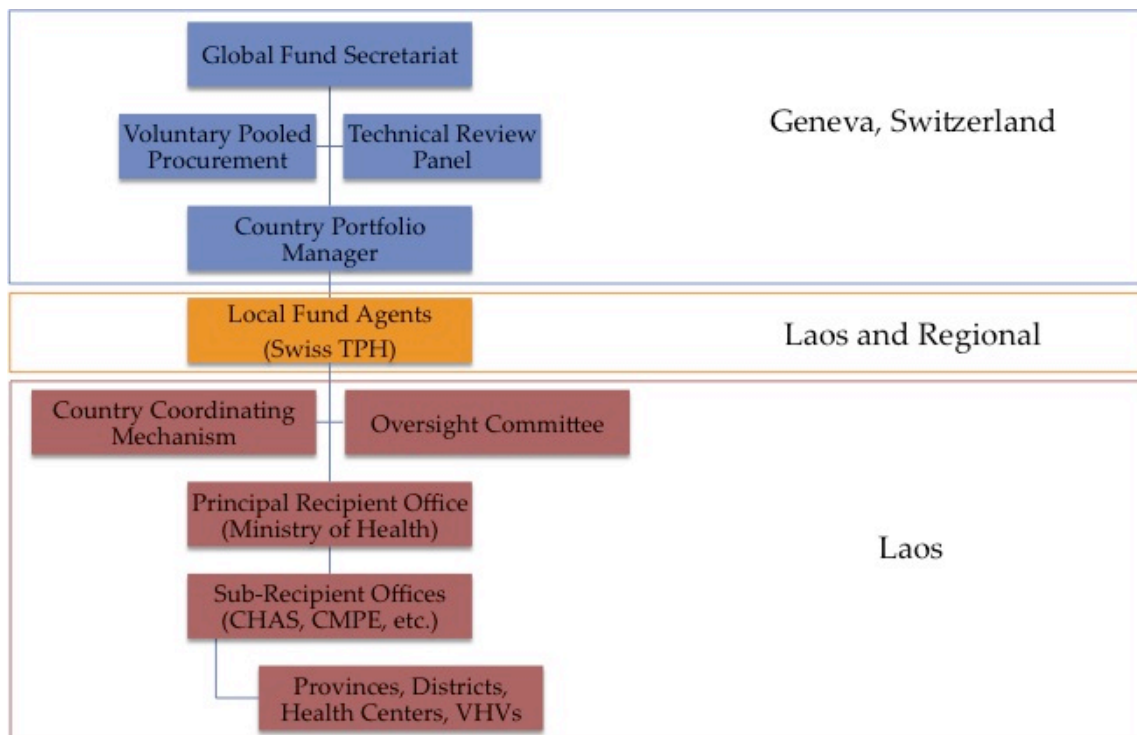


Figure 6: The Global Fund operational structure in Laos

2.1.2 Supply Chains in Developing Countries

Supply chains in developing countries are often strained and weak. Because a supply chain consists of separate, yet interdependent, entities, creating coordinated and sustainable PSM processes is vital to the overall success of a country's health system.²²⁻²⁴

Health systems sustainability is a serious challenge in many low-income countries, particularly where donor aid is the primary source of funding for health programs.

Creating systems that allow in-country MoH units to take over PSM activities as donor

aid is phased out is necessary for long-term sustainability.^{7,23,25} Global sourcing of commodities causes extended lead times and the potential for delays in procurement; however, life-saving commodities must reach those who need them in order to meet national health targets.^{4,26} Any movement of products, services, information, and money between any tier can be considered supply chain activity, and a complication in one area of the supply chain can disrupt activity at all levels.^{4,27} Opportunities for conflict between tiers of the supply chain are common, particularly in social service settings.¹ PSM activities are highly complex and well-functioning supply chains require that each link of the chain be synchronized with and supportive of the operation of the chain as a whole.²⁸ Supply chains should be fully integrated into health programming to ensure the most effective means of delivering commodities to patients.^{4,28}

According to the USAID|DELIVER Project (DELIVER), integrated supply chains share common characteristics including clarity of roles and responsibilities, agility, streamlined processes, visibility of information, trust and collaboration, and alignment of objectives. There must be clear structure in the job descriptions and contracts for employees working within the supply chain, and all employees should be aware of others' roles and responsibilities. Supply chains must be agile enough to adjust to changing procurement landscapes and plans should be flexible to accommodate changing priorities. Financing should be diverse and funds should be able to get dispersed quickly and on time. Processes must be streamlined and require the minimum

number of layers necessary to keep the chain connected. The Logistics Management Information System (LMIS) must be robust enough to provide accurate data on demand, and data within the LMIS should be utilized to design and implement supply chain improvements. Quantification and forecasting plans should be developed, updated, and shared amongst partners. Information flow is optimized, and the oversight committee of the supply chain operations is actively engaged. Perhaps most importantly, objectives and incentives are aligned across key stakeholders and a supply chain management plan is developed collaboratively among key stakeholders.^{29,30} Figure 7 is based on DELIVER's logistics cycle, but is updated to reflect PSM activities in Laos.²⁰

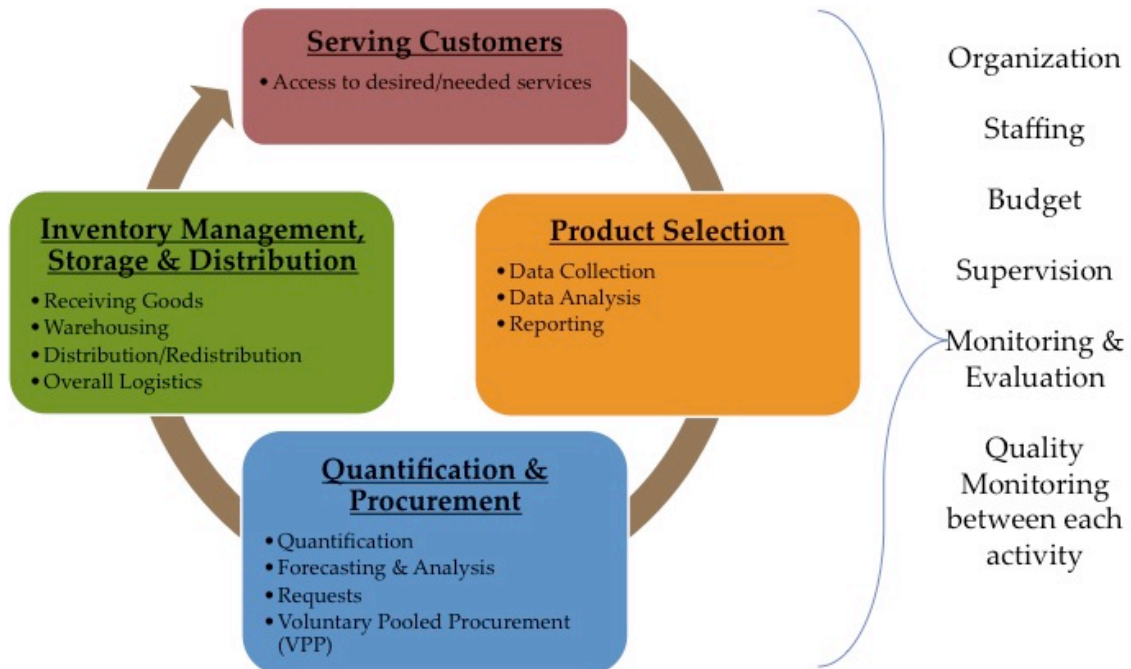


Figure 7: The logistics cycle and operations in Laos

Because all supply chains, regardless of the level of integration, can be strengthened, DELIVER developed a supply chain management evolution framework that identifies qualities of and necessary improvements to public health supply chains in developing countries. The DELIVER framework was designed to evaluate HIV supply chains, but DELIVER has found that many supply chain interventions and solutions are not unique to HIV commodities. Therefore this framework may be extrapolated to help strengthen other public health supply chains, specifically malaria in this context.²⁰ The DELIVER framework helped guide the research when formulating data collection and analysis methods. Specific questions included:

- Has the system developed mechanisms to facilitate coordination between partners throughout the supply chain?
- How is information managed throughout the supply chain?
- Does the system effectively use standard operating procedures to define roles and guide logistics functions, and include a process for training staff on their use?
- Does the system have a team in place that is sufficiently empowered to manage overall logistics across separate entities to the service delivery level?

Laos is confronting many of the same PSM challenges other low-income countries face. Poor PSM practices are reflective of and reinforced by a weak health system at all levels and include problems of governance, human resources and capacity, information flow, and data management.^{5,7,23-25} Laos also faces additional PSM challenges due specifically to its landlocked status, which negatively affects delivery

times and in-country infrastructure.³³ Kauffman, Miller, and Cheyne found that developing countries often have two separate, poorly connected supply chains for vaccines: the segment that moves vaccines into the country, and the segment that moves vaccines from the point of entry through the public health system ultimately to the end user. Moving vaccines from the port of entry to the end user can have up to seven steps.²⁸ While this research is not looking at vaccine supply chains, the topic is well understood and the principles are useful to apply to critical examination of HIV and malaria supply chains as well.

The direct correlation between supply chain management and health is increasingly a concern among health workers, donors, and academics, yet the scarcity of information regarding the structure, functions, and performance of public health supply chains in developing countries hampers informed decision making and capacity transfer. In-depth, country-level analysis of the challenges and barriers to successful PSM in developing and low-income countries is essential to improving long-term sustainability of health systems.¹⁻⁵ For Laos, the substantial investment by the Global Fund and other donors in the country's health system, as well as the Global Fund's focus on PSM capacity and the lack of detailed understanding about the supply chain system, necessitates an in-depth country-level assessment of Laos' PSM activities.²⁴ The aim of this research is to improve supply chain management for HIV and malaria control programs. The specific objectives are:

1. To identify barriers and bottlenecks through a situation analysis of Laos' supply chains for national HIV/AIDS and malaria control programs.
2. To analyze factors affecting HIV/AIDS and malaria supply chains in Laos.
3. To suggest policy recommendations for the WHO, the Global Fund to Fight AIDS, Tuberculosis and Malaria, the Lao Ministry of Health, and other institutional or organizational stakeholders for improved supply chain management and function.

2.2 Study Design and Methodology

The study design uses a combination of different qualitative data collection methods to achieve the research objectives including key-informant interviews, document review, and informal observations (see Figure 8 for study design). The research team developed the methods according to what would produce the highest quality data, but also taking into account what was feasible for the scope of research. This research was conducted in collaboration with the WHO country office in Vientiane Capital. Research ran from February-September 2012, with three months (May-July) spent in country.

