



Open-source LIMS in Vietnam: The path toward sustainability and host country ownership[☆]



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ABSTRACT

Objective: The objectives of this case report are as follows: to describe the process of establishing a national laboratory information management system (LIMS) program for clinical and public health laboratories in Vietnam; to evaluate the outcomes and lessons learned; and to present a model for sustainability based on the program outcomes that could be applied to diverse laboratory programs.

Methods: This case report comprises a review of program documentation and records, including planning and budgetary records of the donor, monthly reports from the implementer, direct observation, and ad-hoc field reports from technical advisors and governmental agencies. Additional data on program efficacy and user acceptance were collected from routine monitoring of laboratory policies and operational practices.

Results: LIMS software was implemented at 38 hospital, public health and HIV testing laboratories in Vietnam. This LIMS was accepted by users and program managers as a useful tool to support laboratory processes. Implementation cost per laboratory and average duration of deployment decreased over time, and project stakeholders initiated transition of financing (from the donor to local institutions) and of system maintenance functions (from the implementer to governmental and site-level staff). Collaboration between the implementer in Vietnam and the global LIMS user community was strongly established, and knowledge was successfully transferred to staff within Vietnam.

Conclusion: Implementing open-sourced LIMS with local development and support was a feasible approach towards establishing a sustainable laboratory informatics program that met the needs of health laboratories in Vietnam. Further effort to institutionalize IT support capacity within key government agencies is ongoing.

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1. Introduction

The United States President's Emergency Plan for AIDS Relief program (PEPFAR) enabled a rapid scale-up of HIV testing and treatment in Vietnam. To effectively manage the increased volume of testing and accompanying data needs, health laboratories in Vietnam required support to strengthen data management. Laboratories services in Vietnam, and particularly testing for HIV care and treatment, are provided in a wide range of facilities (i.e. high and low throughput, automated and manual testing methods, urban and rural settings). The Government of Vietnam desired a

laboratory information management system (LIMS) that was both flexible and scalable. The US Government required all PEPFAR-funded programs to have a focus on sustainability, which meant that ownership and financing of these programs would be transferred to the country government over time.

Therefore, in 2006, the U.S. Centers for Disease Control and Prevention (CDC) and the Government of Vietnam (GVN), “the stakeholders”, set out to create a sustainable national open source LIMS program in Vietnam in clinical and public health laboratories.

2. Background

Health services in Vietnam fall into two parallel, tiered systems: preventive medicine—managed by the General Department of Preventive Medicine (GDPM) – and medical services – managed by the Vietnam Administration for Medical Services (VAMS). Specialized (e.g. disease-targeted) programs, often with substantial donor funding, operate alongside these systems with separate leadership and program management structures. The medical services system includes 1100 hospitals from the national, provincial/municipal and district level, with over 100 additional private hospitals. The preventive system is comprised of national research institutes, provincial or municipal preventive medicine centers, district health centers and commune health stations. The majority of laboratory services are offered at the district level or higher, with commune health stations providing simple screening tests or collecting and transporting samples for further testing [1].

Published data on the medical informatics landscape in Vietnam is limited. In 2004, two years before the start of the LIMS program, a survey showed that hospital information systems were present in many national and provincial hospitals. District hospitals, while not yet implementing HIS, often had computers and internet access. This survey did not look at systems for laboratory data management [2]. A study conducted in 2008 similarly showed that paper records remained the norm for patient records with only 5% of public hospitals using computerized systems for patient management [3]. A 2008 case study found that the biggest factors limiting adoption of health information systems were lack of qualified IT staff in the health field and lack of financial investment [4]. By 2012, computers had become widespread at district health centers, and in 2016, the Government of Vietnam set the goal that 99% of health facilities would have broadband internet access by 2020 [1,5]. A number of eHealth projects have been implemented in Vietnam, often through donor financing, to support patient management and case reporting, with varying degrees of success [6–8].

Globally, LIMS have helped laboratories meet quality standards, decrease transcription errors, reduce turnaround time from specimen receipt to reporting of results, and improve patient outcomes [9]. Although interest in establishing a LIMS program in Vietnam was motivated by a desire to support testing for HIV care and treatment, the selected LIMS application needed to support broader clinical and public health testing services and, therefore, have an appropriately scalable data model. Indeed, implementers of eHealth projects in developing settings have noted the necessity to design data models with future data needs in mind [10]. Open-source LIMS have been implemented around the world, including resource-constrained settings [11,12]. The Government of Vietnam favored the use of open source applications to reduce software procurement costs and to build information technology capacity within Vietnam [13,14].

Sustainability is essential to the viability and longevity of health interventions in resource-constrained settings, particularly those funded and implemented by international donors [15]. PEPFAR's Sustainability Agenda includes country ownership, local leadership and appropriate national policies for successful program

implementation [16]. Factors linked to the sustainability of open-source projects include presence of developer and user communities, reliable release cycle, governance, modular architecture, software documentation, and professional support services [17]. Open-source projects with sponsorship and reliable financial support have demonstrated improved project success metrics [18]. As with projects in many other fields, the support of executives and the presence of “champions” within an organization have also been shown to improve the outcome of health information system (IS) projects [19]. A model for implementing open-source EMR presented by Ludwick and Doucette recommends the following strategies to mitigate risks: establishing strong leadership, using accepted project management techniques, ensuring adequate staff training, and using a standards-based approach [19]. Implementers of LIMS in resource-constrained settings have identified the importance of building expertise in-country and utilizing local resources in order to maximize impact and ensure financial viability [20].

Informed by this, the stakeholders set out to establish a sustainable, national LIMS program for health laboratories in Vietnam. Routine program monitoring sought to evaluate the efficacy of the LIMS application and enable implementers to adjust development, deployment and management strategies in an iterative process. This report describes the process of establishing an effective national LIMS program in Vietnam and presents a proposed model for sustainability that could be applied to a wide variety of laboratory programs.

3. Research methods

Qualitative methods are particularly useful in IS research when studying a process as it develops and emerges [21]. Published research on LIMS implementation in developing settings, and the contribution of open-source software to sustainability in this context, are limited. Sources of qualitative data for IS research can include documentation, archival records, interviews, direct observation, and physical artifacts [22,23], this analysis.

This case report relies primarily on monthly progress reports from the implementer, ad-hoc trip reports from technical advisors and independent consultants, annual reports from Government of Vietnam agencies, and planning records of the donor. These sources were reviewed for information regarding the formation of the national LIMS program as well as descriptive data on program efficacy and the challenges experienced during implementation. Archival budgetary records were used to conduct a longitudinal financial analysis of program expenditures for consumables, personnel, development and contracted maintenance costs. In 2016, a national monitoring tool was implemented in order to continuously improve the program by assessing user adoption, operational processes, the policy framework, the organizational and external environments, and system functionality. This tool was used at six geographically diverse laboratories in Vietnam and uses a structured questionnaire and direct observation to observe laboratory processes and assess laboratory policies and procedures. This LIMS Policy and Adoption Assessment yielded valuable information that could be used for qualitative analysis (Table 1).

The qualitative case report approach in IS research allows investigators to generate theories from practice and explore the complex interactions between numerous variables including environment, processes and the application system [23–25]; indeed, through an iterative process of planning, development, deployment and assessment, the implementers developed a sustainability model and attempted to identify the key factors required for sustainability. These factors, and their effects on development and deployment processes, user acceptance and system functionality, are presented for discussion.

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