An Evaluation of the Village Health Volunteers-based Aedes Larval Indices Surveillance System in Thailand, 2022: A Mixed-methods Study

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Abstract

Objectives: To describe the usefulness, processes, and qualitative and quantitative attributes of the Village Health Volunteer-based Larval Indices Surveillance System (VHV-LISS) in Thailand.

Methods: We used a mixed-methods approach to assess three reporting platforms under the VHV-LISS from 1 Jan to 31 Dec 2022. Qualitative analysis encompassed interviews of 57 stakeholders in Chaiyaphum and Mae Hong Son Province, summarized by thematic analysis. Quantitative analysis involved assessing completeness of larval indices data, and comparing the VHV-LISS with another surveillance platform, specifically the "TanRabad" survey.

Results: We found the VHV-LISS to be a long-standing, integrated vector surveillance and control activity conducted by village health volunteers. Although the system is useful for controlling local vectors, community engagement, resource allocation, and stakeholder acceptance varied. Technological constraints, such as volunteer capacity and difficulties in using applications, and inconsistent reporting methods were observed. VHV-LISS platforms provided 85.4% completeness in larval indices data and covered more households than the TanRabad survey. However, the surveillance platform was limited in data accessibility and exchanging mechanisms, and reporting redundancies were evident. Correlation coefficients of larval indices between surveillance platforms ranged from 0.00 to 0.13, which led to low confidence in using the data.

Public Health Recommendations: Standard guidelines and unified larval indices data structures alongside local training and support for village health volunteers are needed to overcome these VHV-LISS limitations.

Keywords: village health volunteers, vector-borne diseases, public health surveillance, mosquito control, larval indices

Introduction

The village health volunteer-based larval indices surveillance system (VHV-LISS) is a surveillance system for *Aedes*-borne diseases in Thailand aiming to reduce the disease burden, aligned with the World Health Organization Global Vector Control Response Framework.[1,2] Local public health officers (PHOs) and village health volunteers (VHVs) routinely conduct surveillance using larval surveys, proposed by World Health Organization. Larval indices such as the house index (HI), container index (CI), and Breteau index (BI), alongside key containers and water-holding containers with the highest CI, are commonly reported. These support policymakers in prioritizing high-risk areas in controlling vector-borne diseases.

The VHV-LISS was implemented in Thailand as a paper-based system, without official and comprehensive documentation on its origin. In 2016, a digital-based surveillance system called TanRabad, was developed for PHOs in order to support the collection and utilization of larval indices. This system was used by PHOs internally, without open access to the public.[3] In the same year, the VHV-LISS was migrated to a digital-based platform. To date, there are three existing online platforms associated with the VHV-LISS, namely AorSorMor Online (ASMO), Smart OrSorMor (SOSM), and the Royal Thai Volunteers Program (RTVP), operated by VHV. To date, there has been no evaluation of the VHV-LISS; and specifically, no comparison has been made across the VHV-LISS platforms and the TanRabad survey, addressing whether these systems conducted separately by PHOs and VHVs were consistent, and could therefore be combined into one national surveillance system. Therefore, we conducted this evaluation to describe the structure and workflow of the VHV-LISS, evaluate its usefulness, and describe its quantitative and qualitative attributes, particularly data completeness and data consistency and compare these with the TanRabad survey as the reference platform.

Methods

Study Overview

A mixed-methods study was used, encompassing the processes of a larval survey, larval indices collection, and larval indices reporting. This evaluation will focus only on routine-based VHV-LISS and use of platforms to report larval indices data (HI and CI). Three surveillance platforms included: 1) ASMO, co-held by the Division of Vector-Borne Diseases (DVBD), Department of Disease Control and a private telecommunication company, 2) SOSM, held by The Primary Health Care Division (PHCD), Department of Health Services Support, and 3) RTVP, a spreadsheet-based platform held by the DVBD. According to the national guidelines, VHVs are recommended to conduct larval surveillance on a weekly basis, and report their results to the platform on a weekly (ASMO, SOSM) or monthly (RTVP) basis. The study period was from 1 Jan–31 Dec 2022. The Centers for Disease Control and Prevention (CDC) guideline for evaluating public health surveillance systems were used as a core framework for the study.[4]

Qualitative Study

We conducted a qualitative study to describe the structure, workflow, usefulness, and qualitative attributes of the systems. Qualitative attributes were acceptability, simplicity, flexibility, and stability as defined in the CDC guideline.[4] The list of questions for each surveillance characteristics are shown in Table 1. Two study districts were purposively selected based on consultations between the principal author and an expert in vector-borne disease control (K.B. and D.A.). Criteria for site selection were the reporting completeness in VHV-LISS platforms; ten districts with the highest completeness (in ASMO, SOSM, or RTVP, in district-week unit) were initially selected, from which two would be purposively chosen based on region representativeness, logistic feasibility, and study site availability. The selected study sites were Chatturat District, Chaiyaphum Province, Northeastern Thailand and Pai District, Mae Hong Son Province, Northern Thailand. Local public health authorities involved in VHV-LISS, including health promoting hospitals, district and provincial public health offices, and the centre of vector borne disease control, were included. The central administrative departments in the Ministry of Public Health involved with VHV-LISS were also included, namely the DVBD and the PHCD. We interviewed stakeholders, including VHVs, local administrative officers, PHOs in local, provincial, regional, and national levels, and policymakers who had at least three months of active involvement in VHV-LISS in 2022. Data collection consisted of focus-group interviews with VHVs and local PHOs, and in-depth interviews with local administrative officers, PHOs, and policymakers. Responses were recorded on standardized questionnaires that asked about structure, workflow, usefulness, and qualitative attributes. We directly observed a larval survey conducted by VHVs using a participant observation method for half a day. The findings were summarized using deductive thematic analysis.