2.2.1 Key-informant Interviews

The research team recruited 39 participants for key-informant interviews through purposeful and snowball sampling, and chose participants for level of involvement with supply chain or procurement issues. Two participants were interviewed twice (once at the beginning and once at the end of research), yielding 41 interviews in total. Interviews were conducted in Vientiane Capital, Savannakhet

Province, and Phine and Xaybouly Districts (see Table 5 for participant demographic information). Selected interviewees were contacted to gauge participation interest and were interviewed at a mutually consented location, usually their office. Interviews were conducted in English when possible and in Lao through a WHO local staff member when necessary. Interviews lasted between 45 and 90 minutes and all interviews were transcribed within 48 hours of completion. Informed consent was obtained from all participants prior to the interview and participants were not compensated for their time. The Duke University Institutional Review Board deemed that this research was exempt from human subjects research ethical review [Protocol #B0045; approved 16 April 2012]. Data was entered into Nvivo 9, then coded and analyzed by themes identified by the research team (see Table 6).

2.2.2 Document Review

The literature and document review began prior to arriving in country and continued throughout the research process. Articles relevant to HMIS and data management were collected via PubMed and Google Scholar, and relevant documents were collected through the WHO, donors in Laos, the Lao MoH, and the Global Fund. Examples of documents reviewed include Global Fund grant proposals and related documentation, national program plans, third-party consultant reports, health information reports, and MoH and partner guidelines.

2.2.3 Informal Observations

Informal observations complemented the in-depth interviews and were conducted primarily during procurement and supply chain-related meetings with key stakeholders in Laos. Meetings types ranged from small staff meetings with individual units to the Global Fund Country Coordination Mechanism meeting on 8 July 2012. Attending meetings provided great insight as to how the national-level programs handled PSM issues as they arose, and also how tight deadlines and requests from the Global Fund were managed.

2.2.4 Frameworks for Analysis

The aforementioned DELIVER framework guided research questions to help identify challenges and necessary improvements for Laos' PSM activities. Following the qualitative data analysis method described by Pope, Ziebland, and Mays, four researchers discussed the content of the interviews and directed the coding scheme throughout the data collection and transcription process.⁶⁰

2.2.5 Research Limitations

This research was restricted to Laos, thereby limiting the scope of extrapolation beyond the Lao content. Research was conducted for nine weeks in Vientiane Capital and one week in Savannakhet Province, and ideally would have allocated equal research time to all 17 provinces. The scope of investigated health commodities was purposefully narrowed to HIV test kits and malaria commodities including rapid diagnostic tests

(RDTs), artemisinin-combination therapies (ACTs), and bed nets; however, all HIV and malaria commodities follow relatively the same supply chain and procurement processes. Ideally, qualitative data would have been supplemented with quantitative analysis of stocks on hand and warehousing capabilities. Lastly, the coordination challenges identified, particularly with outside partners, would ideally be compared across the region and among similar countries in Africa, Eastern Europe, and South America. Unfortunately conducting similar research across different countries was not feasible as part of this study.

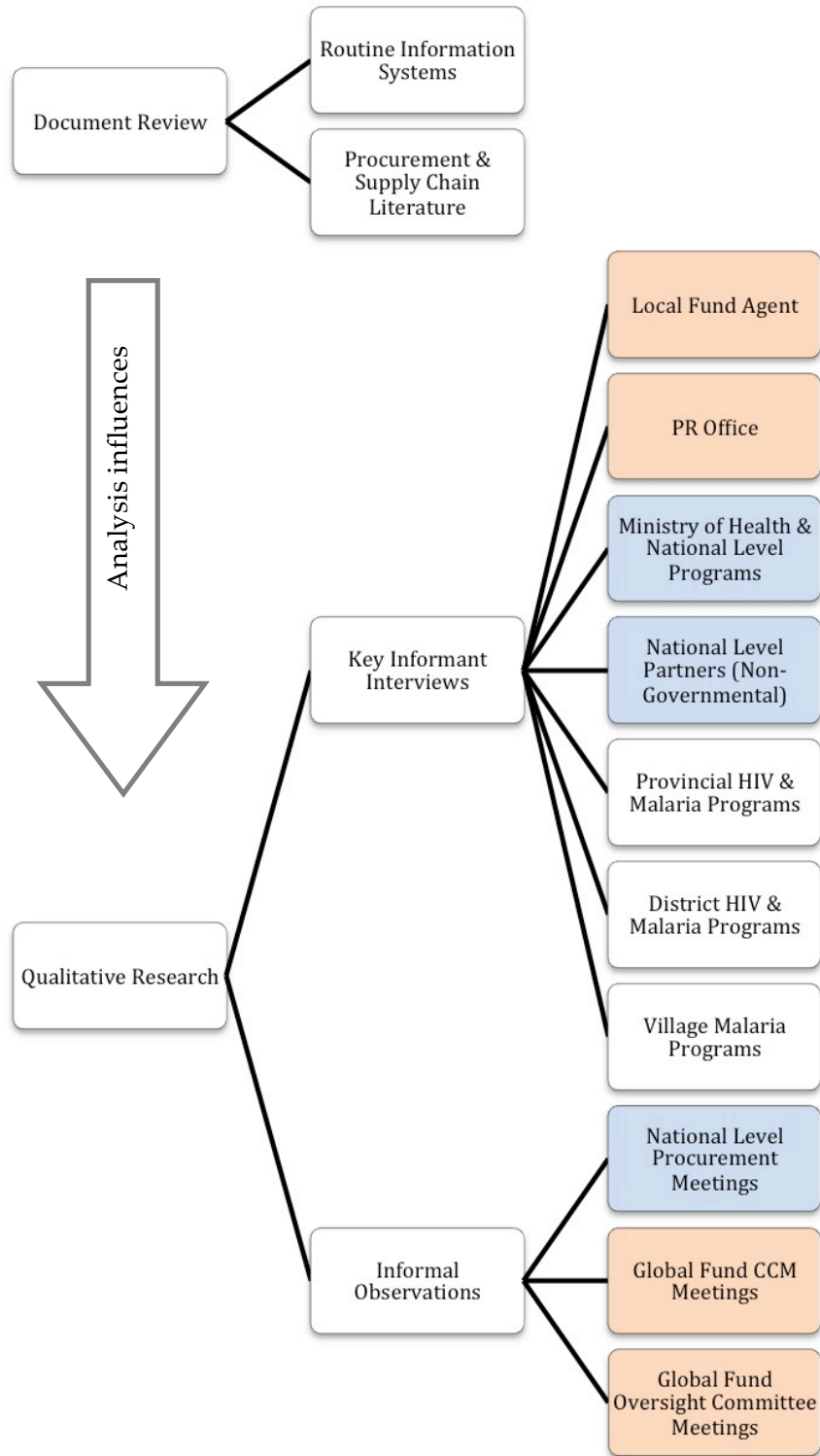


Figure 8: Study design and methodology (orange boxes indicate Global Fund level; blue boxes indicate national-level programs)

Table 5: Participant demographic data

Region	Program Level	Number of Interviews	Interview Languages
Vientiane Capital	Global Fund	4	English: 4 Lao: 0
Vientiane Capital	Ministry of Health & National-level programs	13	English: 9 Lao: 3
Vientiane Capital	National-level partners (non-governmental)	9	English: 9 Lao: 0
Savannakhet Province (Capital)	Provincial	6	English: 1 Lao: 5
Savannakhet Province (Capital)	Provincial-level partners (non-governmental)	1	English: 0 Lao: 1
Phine District (Savannakhet Province)	District & Health Center	5	English: 0 Lao: 5
Xayabouly District (Savannakhet Province)	District	3	English: 0 Lao: 3
	TOTAL	41	English: 24 Lao: 17

Table 6: Selected coded themes by focus area

Focus Area	Coded Theme	Number of Citations	Total Number of Citations
Data Collection and Reporting	Quantification	41	194
	Requesting	37	
	Data	36	
	Reporting	34	
	Monitoring & Evaluation	17	
	Data Analysis	13	
	Forecasting	9	
	Language Barriers	7	
Management and Leadership	Coordination	113	269
	Management	51	
	Guidelines and Strategies	33	
	Unnecessary Time	30	
	Oversight	27	
	Accountability	15	
Procurement	Procurement Processes	64	156
	Logistics	58	
	Planning	34	
Human Resources	Capacity	62	124
	Training	37	
	Lack of Understanding	18	
	Happiness with Job	7	

2.3 Results and Discussion

This section will focus on four areas that are key components of supply chain management and procurement activities: data collection and reporting of PSM

information, management and leadership of PSM activities, procurement processes, and human resources and capacity within the PSM system. Each area is divided into subcategories that capture specific challenges related to PSM in Laos.

2.3.1 Data Collection and Reporting of PSM Information

Poor data collection and reporting are fundamental problems throughout Laos' health system. Deficiencies in the timeliness and quality of reporting at every level of the supply chain were indicative of the larger failure of effective supply chain management throughout the health system. Data collection and reporting is a major hurdle in supply chain management and procurement in Laos, but supply chains and procurement processes demand access to timely and accurate data. In addition to reporting problems, the information that is available is not analyzed at each level of the chain, which results in faulty data reported all the way to the national level and PR offices. The PR office is then left to synthesize data, which causes undue work for the national programs and the PR office, and increases the likelihood of delayed or inaccurate reports to the LFA and Portfolio Manager. This research found that each program has developed its own data and reporting systems with limited success. Mounier-Jack et al. reported similar data challenges in their work on Laos.⁷ Data collection and reporting challenges will be discussed further in a separate manuscript.

2.3.2 Management and Leadership of PSM Activities

This research found three main areas of management that are lacking and cause systemic weaknesses in Laos' PSM: accountability, communication, and relationship management, particularly between the Global Fund and country-level programs. The MoH has designed the HIV and malaria programs such that information and commodities flow in a top-down approach from Vientiane, thus necessitating strong leadership and clarity at the national level. In this context, it is necessary to look at management in two areas – national level management of provincial and district programs and national level management of the Global Fund.

Well-integrated supply chains demand high levels of management and coordination, as well as good governance. Good governance requires one entity of the supply chain to influence or determine the activities of the supply chain and, in Laos' case, dictate how PSM activities fit into the larger programmatic plan for health.^{58,59} Windisch et al. state that good governance is a key driver of health systems performance.²³ The current situation in Laos demonstrates how weak management and leadership can have direct negative effects on the quality of supply chain management and, ultimately, on health outcomes.

2.3.2.1 Accountability and Ownership

Accountability within the health system and national disease programs suffer from fundamental systemic problems that are severe, although in many respects not

unique to Laos. As one national-level NGO participant said, “Accountability is diluted...when people can escape from responsibility, they do.” Another Global Fund-level participant said, “People do not know anything and no one is helping them figure it out...they have a meeting and then everyone leaves with no plan and no responsibilities.” While recent leadership changes have promoted people who show concern for accountability and ownership of individual responsibilities, whether or not systemic changes will result from new leadership has yet to be seen.

There is an overall sense of a lack of responsibility over tasks and projects, clearly articulated by a Global Fund-level participant who said that people in the PR office simply do not show up for work. Repercussions for not following established protocols (i.e. reporting deadlines for sites) are not established or enforced, and citing specific infractions is difficult. Specific program site management from the national level is difficult because of Laos’ decentralized healthcare system, where provinces and districts maintain a considerable degree of autonomy to make decisions on PSM activities. Site management is particularly challenging for CMPE due to the thousands (6,064 as of July 2012) of sites that are supposed to engage in malaria activities (prevention, diagnosis, treatment, and follow-up). At the national level it is difficult to hold individual village and district sites accountable from such a removed position. Districts and provinces should in turn oversee sites, but do not do so consistently or systematically across the country.

There are also problems of accountability between the national level programs and the Global Fund PR office within the MoH. The relationship between the national programs and the PR office is tenuous at times, due in no small part to a poor accountability structure between the PR and SR offices, where the PR office depends on information and feedback from CHAS and CMPE (and other SRs), but is not empowered to hold them accountable. Similarly, the SRs often feel little ownership of program elements that are dictated by the Global Fund (via the PR office). A clear example of this is the conflict between the indicators related to HIV test kits. Indicators selected by CHAS do not align with Global Fund indicators and CHAS technical staff are not always aware of what the Global Fund is requesting.

Accountability issues are not unique to Laos, and while there has been limited research on PSM activities in developing countries, both Schouten et al. and Windisch et al. found that HIV supply chains in Malawi and Uganda had similar accountability challenges.^{5,23} When lines of reporting, authority, and responsibility are unclear it causes a source of both confusion and friction that affect overall performance.

2.3.2.2 Communication and Coordination

Coordination and communication gaps are barriers to effective cooperation necessary for effective PSM.¹ Coordination and communication challenges between relevant parties were cited 113 times, the single most cited theme, throughout the data indicating that coordination and communication are significant to supply chain

function. Coordination between levels of the supply chain (i.e. between districts and provinces) is currently a barrier that causes unnecessary time delays and frustration. Many of the coordination problems arise during reporting and making requests for additional commodities, but also involve the design and implementation of national guidelines and strategies. Systems (i.e. reporting schedules) are in place to help facilitate coordination within the MoH system, however strategies are not consistent throughout and are not easily enforced.

Participants reported that national guidelines are often not clear and sometimes irrelevant at the patient level. Participants cited gaps in protocols relating to HIV testing age, PMTCT guidelines and recommendations, testing sex worker's partners, VCT expansion, requesting timetables, redistribution of health commodities at the village and district levels, health impact assessments for development projects, and responsibility for monitoring stock levels. This wide range of problems indicates a clear confusion over basic strategies for HIV and malaria prevention and treatment that complicate supply chain function at all levels.

Changes in PMTCT guidelines are an excellent example of supply chain failures due to weak coordination. The national PMTCT strategy dates from 2007 and is almost universally seen as ineffective and not practical, but changing the guidelines has been a slow process. In 2011, UNICEF campaigned to make PMTCT recommendations in Laos much more aggressive and was successful in their bid with the MoH. As a result,

demand for test kits increased substantially, but supply through the Global Fund procurement process was not increased because the forecasting arm of CHAS was not aware of UNICEF's recommendations. Although pregnant mothers are considered a low-risk HIV group in Laos, pregnant women are sometimes tested twice during routine antenatal care services in the first and third trimesters. This unforeseen demand for HIV test kits caused a severe shortage of kits and ultimately an HIV test kit stock-out nationwide. Pregnant women, not the most at-risk populations, are given priority for the few tests that are available. As national-level NGO participant said, "You build your whole program on sand – how can you make your program credible if you can't even offer someone an HIV test? Not having HIV tests is the worst problem for the national [HIV] program."

Our research shows that the necessary understanding of interdependence between supply chain entities was largely absent in the Lao public health system and was widely recognized as a major shortcoming. Arshinder et al. and Gereffi et al. note that coordination in supply chains should encourage and guide key members to identify interdependences within the supply chain and to define mutually agreeable goals to fairly share risks and rewards, however coordination can take on various forms.^{22,59} Kauffman found that there was a considerable lack of coordination between entities who procure vaccines and those who are responsible for receiving and administering them in

developing countries. These authors echo the coordination problems that are rampant in Laos causing significant PSM challenges.²⁸

3.2.3.3 Relationship Management

Relationship management was a highly cited barrier to successful supply chain management. “Relationships” were broadly defined by participants, ranging from interpersonal relationships between two colleagues to systemic challenges. The relationship between the MoH and the Global Fund was of particular significance. As described in the introduction, implementation of a Global Fund grant involves many players, and coordination between all levels is not always smooth. Frustrations with poor relationship management between the Global Fund and grant implementers were expressed primarily at the LFA, PR, and SR levels; however, some participants at the provincial level also expressed concerns about the role of the Global Fund in Laos. The role of and relationship with the Global Fund was not mentioned at the district and village levels. The reported challenges pertaining to the Global Fund mimic management issues present throughout the Lao health system but are viewed through a more complicated lens. The Global Fund recently downgraded Laos’ grant performance ratings (HIV has been downgraded from A1 to B1 and malaria has been downgraded from A2 to B1), which reduces the overall level of funding available to Laos. This downgrade came in tandem with a required 20% financial co-contribution from the

government due to Laos' new Lower-Middle Income status and adds additional strain to the relationship.

Global Fund expectations were a prominent theme throughout the data. One Global Fund-level participant said, "the Global Fund provides a model for how programs should work," but most participants believe that the model set out by the Global Fund is unattainable. When speaking about working with the Global Fund, the majority of participants cited "unrealistic expectations," "targets are too high," or "objectives are hard to meet" as major challenges. One national-level participant said, "I know what they want, but it's very difficult to manage." Although most participants felt overwhelmed by Global Fund demands, some participants did recognize benefits from working with the Global Fund including, "the Global Fund is reasonable because they don't want to spend money on products that are not necessary" and "[the Global Fund] is helping to build capacity by being stricter with requirements."

The Global Fund has more rigorous reporting and financial planning requirements than other organizations that historically have worked in Laos. The Japan International Cooperation Agency (JICA) has worked on PSM activities, notably with warehousing capabilities, and was cited as being easier to work with and more flexible, but JICA's roles and responsibilities within the health system was beyond the scope of this research. The Global Fund is now allowing fewer assumptions on procurement plans and reports, particularly when looking at quantities of stocks on hand,

consumption, and commodities in the pipeline. This newfound sensitivity to actual data (as opposed to assumed) is forcing a rapid scale up of accurate reporting practices.

Because the Global Fund is a performance-based funding agency, achieving and surpassing proposed indicators determines future programming and funding. This led one national-level participant to say, “the Global Fund only wants to know about indicators and numbers, they are not focused on quality.” Changes in the Global Fund’s indicators and expectations between funding rounds complicates matters further. One Global Fund-level participant went so far as to say, “the Global Fund asks for too much and national level people feel that the Global Fund is too much work.”

The relationship challenges are not one-sided, however. Different levels of Global Fund participants cited frustrations with the SRs and their ability to produce quality information in a timely manner. One Global Fund-level participant suggested that the continuing errors committed by the SRs may be “trying to back the Global Fund against a wall and force them to accept substandard reports and documents.” Both the Global Fund participants and the national-level participants recognize a disconnect between Global Fund expectations and what is actually happening at the country level.

3.2.3.4 One Party Politics

The influence of the Lao People’s Revolutionary Party politics cannot be overstated; however, measuring outcomes due to the influence of Party politics and clearly identifying areas where politics influences the health system is nearly impossible.

Researchers could not find unbiased accounts of the Lao political structure, and participants were, understandably very reticent to discuss the role of the government in the health system given their employment or close working relationship with the MoH. Some participants did reference that the government “influences everything” and that the “complicated political system is always an undercurrent to any and all activities,” but this research could not accurately delve into this subject. At minimum, the political system in Laos is a very complicated, entwined system that has significant influence on the health system.

2.3.3 Procurement Processes

Successful procurement is fundamental to any health program and is a vital component to any functioning supply chain. As one participant at the national level said, “Procurement is not just buying and using, it’s also how commodities are being used and why.” Procurement and forecasting are challenging even in well-functioning supply chain systems and are particularly vulnerable to inefficiencies in the larger health system. About 34% of Global Fund support for the second commitment (2013-2015) in Laos is dedicated to procurement, and despite nine years of Global Fund financing, the national procurement system has only improved incrementally. Alemnji et al. noted that incorporating procurement into health programs is particularly challenging in developing countries because of the financial involvement and benefits derived from supply chain management.²⁵

2.3.3.1 Voluntary Pooled Procurement (VPP)

As discussed in the introduction, procurement of health commodities is more complex than other types of goods. Many partners in Laos contribute to the HIV and malaria procurement processes, and managing the process requires strong leadership and oversight. Any commodities procured with Global Fund monies must go through the VPP mechanism, instituted through the Global Fund headquarters in Geneva. Laos initially handled procurement on its own, but was compelled by the Global Fund secretariat to enter the VPP once it became clear that there was not enough local capacity to handle procurement of goods for the national scale. VPP requires that the PR office submit once per year a detailed PSM plan with accurate data indicating consumption, stocks on hand with expiry dates, pipeline commodities, pricing, lead times, and buffer stocks. One national-level NGO participant said, “procurement has always been a problem” and any delays in receiving necessary information can cause significant ripple effects throughout the system. A striking example is the one-year delay of the procurement cycle in 2010 for malaria commodities. Commodities arrived a full year late due to difficulties submitting and agreeing on the PSM plan. A national-level participant talking about this failure said, “When you miss one cycle of procurement, you never catch up. Everything gets distorted.” Another national-level NGO participant said, “You can have a system that is running well, but if your ACTs don’t come, then everything gets screwed up.” The delays also put notable strain on CMPE’s relationship with the

provincial malaria units. Schouten et al. reported similar challenges with using Global Fund funds to procure, stating that lacking alternative funding sources makes programs very susceptible to bottlenecks in grant disbursement.⁵

VPP is intended to lower procurement costs by pooling orders for multiple countries, but VPP is not agile enough to process emergency procurements, forcing CMPE and CHAS to find alternative procurement mechanisms in emergency situations (i.e. the HIV test kit stock-out). Another foreseeable problem with VPP is the long-term sustainability of the program. Participants expressed concerns over what will happen when Global Fund money inevitably lessens or disappears altogether, particularly given the weak procurement capacity at the local level.