Quantitative Study

We extracted the nationwide larval indices data from the public dashboards of the VHV-LISS surveillance platforms (ASMO, SOSM, and RTVP), between 1 Jan–31 Dec 2022. We assessed the data completeness of larval indices for each platform alongside cumulative and overlapping data completeness. First, we accessed the platforms through publicly available channels. We then identified the geographical units (province, district, subdistrict, village) and time units (month, week) used to report larval indices and determined the comparable geographical time units (e.g., district-month) for which larval indices data were available and could be compared across platforms. Data completeness was defined as the proportion of geographical time units with available larval indices

data (either HI or CI) relative to the total number of geographical time units during the study period. Cumulative data completeness was defined as the proportion of geographical time units with available larval indices from either surveillance platform divided by the number of geographical time units during the study period. Overlapped data completeness was defined as the proportion of geographical time units with available larval indices in all platforms divided by the number of geographical time units during the study period. Completeness was reported as a percentage. The Mann-Whitney U test was used to compare completeness between outbreak (May–August) and non-outbreak months within each platform.

We examined the data consistency within VHV-LISS platforms and the TanRabad survey by comparing the available larval indices and analyzing the correlation coefficients in geographical time units, as described above. Data consistency was defined in terms of similarity of larval indices data across the platforms. We assumed that the larval indices retrieved from every surveillance platform in the same geographical time unit should be similar, and the correlation coefficient should be nearly 1. Access to the TanRabad database was provided by the co-authors employed by the DVBD (TP and PW). Python with the Pandas and Seaborn packages were used as analytic tools.

Table 1. List of questions used in assessing the characteristics of the VHV-LISS, 2022.

Characteristic	Question (responder)
VHV-LISS structure and workflow	• When do you conduct larval surveys in your community? (VHVs)
	• Please describe the method you use to conduct larval surveys in your community. (VHVs)
	• How do you record and transmit the larval indices data from the surveys in your community? (VHVs)
	• What resources—such as personnel, time, and money—do you use for each larval survey? (VHVs)
	• How have you been supported with resources or enumeration for conducting larval surveys in your community? (VHVs)
	• What role do you and your organization play in the VHV-LISS? (PHOs)
	• What resources—such as personnel, time, and money—are required for VHV-LISS? (PHOs)
	• How are you supported with resources or enumeration for VHVs participating in the VHV-LISS? (PHOs)
	• How do you receive information from the VHV-LISS? (Policymakers)
	• Please describe the steps of the VHV-LISS, as far as you know. (Policymakers)
	• How do you support resources or provide enumeration for the VHV-LISS? (Policymakers)
Usefulness	• How do you use the data from larval surveys in your community? (VHVs)
	• How do you utilize the data from VHV-LISS in your area of responsibility? (PHOs, Policymakers)
Acceptability	• What are your thoughts on the current larval survey process in your community? (VHVs)
	• What are your thoughts on the current larval survey practices in your area of responsibility? (PHOs, Policymakers)
	• What policies and strategies do you currently implement related to the VHV-LISS? (Policymakers)
Simplicity	• Do you think the current system for surveying and reporting larval indices data is easy? Please explain. (VHVs, PHOs)
Flexibility	• If there is any change in larval indices reporting format —such as adding/removing data fields, increasing survey frequency, or changing the reporting channel/application—how would this affect your work? (VHVs, PHOs, Policymakers)
Stability	• If VHVs are insufficient or are occupied with other duties, how do you think this would affect the larval indices survey and reporting activities? (VHVs, PHOs)
	• If VHVs responsible for recording larval indices encounter problems (e.g., application crashes or inability to use the platforms), how would this affect the VHV-LISS, and how would you handle such situations? (PHOs)
	• If VHVs or PHOs are insufficient or are occupied with other duties, how do you think this would affect the VHV-LISS? (Policymakers)

VHV-LISS: village health volunteer-based larval indices surveillance system. VHVs: village health volunteers. PHOs: public health officers.

Results

Qualitative Findings

We interviewed 57 stakeholders, including 33 VHVs who had a median experience of conducting larval surveys of 10 years (interquartile range 7–17 years), two local administrative officers, eight local PHOs, six provincial PHOs, three regional PHOs, three national PHOs, and two policymakers.