2.3.3.2 Procurement Planning

Countries must submit a five-year proposal to the Global Fund and submit biannual reports for the duration of funding. Participants noted that the five-year time frame was too long to plan for and did not allow enough funding and programming flexibility. PSM plans are intended to plan for an entire year, but participants reported difficulties producing and submitting PSM plans that accurately reflected their needs for the upcoming year. Decision-making capabilities were mentioned as a cause of delay in PSM plans. As one Global Fund-level participant stated, “If there is no decision on how to move forward, there is no forecasting, no PSM plan, and no procurement.” In addition, procurement plans do not always match implementation plans, causing

irregularities with forecasted needs. When referencing having extra stock on hand, one national-level NGO participant said, “The more food you have the more food you eat,” meaning consumption varies according to how sites perceive quantities of commodities. If there is a shortage or stock-out, sites will hoard commodities and use them only on high priority patients. When stocks are more abundant, a greater number of people have access to commodities. Mounier-Jack et al. also found similar results in their study, including that Global Fund promotes strict earmarking and lacks the capacity to reallocate funds when necessary, making it difficult for the country to adjust to changing needs.⁷

2.3.3.3 Receiving Goods

Procurement is a long process and goods often arrive four plus months after they are ordered, and in some cases can take upwards of nine months to arrive. Because Laos requires such small quantities of commodities as compared to other Global Fund recipient countries, they often receive orders in multiple shipments. Multiple shipments require additional logistics coordination and prevent commodities from being dispatched from the central warehouse in a uniform manner. Laos has also received multiple commodities shipments with extremely short expiry dates that prevent goods from being used throughout the year.

2.3.4 Human Resources and Capacity within the PSM system

Laos has a severe shortage of procurement and supply chain management professionals. Very few people at the national level are in charge of managing the HIV and malaria programs, and even fewer people at the provincial and district levels are adequate managers with supply chain experience. Multiple participants at the Global Fund and national levels cited capacity and human resources at the district and provincial levels as a problem with overall supply chain management. Countrywide capacity and training were two reoccurring themes throughout the data.

2.3.4.1 Countrywide Capacity

The majority of supply chain and procurement capacity to date has come from international assistance through the Global Fund, UN agencies, and other non-Laotian partners. The MoH authorized the Medical Product Supply Center (MPSC) (housed within the MoH) to manage a one-warehouse system in August 2009 in an effort to begin transitioning capacity from outside experts to the national programs. While the MPSC is decreed to manage all MoH procurement, the actual role of the MPSC is unclear. It took nearly two years before the first national-level program, CHAS, signed a memorandum of understanding with the MPSC to store and distribute HIV-related commodities. To date, ten national programs store commodities at the MPSC central warehouse in Vientiane Capital, but MPSC does not have enough transport capacity to deliver goods to the provinces. Participants at the national level and with the Global

Fund said that the MPSC concept is good in theory, but positive outcomes have yet to be seen. Concerns were raised over the MPSC's ability to management procurement for one disease, let alone all MoH programs. One national-level NGO participant said, "The MPSC has not been able to show that they are able to procure, and if they could it would not be done with innovation."

2.3.4.2 Training

Procurement training for local staff has been limited and those in procurement roles often have inadequate training for their positions. Although some staff have participated in formal procurement trainings (JICA-led programs were mentioned by several participants), the majority of people "learn by doing" or through ad hoc training opportunities. Both national level and Global Fund participants highlighted that the right people are not usually in the right positions, which is echoed in Meijboom et al.'s results as well.¹ There also seems to be some resistance from Lao staff employed in procurement-related positions to embrace their roles. One national-level participant said she felt "overwhelmed" when she was asked to produce procurement data and another said, "We are all doctors - we are not trained in procurement." Another Global Fund-level participant echoed this sentiment with, "staff don't feel like they can use their medical education." Given how highly the Global Fund values procurement process improvement, the MoH has not allocated sufficient resources to fill the current capacity void. One Global Fund-level participant went so far as to say, "Procurement is not

highly regarded by the Ministry.” Kauffman et al. found similar results in that training supply chain personnel is usually focused on specific activities such as storekeeping rather than higher-order planning, analysis, and performance management required by supply chain managers.²⁸

2.3.5 Summary of Results

The data shows important trends related to Laos’ overall supply chain and procurement functionality. Our thematic analysis guided by the DELIVER framework indicates that data collection and reporting, management and coordination, procurement, and capacity are important issues at all levels of the supply chain in Laos, and suggest that the Laotian supply chain is far from a fully integrated system. Coordination within the MoH and among partners is lacking, and communication breakdowns have acutely affected the health system. Information is not shared among units, departments, across the MoH or to partners, and confusion and misinformation is a direct result of poor information flow. Although data collection and reporting will be addressed in a separate manuscript, it can be said that data management is poor and has a direct negative impact on the overall supply chain and healthcare system. Patients do not have access to commodities they need because people within the health system are not sharing pertinent information in a timely manner. System-wide guidelines and recommendations are not universally followed, and widely acknowledged procedures for logistics functionality and training are not in place. Perhaps most critical to overall

supply chain function is the lack of a cohesive team in place to manage procurement and supply chain function. Neither HIV nor malaria has a team in place that represents interest across units and partnerships. The MPSC is designed to fill that role but thus far has failed to make a substantial impact on the health system due to limited capacity and a lack of crosscutting support from national programs.

The long-term sustainability of the supply chain and procurement processes is directly tied to international funding and assistance, with minimal improvements having been made to bolster in-country capacity. Our research suggests that successful planning and supply chain integration is rooted in the country's ability to have consistent, timely information and requires adaptability at both the national and Global Fund levels.

2.4 Conclusions and Recommendations

Our research found that supply chain and procurement barriers exist at all levels of the supply chain, but are particularly damaging at the national level. The countrywide HIV test kit stock-out and 2012's three-fold increase in malaria cases are poignant reminders that supply chain management is vital to public health outcomes. While all participants were quick to acknowledge that problems exist, there seems to be very few people who are taking active strides to improve overall supply chain function. It is essential that the MoH begin actively utilizing resources available to make changes

to the current system so that capacity, and hopefully financing, can be turned over to the country.

2.4.1 Suggestions for Improvements

Until recently, Laos has sufficed with a substandard supply chain system. It is now imperative that the MoH takes measurable steps to improve procurement capabilities and supply chain management for HIV and malaria. Although making improvements to the supply chain management and procurement functionality nationwide seems daunting, Laos can make tangible actions to move the country's capabilities forward. Laos is a small country with comparatively low risk levels for HIV and malaria, and the substantial support from partners that value supply chain improvements should allow country officials to increase supply chain and procurement potential in a reasonable timeframe. Making improvements in HIV and malaria supply chains will ultimately benefit the entire health system, particularly at the Provincial and District levels where there are fewer people who are responsible for managing multiple diseases. Building lasting capacity at the national level will take time, but Laos must work aggressively to use resources currently available to the MoH via the Global Fund and other partners to make improvements. Suggestions for improving data collection and reporting will be addressed in a different manuscript, but suggestions related to national level policies are as follows.

Suggestion 1: Develop a supply chain team at the national level

Procurement, logistics, and supply chain management is a fulltime job that necessitates a dedicated team of people to oversee activities. Multiple sources suggested creating dedicated teams to manage PSM activities.^{5,26,28} While there are people employed by both CHAS and CMPE who work on these issues, they are often done in parallel with other responsibilities. Staff working on supply chain management issues must be properly trained with an expertise in disease management or PSM, and have a desire to work within the field. Having well trained staff who do not show up to work or care about their responsibilities will not make even marginal differences in overall function. While the MoH should move away from dependence on international experts, it would serve the MoH well to employ at least one technical expert for a short timeframe for each disease to help increase capacity within the national programs. Although the Global Fund has emphasized a need to move away from relying on international staff to manage supply chain function, a clear plan of how international staff can transfer knowledge and skills to local staff would most likely be accepted for funding.

This team would oversee procurement, logistics, and supply chain functions at the provincial and district levels, and would also be responsible for coordinating supply chain-related events that happen outside of VPP (i.e. emergency procurement of antibiotics for opportunistic infections in HIV patients via UNICEF). The team would be

responsible for having a firm grasp of supply chain operations at all levels and would be required to synthesize and report on supply chain functions as needed. The creation of a supply chain-focused team would ultimately reduce duplication of and conflicts between activities, and would facilitate work in liaison with the MPSC to ensure timely procurement and distribution of goods. Ultimately, the PSM team should transition over to become part of the MPSC.

Suggestion 2: Strengthen capacity and focus of the MPSC

Despite being endorsed by the MoH as the proprietor of procurement and logistics for the Lao health system, the MPSC has yet to develop a well-rooted place within Laos' national programs. Having multiple supply chains creates increased risks of failure and adds additional costs for countries, so bolstering the MPSC would directly benefit all health programs.²⁸ The role of MPSC must be clearly defined among MPSC employees, within the MoH, and to partners outside of the Ministry. MPSC and the PR office are currently working at cross purposes and are engaged in a power struggle over who should maintain control over the procurement and logistics processes. It is essential that the MPSC and the PR office work together to transfer capacity to the MPSC and build capacity at the local level. MPSC should proactively work with national level programs to develop clear, straightforward plans for program commodities and establish realistic goals for each program. Per Meijboom et al.'s recommendations, it would behoove the MPSC to create program-specific job postings that would manage

the relationship between the national level supply chain teams and the MPSC.¹ The MoH and the MPSC must be explicitly clear as to what their current capabilities are and how they plan to expand those capabilities (and when).

Suggestion 3: Streamline program-specific and national guidelines

Failures in the supply chain can be linked directly to confusion over guidelines and recommendations for specific diseases within the greater health system. It is essential to have cohesive, straightforward guidelines that are easy to interpret and follow. This is particularly relevant for the lower levels of the supply chain (i.e. the District level) that are not empowered to make decisions about health policies. There is a clear divide between policies in place and actual behavior, as shown by the increase in PMTCT testing despite an absence of national PMTCT testing guidelines. Guidelines and policies must be comprehensive and offer recommendations for when exact guidelines cannot be followed. It is also recommended that a national early-warning system is established to indicate when stocks are becoming low in certain regions. An early warning system would require setting minimum thresholds for commodity quantities and enact a redistribution plan to ensure equitable use of commodities across the country.

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3. Data Management and Supply Chain Barriers in HIV and Malaria Programs in Lao People's Democratic Republic

3.1 Background

Access to timely and reliable health data is critical for ensuring patients have access to health commodities that they both want and need. Supply chains and logistics management rely heavily on facility and patient data, and an absence of quality data has direct negative impacts on the overall health system and health outcomes. However, developing effective data management systems in resource-poor countries has proven challenging, particularly in vertical health systems that have multiple fragmented funding streams for specific diseases.⁴³ Lack of access to data for forecasting, supply planning, and delivery of health commodities has been cited as a key impediment to countries' ability to support health programs and meet targets.⁴⁴ Developing countries often struggle to effectively manage health data, including an absence of data, unreliable data, poor data analysis, and linking data between and across programs. Braa, Heywood, and Sahay found that data use and data quality are interrelated in developing countries, whereby poor quality data will not be used, and because they are not used, the data will remain of poor quality.⁴⁵ This is this case in Lao People's Democratic Republic (Laos), where the country has experienced difficulties with a successful uptake of a data management system and ensuring access to consistent, timely data.^{4,15,23,28,46} A lack of dependable evidence and analytic methods for identifying program options

makes priority setting and planning in developing countries challenging and uncertain.^{47,48}

Implementing a Health Management Information System (HMIS) can help countries integrate data collection, reporting, and data use to improve health service effectiveness and efficiency through better management of health services at all levels.³¹ Krishnan et al. found that a computerized HMIS system in rural India improved program effectiveness, efficiency, and saved resources, all while reducing time spent by healthcare workers in record keeping and report generation.³² The literature explicitly states that poor data management can have serious repercussions for health programs, and increased access to accurate data through a HMIS can benefit PSM activities by improving quantification and forecasting estimates and reducing errors or stock-outs. In addition, improved access to data can reduce costs, delays, bottlenecks, and time spent by health workers, as well as streamline logistics operations, limiting the need for expansive buffer stocks. Improving PSM functionality ultimately improves patient care and health outcomes.^{2,5,23,26,28,33-42}

The USAID | DELIVER Project (DELIVER) has developed a logistics cycle that visualizes the four main areas of logistics and PSM activities including serving customers (patients), product selection, quantification and forecasting, and inventory management, storage and distribution. These four areas must function interdependently in order to maximize efficiency, and if one area of the cycle is

performing weakly, all other areas are also affected. Larger systemic functions including system organization, staffing, budgets, supervision, monitoring & evaluation (M&E), and quality monitoring influence the cycle (See Figure 9). While the entire PSM cycle is data-driven, product selection and quantification and forecasting are particularly sensitive to accurate data collection and analysis. Quantification is “a critical supply chain activity that links information on services and commodities from the facility level with program policies and plans at the national level, and is then used to inform higher level decision making on the financing and procurement of commodities.”⁶¹

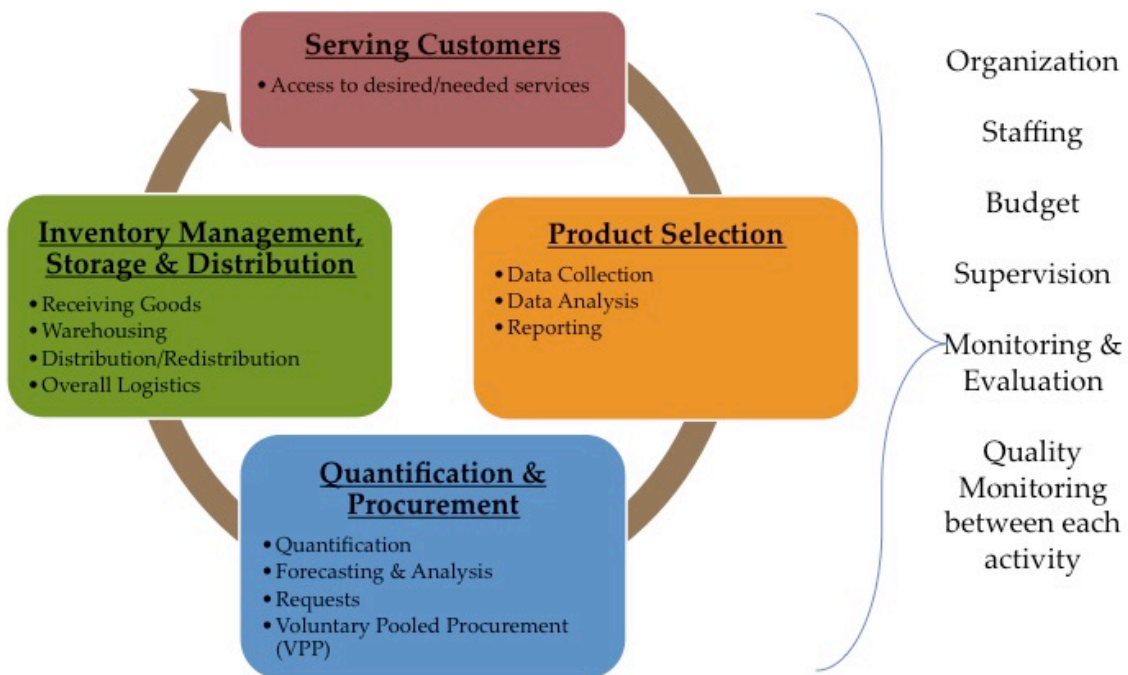


Figure 9: The procurement and logistics cycle (based on the USAID|DELIVER Project, but adapted for the Laotian country context). The four main points of the cycle are all interconnected, and larger management and systemic issue influence overall functionality.

The Lao Ministry of Health (MoH) recognizes the importance and value of an integrated HMIS and has designed a National Information System Strategic Plan for 2009-2015, with the support of the World Health Organization (WHO) country office. This plan aims to unite health departments and national programs in Laos in an effort to increase evidence-based decision-making, planning, and M&E, all of which will result in better health for the population. While this plan is not specific to public health supply chains, it does include plans for both population-based and facility-based information, the latter of which is directly relevant to PSM activities. The plan revolves around five goals for Laos, of which three are directly pertinent to PSM: rationalize and integrate, where appropriate, all stakeholders' and programs' data and information on mortality, morbidity, disability, social determinants and health systems, into one national health information system; revitalize and strengthen current data management to develop one unified national HIS data base; to develop and implement population and institution based data sources, especially the vital registration system, and improve health and disease recording.³⁵

The Global Fund to Fight AIDS, Tuberculosis, and Malaria (Global Fund) has heavily supported HIV, malaria, and tuberculosis programs in Laos since 2003, and has played an important role in the scale up of prevention and treatment activities. As in most developing countries, PSM and M&E have not historically been high priorities in Laos, but the Global Fund has recently expressed concern over the lack of progress in

PSM and M&E capabilities and is stressing the need to increase in-country capacity in both areas.^{15,20,62} M&E mechanisms can enable or facilitate improved PSM activities, and also help identify weaknesses in overall health programing. Our research looks specifically at Global Fund-supported HIV and malaria activities, which are vertical programs with limited integration into Laos' public health system. Laos' public health system is implemented by the MoH and has four administrative levels: national, provincial, district, and health center, as well as a Village Health Volunteer (VHV) program that is loosely affiliated with formalized MoH activities. Global Fund financing and grant requirements guide all levels of the public health system and influence the PSM goals and objectives for the HIV and malaria programs.

All levels of the health system contribute data to PSM activities. Laos' HIV and malaria programs are structured differently, and therefore capture and handle data differently. The MoH administers the national HIV program through the Center for HIV, AIDS, and STIs (CHAS) and currently has two software systems tracking the HIV epidemic in Laos. HIVcam is a facility-based software used for antiretroviral therapy (ART) case management and the national M&E software, MERS, is used to track prevention activities. MERS does not incorporate traditional M&E indicators, but rather looks at the broad strokes of prevention and outreach operations across the country. Both HIVcam and MERS operate in parallel and are not automatically synchronized to reflect current HIV trends.⁴⁹ Primary data is collected and compiled via a paper

reporting system at community-based service providers such as voluntary counseling and testing (VCT) sites, drop-in centers for sex workers and men who have sex with men, and district hospitals. These data, together with reports from ART sites, are compiled with provincial-level data and reported to CHAS. In all, there are 149 sites throughout the country that are supposed to report monthly on HIV indicators (see Figure 10 for reporting structure and Table 7 for reporting sites).

The Malaria Information System is based on passive case detection data, much of which is identified at the village and health center levels. The first level of malaria surveillance is the VHVs who are required to report the number of confirmed *P. falciparum* malaria cases (alongside other indicators) each month to the health center or district malaria office in their area. A health center aggregates data from all villages in its catchment area by sex and age-group and reports this information to their district malaria office. The district malaria office is responsible for summarizing the data from all health centers (including village data) in the district as well as collecting data from district hospitals. This synthesis happens again at the provincial level and is reported to the national program overseen by the Center for Malariology, Parasitology, and Entomology (CMPE), whose role is to validate and collect data from provincial, military, and police malaria sites.⁵⁰ In all, there are 6,064 malaria sites in Laos, all of which are supposed to report monthly on malaria indicators (see Figure 11 for reporting structure

and Table 8 for reporting sites). As with HIV, most malaria sites collect and report data via a paper reporting system.

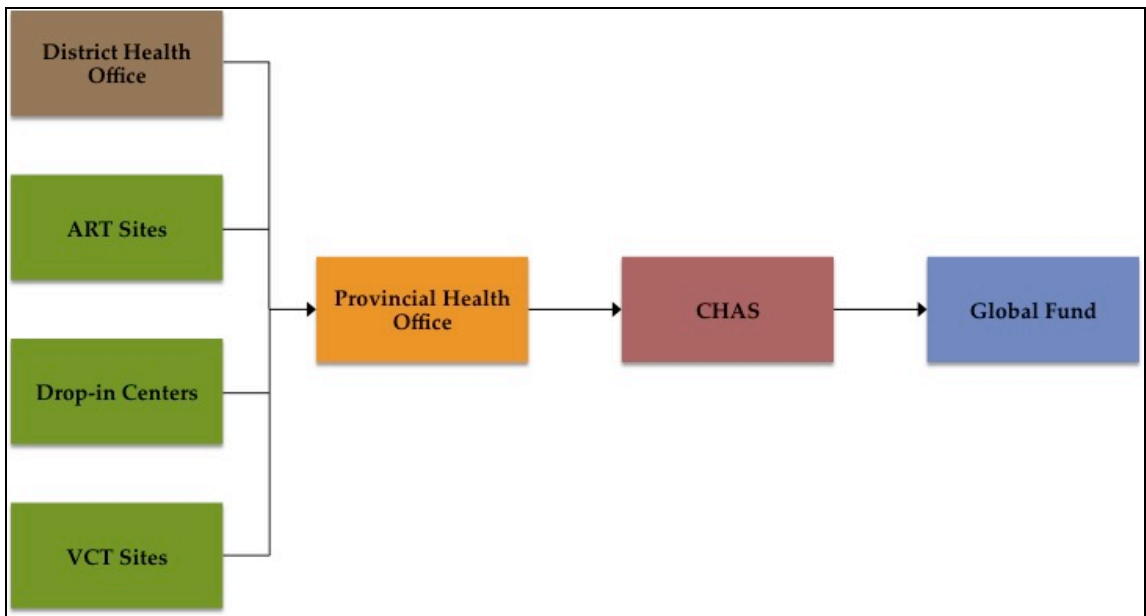


Figure 10: HIV reporting structure

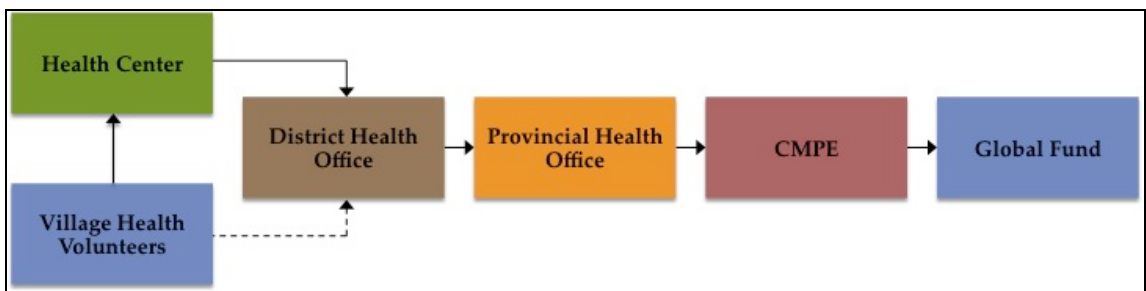


Figure 11: Malaria reporting structure

Table 7: HIV Reporting Sites

HIV Site Level	Number of Reporting Sites
Central	7
Provincial Hospitals	18
Military/Police Hospitals	19
District Hospitals	89
Drop-In/Health centers	16
Total	149

Table 8: Malaria reporting sites (Strata 3 is most at risk for malaria, Strata 1 is least at risk for malaria)

Malaria Site Level	Number of Reporting Sites
Provincial	17
District	135
Health Centers	61 (Strata 3)
	218 (Strata 2)
	415 (Strata 1)
Villages	649 (Strata 3)
	694 (Strata 2)
	3875 (Strata 1)
Total	6064

Monda, Keipeer, and Were cite that the quality of a system's data is directly proportional to the length of time workers spend on the database, and Laos' malaria data is particularly susceptible to bottlenecks in data collection and analysis because of the emphasis placed on village and health center-level data.⁵¹ VHV's are community members trained as lay health workers who provide primary healthcare services including diagnosis and management of basic diseases (respiratory diseases, diarrhea,

and uncomplicated malaria); they also participate in health education activities, assist in vaccination and insecticide treated bed net campaigns, and report morbidity and mortality data to health centers or district offices.^{50,52} The village committee and villagers determine VHV selection in consultation with the Community and District Health Offices. While there are pre-determined criteria for VHV selection, the criteria often cannot be met. Literacy is a major barrier for recruiting VHVs, and often selected VHVs will be one of a few community members who can read and write. VHVs are not paid employees; rather, their incentives for working are an exemption from medical expenses and an irregular allowance paid by vertical programs (usually donor-supported) when they attend a training or help conduct an outreach activity.⁵²

VHVs were integrated into malaria care seven years ago and play a pivotal role in malaria control through data collection, monthly reporting, education, diagnosis and treatment, and distribution and retreatment of insecticide treated bed nets. VHVs are given one week of training and supplied with rapid diagnostic tests (RDTs) and treatment through CMPE's distribution channels, although most VHVs receive very few quantities of each. VHVs have had mixed success with diagnosing and treating malaria, and their low level of training often presents a significant challenge to effective malaria data collection. Village-level data is crucial to overall malaria PSM planning, yet VHVs do not provide reliable, timely reports or feedback.⁵⁰

Despite these barriers, high-quality data can be obtained in developing countries if practical quality assurance procedures are in place.⁵³ Braa, Heywood, and Sahay found that data-use workshops on Zanzibar Island in the United Republic of Tanzania significantly helped improve overall data management including data quality, analysis and interpretation, integration across programs, problem solving skills, teamwork, and practical computer skills.⁴⁵ Improving these functions within PSM activities can help overall health programming, as can selecting valid PSM indicators that reflect the overall quality of the program. PSM activities require a minimum level of reliable indicators to run successful programs.^{20,54} Both CHAS and CMPE designate key data indicators based on what the Global Fund requires for reporting, and those indicators are incorporated into PSM activities and planning.

The purpose of this paper is to look at data management in PSM activities in Laos' HIV and malaria programs, and to identify where weaknesses and unnecessary delays occur because of data management. This research is limited to identifying data management challenges, but will make suggestions about how to improve data management based on our findings. This article does not cover governance issues such as leadership and management in HIV and malaria programming and PSM activities. (Manuscript 1 examines those and related issues.) The aim of this research is to improve supply chain management for HIV and malaria control programs. The specific objectives are:

1. To identify barriers and bottlenecks through a situation analysis of Laos' supply chains for national HIV/AIDS and malaria control programs.
2. To analyze factors affecting HIV/AIDS and malaria supply chains in Laos.
3. To suggest policy recommendations for the WHO, the Global Fund to Fight AIDS, Tuberculosis and Malaria, the Lao Ministry of Health, and other institutional or organizational stakeholders for improved supply chain management and function.

3.2 Study Design

The study design uses a combination of different qualitative data collection methods to achieve the research objectives including key-informant interviews, document review, and informal observations (see Figure 12 for study design). The research team developed the methods according to what would produce the highest quality data, but also taking into account what was feasible for the scope of research. This research was conducted in collaboration with the WHO country office in Vientiane Capital. Research ran from February-September 2012, with three months (May-July) spent in country.

3.2.1 Key-informant Interviews

The research team recruited 39 participants for key-informant interviews through purposeful and snowball sampling, and chose participants for level of involvedness with supply chain or procurement issues. Two participants were interviewed twice (once at the beginning and once at the end of research), yielding 41 interviews in total. Interviews were conducted in Vientiane Capital, Savannakhet

Province, and Phine and Xaybouly Districts (see Table 9 for participant demographic information). Selected interviewees were contacted to gauge participation interest and were interviewed at a mutually consented location, usually their office. Interviews were conducted in English when possible and in Lao through a WHO local staff member when necessary. Interviews lasted between 45 and 90 minutes and all interviews were transcribed within 48 hours of completion. Informed consent was obtained from all participants prior to the interview and participants were not compensated for their time. The Duke University Institutional Review Board deemed that this research was exempt from human subjects research ethical review [Protocol #B0045; approved 16 April 2012]. Data was entered into Nvivo 9, then coded and analyzed by themes identified by the research team (see Table 10).

3.2.2 Document Review

The literature and document review began prior to arriving in country and continued throughout the research process. Articles relevant to HMIS and data management were collected via PubMed and Google Scholar, and relevant documents were collected through the WHO, donors in Laos, the Lao MoH, and the Global Fund. Examples of documents reviewed include Global Fund grant proposals and related documentation, national program plans, third-party consultant reports, health information reports, and MoH and partner guidelines.

3.2.3 Informal Observations

Informal observations complemented the in-depth interviews and were conducted primarily during procurement and supply chain-related meetings with key stakeholders in Laos. Meetings types ranged from small staff meetings with individual units to the Global Fund Country Coordination Mechanism meeting on 8 July 2012. Attending meetings provided great insight as to how the national-level programs handled PSM issues as they arose, and also how tight deadlines and requests from the Global Fund were managed.

3.2.4 Frameworks for Analysis

Both the WHO and the USAID | DELIVER Project (DELIVER) have established guidelines for looking at data in healthcare programs in developing countries. This research is based on these guidelines, including: the WHO's "Developing Health Management Information Systems: A Practical Guide for Developing Countries" and "Framework and Standards for Country Health Information Systems," and USAID's "The Logistics Management Information System Assessment Guidelines" and "Measuring Supply Chain Performance" Guide to Key Performance Indicators for Public Health Managers."^{31,55-57}. All four frameworks stress the importance of data that is accurate, complete, has adequacy, and is timely. The frameworks also provide guidance on how the components of an HMIS should be integrated into health

programming, as well as how data should be disseminated to stakeholders for policy decisions.

DELIVER has also identified essential indicators for PSM activities for HIV and malaria.⁶¹ These indicators also guided the research and helped identify where Laos is experience data management challenges. The indicators include:

- Consumption data: The quantity of each product dispensed or used over the past twelve months
- Services data: The number of visits or services provided, treatment episodes, or number of patients on treatment over the past twelve months
- Morbidity data: Incidence and prevalence of HIV/AIDS, opportunistic infections, malaria
- Demographic and population data: Population numbers and growth, demographic trends
- Information on current program performance: Plans, strategies, and priorities, including specific programs targets for each year of the quantification

PSM-specific indicators required for programing planning include:⁶¹

- National- or program-level stocks on hand: The quantifiable number of commodities available, preferably based on physical inventory (including losses and adjustments)
- Expiry dates of stocks on hand: Used to determine whether goods will be used before they expire
- Quantity on order (pipeline stocks): Quantity of commodities already ordered, but not yet received
- Procurement lead times: Amount of time before stocks arrive in country

- Supplier lead times: Amount of time a supplier needs to produce goods
- Shipment intervals and current delivery schedule
- Established national- or program-level minimum and maximum stock levels
- Product information: Patent status, registration status, prequalification status, specific product characteristics (formulations, dosages, number of units per pack size, unit cost, etc.)
- Supplier information: Prices, packaging, lead times, shipping and handling costs
- Funding information: funding sources for procurement, funding disbursement

3.2.5 Research Limitations

This research is restricted to Laos, thereby limiting the scope of extrapolation beyond the Lao content. Research was conducted for nine weeks in Vientiane Capital and one week in Savannakhet Province, and ideally would have allocated equal research time to all 17 provinces. Data management and HMIS challenges were not the sole focus of this research, and as a result, the study design is not optimized to focus specifically on these issues. Ideally, qualitative data would have been supplemented with quantitative analyzes of data management systems and processes.

Table 9: Participant demographic information

Region	Program Level	Number of Interviews	Interview Languages
Vientiane Capital	Global Fund	4	English: 4 Lao: 0
Vientiane Capital	Ministry of Health & National-level programs	13	English: 9 Lao: 3
Vientiane Capital	National-level partners (non-governmental)	9	English: 9 Lao: 0
Savannakhet Province (Capital)	Provincial	6	English: 1 Lao: 5
Savannakhet Province (Capital)	Provincial-level partners (non-governmental)	1	English: 0 Lao: 1
Phine District (Savannakhet Province)	District & Health Center	5	English: 0 Lao: 5
Xayboully District (Savannakhet Province)	District	3	English: 0 Lao: 3
TOTAL		41	English: 24 Lao: 17

Table 10: Coded themes by focus area

Focus Area	Coded Theme	Number of Citations	Total Number of Citations
Data Collection and Reporting	Quantification	41	194
	Requesting	37	
	Data	36	
	Reporting	34	
	Monitoring & Evaluation	17	
	Data Analysis	13	
	Forecasting	9	
	Language Barriers	7	

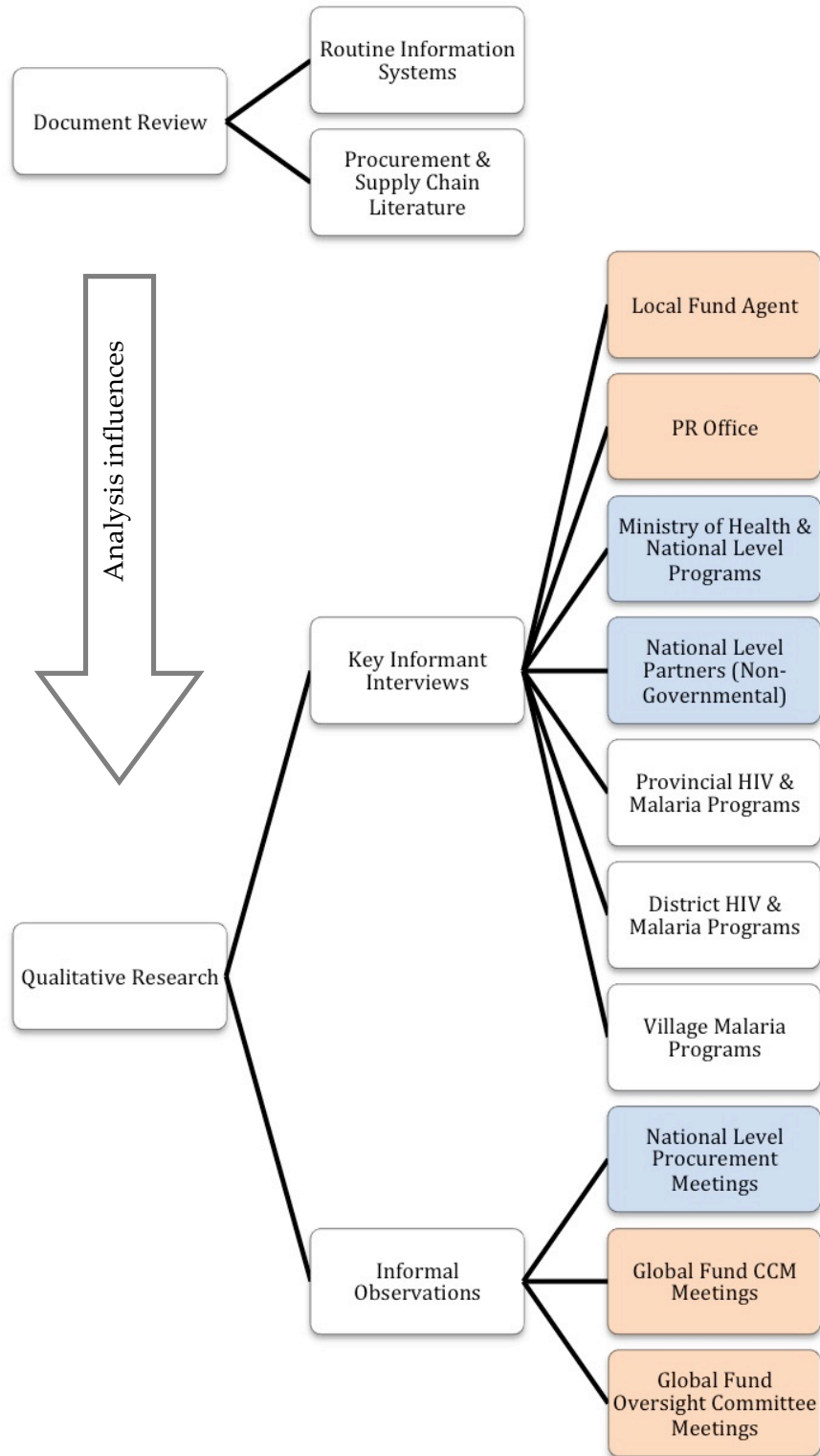


Figure 12: Study design and methodology (orange boxes indicate Global Fund level; blue boxes indicate national-level programs)

3.3 Results and Discussion

Data management is a significantly problem for Laos' HIV and malaria programs. The aforementioned frameworks guided data analysis and yielded three areas of data processes that are particularly problematic: data collection, data analysis, and data reporting. As the literature shows, Laos is not alone in its struggle to main data management systems, but an absence of data and poor quality data are deleterious for national health programs and PSM activities. This section will discuss the results found pertaining to data collection, analysis, and reporting, as well as touch on the issues that contribute to overall poor data management.

3.3.1 Data Collection

Timely, reliable data collection is essential program management and supply chain implementation. Key-informant interviews, informal observations, and document review all stated that primary data for both HIV and malaria is either missing or of questionable quality, but HIV and malaria have different core issues with data collection. HIV indicators are primarily collected from patient records and facility-based data and collecting that information is part of routine care. CHAS determines which HIV indicators are collected and reported based on the demands of the Global Fund, but patient and facility logbooks were reported by participants to have more indicators than what is required for monthly reporting. Facility-based participants indicated that collecting HIV data was part of their daily routine care and could be done easily,

however CHAS participants said that receiving this information from HIV sites was a challenge (see reporting results). M&E indicators are limited to what is required by the Global Fund and are not an adequate check for data quality. CHAS is currently developing an M&E strategy for all HIV programming, but it has yet to be implemented and thus is not currently a tool for collecting M&E data. Because CHAS is so heavily focused on reporting to the Global Fund, they only are interested in receiving data from Global Fund-supported programs administered through the MoH. As a result, data from programs that function outside of Global Fund programming are not factored into CHAS's overall program plans and reports. These organizations (i.e. World Vision) operate in specific provinces and districts and are accountable to local governments and their own stakeholders, but data from those programs are not aggregated by CHAS to understand the complete HIV landscape in Laos.

Malaria primary data collection begins at the village level with VHVs and health centers, and the unreliability of those entities cause problems for the entire supply and reporting chain. VHVs were the most commonly cited reason that data does not move smoothly through the malaria reporting chain. One national-level participant at a UN agency said, "You want good diagnosis, good treatment, good follow-up – it's a lot to ask, especially of volunteers." VHVs are given very limited training and are not always aware of the importance of their participation in the system. A participant from a provincial malaria office said that they would sometimes call a VHV's mobile phone to

follow up on missing data, but there was not a clear protocol in place to retrieve missing data. A national-level participant at CMPE said, “We ask VHVs to report so much without incentives.”

The Global Fund Principal Recipient Office at the MoH (PR Office) is the office ultimately responsible for reporting to the Global Fund and is increasing “chasing data”. Because the Global Fund is becoming more stringent on data quality, participants at the PR Office reported that they have to repeatedly ask CHAS and CMPE to revise or track down information that was previously submitted. This causes confusion and tension between the Global Fund, the PR Office, and national programs, as well as increases delays in data analysis and reporting. The tension between the Global Fund, the PR Office, and national-level programs was also seen during informal observations at meetings. While national-level participants were quick to cite lower levels of the system as the reason for poor data collection (“Data management doesn’t work at the province or district level” – National-level CHAS participant), there is a larger systemic problem with understanding the need for good data collection and using the correct indicators for program evaluation. As one national-level NGO participant at a UN Agency said, “Unless the boss uses data, no one will create it.”

Poor quality or missing data is highly problematic for PSM activities. There is currently no database for the whole country about primary data indicators or logistics, and there seems to be a critical disconnect between CHAS and CMPE and the lower

levels of their respective reporting chains, particularly related to PSM activities. CHAS and CMPE have data about the number of commodities used in country, but distribution data beyond what is delivered to the provincial levels is difficult to track down. Once commodities are distributed from the central warehouse, the ability to control what data is collected about each commodity seems to dissipate.

3.3.2 Data Reporting

Submitting and receiving data reports on schedule is an integral part of a data management system. However, participants at all levels indicated that receiving reports was a huge challenge and that they often did not receive reports on times. CHAS and CMPE participants reported that the provinces range in efficiency and timeliness of reporting, but “it is not always [the province’s] fault because they receive data late and submit what they have.” A national-level participant cited “Reporting is a problem you cannot avoid. We all have to work together to make reporting possible.” Reports are difficult to collect, particularly from Health Centers and villages where there are very limited human resources working on a wide range of activities. A provincial-level malaria participant said that they were usually able to get reports from VHVs that live near a health center, but VHVs in far villages are more difficult to track down. Reporting channels are not straightforward, and there are often multiple departments at the same facility that report separately on indicators. A provincial-level hospital employee noted that VCT for HIV is reported from the tuberculosis clinic, the maternity

ward, and the general outpatient HIV ward. It was not clear if HIV data from different wards of the same facility were reported together or separately to CHAS. A health center-level participant explained that they had to submit malaria forms to two different entities. ACT and RDT data go to one group at the District Health Office and the daily office report goes to a different group at the District Health Office. This dual reporting includes overlapping data and causes unnecessary work for healthcare workers.

In order to track the HIV epidemic, it is important to understand what types of patients are coming in for HIV testing and then reporting on that information. Female sex workers, men who have sex with men, injectable drug users, and pregnant women all participate in testing, but there are other populations that engage in testing as well (i.e. sex workers' partners and men accompanying their pregnant wives or girlfriends). Tracking all populations that engage in HIV program activities will help CHAS develop a better understanding of how Laotians are interacting with HIV programs and what must be done to increase access to HIV services. A Global Fund-level participant expressed frustrations over poor reported data saying, "the country must report clearly and accurately and be honest if you do not have the data. Do not overinflate data or lie just to fill out the forms."

Terminology used on reporting forms was also cited as a challenge. Sites report data differently, resulting in inconsistent data. For instance, one provincial-level hospital employee noted that their facility indicates someone is Ab+ (positive for

antibodies) if they are HIV positive, where as other facilities indicate patients as HIV+.

There are not guidelines for how to report facility-level indicators for HIV or malaria patients, resulting in data translation issues and uncertainty. Many participants said that forms were difficult to use and that indicators change between Global Fund rounds and amongst donors. Forms are paper-based and require stamped approval before they can be passed up through the system. This requires the physical form to be passed along to superiors and is a time burden for those responsible for reporting. Transporting forms is done on an ad hoc basis, with some people using their own vehicles and other depending on local buses to connect different levels of the supply chain.

A participant from an UN Agency cited language as a challenge with international procurement and reporting, and this was also often reiterated during observations. The MoH operates in Lao and the Global Fund operates in English and French. The Global Fund also requires detailed spreadsheets and forms, which arguably are a language in and of themselves. Data management skills in Microsoft Excel or other data software are not integrated school programs and those involved with data management are expected to learn software independently. Observations confirmed that conversations would be held in both English and Lao, and those who did not speak Lao (notably international employees who worked for non-governmental organizations and the Global Fund) were often given short synopsis of what was discussed in Lao, clearly missing the nuances of what was said.

3.3.3 Data Use

Looking at collected data and analyzing it for accuracy and cohesion is a necessary part of any data management system. Each level of the supply chain is supposed to collect and analyze their own and aggregated data from lower levels of the system before reporting indicators up the chain. For example, a District Health Office is supposed to collect and analyze malaria data on patients seen at their own site, as well as analyze and report data from VHVs and Health Centers in their catchment area to the Provincial Health Office. Data should be analyzed for accuracy, clarity, and provide an overall sense of how programs are running. Currently, interviews and observations indicated that collected data is rarely analyzed for consistencies or continuity before it is passed up the chain. The fragmented data collection system makes it difficult to get a comprehensive view of health programs, and the lack of data analysis at the aggregation point causes problems throughout the system, notably for quantification and forecasting.

Participants from all system levels reported frustrations about the lack of data analysis and the challenge of working with poor quality data. One Global Fund-level participant said, “people get data, but they don’t analyze it. They just push paper along to the next person.” A national-level CHAS participant said, “We need to not just see numbers, but analyze them and give feedback.” Quality checks need to be done on data received from villages and health centers, but there is not a thorough M&E process

established. A Global-Fund level participant noted and informal observations confirmed that spreadsheets are filled with errors and inconsistencies, including multiple names for the same drugs, and different expiry dates and quantities from report to report. A national-level CMPE participant explained that if procurement indicators are left blank on reporting forms, they leave those provinces out of the overall report to the Global Fund and will report only on provinces that submit data. This skews information downward and does not accurately reflect the country's situation.

3.3.3.1 Quantification and Forecasting

Quantification and forecasting has been weak to date. Participants and document review found that poor quantification has resulted in reduced budget allocations, as exhibited in the 2010-2011 procurement cycle. CHAS estimated that 4,000 people would be on ARVs that year, but data from that time period showed that only 2,000 patients were on ARVs. The Global Fund required a budget reduction for ARVs the following year due to the discrepancy in indicators. The national-level employees in charge of quantification are at different levels of training and understanding, but are expected to manage commodity groups for different elements of the CHAS and CMPE programs. Observations indicated that these individuals, particularly in CHAS, did not cross check information with each other.

Procurement plans must incorporate all commodities and services for the entire program. HIV must incorporate indicators for the three most at-risk populations

(female sex workers, men who have sex with men, and injectable drug users), pregnant women, and tuberculosis patients, as well as indicators on opportunistic infections and healthcare for HIV positive patients. HIV testing sites run the risk of counting the same patient multiple times if they go to different sites to get tested multiple times, or if they get tested every three months due to the HIV infection window period. There is not a mechanism to track patients at the individual level, so consumption data may not accurately reflect how many individuals are being tested for HIV, which would skew reported information. Malaria receives reports from malaria sites, but also from epidemiological reports that characterize outbreaks of malaria by province. Two national-level participants at CMPE felt that the epidemiological data should be the foundation for planning and forecasting, but it does not currently serve that role.

Both HIV and malaria participants at the national level indicated that forecasting for both HIV and malaria is based on last year's consumption rates with an additional 10% added for presumed use. The Global Fund does not provide forecasting models, so each program essentially creates their own forecasting requirements. This has not proven to universally work, as HIV test kit consumption was much higher than expected and projecting malaria need is difficult to predict. One Global Fund-level participant said, "working together on quantification and forecasting is helpful and we need to have good communication." The Global Fund's Voluntary Pooled Procurement mechanism (in which Laos was mandated to join in 2009 and all Global Fund-supported

procurement goes through) is not agile and does not easily allow for changing quantification and forecasting data. If a program needs to change a requested quantity of goods, that change must also be reflected in other Global Fund reports, including work plans, PSM plans, target indicators, budgets, etc. While the need to have all elements of a country's plan consistent make sense, national-level participants at both CHAS and CMPE reported that they felt they were constantly reworking Global Fund reports, not actually implementing HIV or malaria programming.

3.3.4 Summary of Results

This research reveals a number of data management issues that negatively impact Laos' health system. Larger systemic issues of program management and information flow are certainly problematic, as is overall technical capacity of those working with data. Incentives for high quality data collection and reporting are weak or absent, and cause health workers to prioritize other activities over data management. Perceptions about data collection and use vary across levels, but there is a general lack of understanding about the importance and role of data in health programs. Training on data management has not stressed the value of quality data, and those working with data do not receive feedback from higher-ups about how the data they provide are used. Health workers at lower levels of the reporting structure will continue to struggle with understanding the value of data management without an established data feedback loop. Informal observations at health centers found that facilities lack access to

computers and calculators, thereby making data analysis very difficult due to a paper-based reporting system. It is vitally important that Laos improves its data systems given that the long-term sustainability of PSM activities are directly linked to improving data management.

3.4 Conclusions and Recommendations

Our research found that data management problems are present throughout the entire supply chain, and poor reporting structures and have a direct negative impact on program performance and health indicators. Laos struggles to maintain adequate data management processes within their HIV and malaria programs, and while there are national guidelines and protocols for managing and reporting data, it does not seem that those procedures are followed. It is evident, however, that without improving data management within both programs, the MoH will continue to operate in crisis mode and will not be able to proactively plan. Because the Global Fund is now stressing the importance of quality data to make informed program and policy decisions, Laos must take steps to ensure better access to quality and timely data in the HIV and malaria programs. Making concrete, tangible changes to the current data management system can help improve overall program functionality and performance.

Suggestion 1: Employ a portion of people for data management at each level

It is imperative that a portion of staff and time are allocated to the data management process at each level of the supply chain. At the national, provincial, and

district levels, full time staff should be assigned to data management and reporting. Those staff require appropriate training and compensation for their requirements, and a sufficient number of staff should be hired to fulfill data management needs. Because so few people work at the village and health center levels, it is not practical to allocate individuals exclusively to data management, but an individual should be assigned with data management responsibilities. Employees at the health center and village levels should be given adequate training to understand how to do data collection and reporting, but should also understand the importance of their role for overall health and programming. Effective oversight of data management is essential and should be built into every level of the supply chain. Using Braa, Heywodd, and Sahay's model of collaboration among healthcare workers involved in data management could help bolster Laos' overall data management system as well.⁴⁵

Suggestion 2: Revise the VHV program and transition it to a Village Health Worker

The public health system depends on VHVs, but the systemic inadequacies of the VHV program are detrimental to the overall health of the country. VHVs are very valuable for data collection, particularly for malaria, but the program has not been successful at ensuring continued access to quality data. Because VHVs are unpaid and not incentivized correctly to participate in data collection and reporting, the program must be reworked so that valuable village-level data is incorporated into health planning. The MoH should transition away from the current VHV program to a paid

and compensated Village Health Worker program or otherwise structure financial incentives to align with good and consistent data collection. Village Health Workers should be given at least six months training (compared to their current 1 week of formal training and ad hoc trainings for specific health outreach opportunities) and specifically taught how to collect and report data. The positions must be viewed by candidates as desirable and offer workers a viable alternative to their current means of employment.

Suggestion 3: In the long-term, simplify and streamline reporting forms amongst health programs

Data indicators and forms are inconsistent among Global Fund funding rounds and amongst different donors. Complicated forms and indicators are difficult for programs to capture, particularly at the health center and village levels where literacy is a major concern. Although this would be very challenging and require coordination amongst different funding partners, the MoH should work towards streamlining forms and indicators, and making literacy adaptations to make completing reports easier. There are formidable challenges to doing this, namely that each donor organization has their own indicators that must get reported on, but it is something to move towards as Laos continues to improve its data management system.

Suggestion 4: Additional data management research is required

This study was not optimized to analyze Laos' data management challenges, so it is important to build on this research with additional studies looking specifically at how

data is incorporated in the health system. Future studies would ideally look at all health programs and identify data harmonization opportunities across programs and sectors.

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Appendix A: Research Instrument

Questions asked of health workers are based on USAID | DELIVER's framework for evaluating public health supply chains in developing countries and were adapted for the Laotian context. Overarching management themes (based on integrated supply chain principles):

- Is there clarity of roles and responsibilities for people involved in procurement and supply chain roles?
- How agile is the supply chain at your level? Are you able to adapt to changing demands and needs of your patients?
- Are there ways to streamline the procurement or supply chain processes?
- Are you able to access data related to the supply chain? Can you easily collect data related to supply chain or procurement?
- Do you feel that you can collaborate with others in the supply chain? Do you receive feedback on your facility/village plans or reports?
- Do you feel you share a common vision, goal, and/or objective with health workers in the supply chain?
- Does the system effectively use standard operating procedures to define roles and guide logistics functions, and include a process for training staff on their use?
- Does the system have and use a functional logistics management informational system that supports higher-level visibility of demand and tracking of metrics for supply chain performance monitoring?
- Does the system have a Logistics Management Unit sufficiently empowered to

manage overall logistics across separate entities in the organization to the service delivery level?

- For coordinating with upstream supply chain partners, particularly suppliers, has the system developed mechanisms such as extending visibility of real-time demand information?

Are the “six rights of logistics” followed at the site? Does the participant have ideas for improving any of these processes?

- Are the right commodities being purchased?
- Are the right quantities being purchased?
- Is the commodity arriving in the right condition?
- Is the commodity being delivered to the right place?
- Is the commodity being delivered at the right time?
- Is the commodity priced right (for both the supplier and customer)?

Procurement and supply chain activities rely on specific indicators to gauge whether or not programs are successful. Ideally, participants should be willing to show logbooks and data collection forms, but it is not required as part of the interview. At facilities, take note of any commodities or records storage. Indicators include:

- Consumption data
- Services data

- Morbidity data
- Demographic and population data
- Information on current program performance
- National- or program-level stocks on hand
- Expiry dates of stocks on hand
- Quantity on order (pipeline stocks)
- Procurement lead times
- Supplier lead times
- Shipment intervals and current delivery schedule
- Established national- or program-level minimum and maximum stock levels
- Product information
- Supplier information
- Funding information

Data management-focuses questioned include:

- Are participants aware of the following indicators?
- Are participants able to identify where this information can be found (both for their site and sites below them)?
- How do participants collect data (paper, computer, cell phone, etc.)? Is data collection part of their routine service delivery?
- Is there an assigned person to handle data?

- Are participants able to get reports from lower levels of the chain?
- What are some of the challenges related to data collection and reporting?

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