Structure and workflow of VHV-LISS

On a weekly basis, each VHV conducted larval surveys for 10 to 30 households. Typically, VHVs worked in teams of 2–3, surveying households for water-holding containers, identifying larvae, and eliminating infested containers by overturning, trashing, or applying larvicides. They also educated household owners regarding larvae elimination. Larval indices (number and type of surveyed and infested containers) were recorded either on smartphones via VHV-LISS surveillance platforms or

on paper-based forms submitted to local PHOs (Figure 1).

From observations, inadequate surveys for containers inside households and underreporting of infested containers were observed, attributed to household closures, lack of cooperation from house owners, and hesitancy of the VHVs to access the interiors. The larvae control equipment, received from the local administrative office, were often inadequate. VHVs often used their personal money to buy resources needed for the survey: "The equipment used for the survey, such as torches, mosquito sprays, and mosquito-repellent coils, was purchased using personal funds. There is also a pooled fund (among VHVs) of about 100–200 Thai baht (around 3–6 USD) per year, which can be used (to buy equipment) when necessary." Inappropriate use of larvicide agents by VHVs was observed. Many VHVs used them haphazardly and were unsure about the recommended dosage or concentration to use in each container.
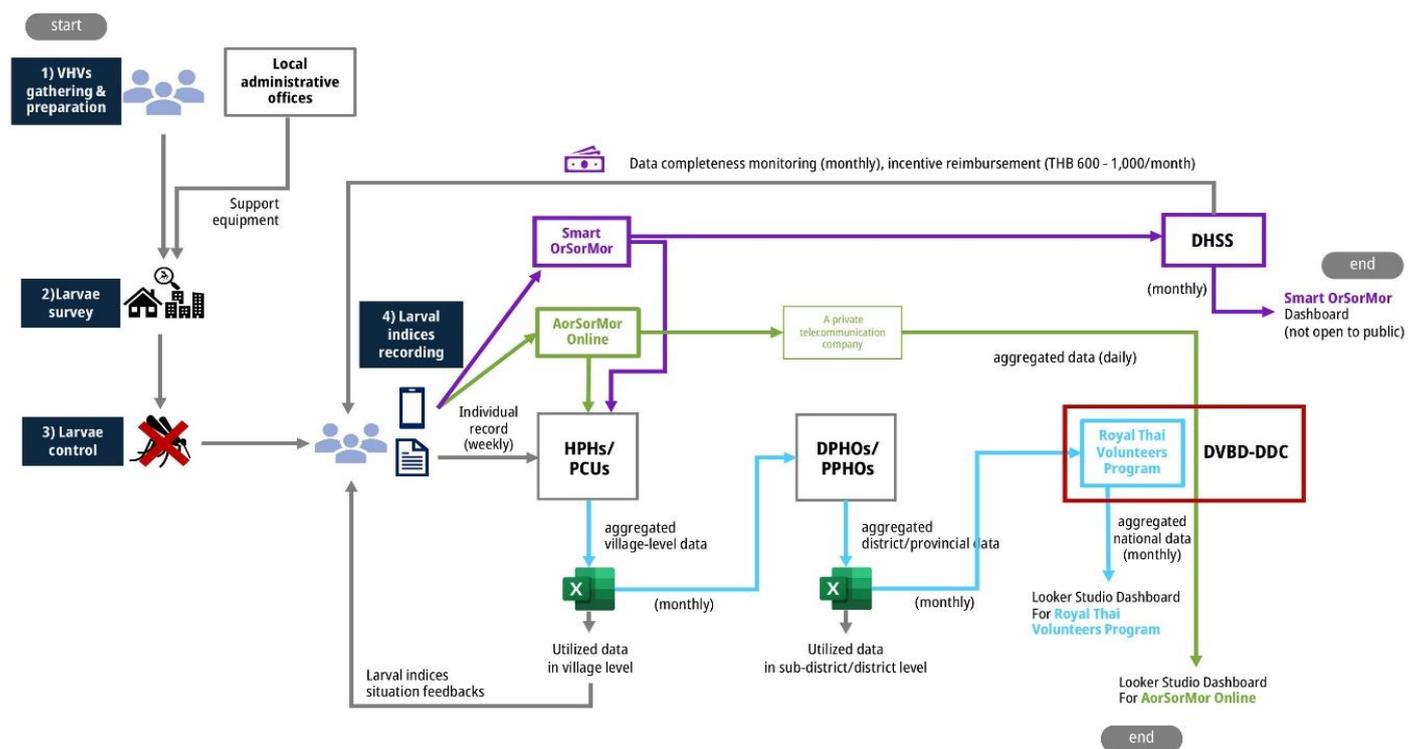
Green arrows represent workflow incorporating with the "AorSorMor Online" platform, purple arrows represent workflow incorporating with the "Smart OrSorMor" platform, and cyan arrows represent workflow incorporating with the "Royal Thai Volunteers Program" platform. HPHs: health promoting hospitals; PCUs: primary care units; DPHOs: district public health offices; DPHOs: district public health offices; DHSS: Department of Health Service Support; DVBD-DDC: Division of Vector-borne Disease, Department of Disease Control.

Figure 1. Workflow of routine-based larval survey in VHV-LISS, 2022.

VHVs only reported larval indices to some platforms, the choice depending on local policy. Several paper-based reporting forms were available as an alternative. In this case, local PHOs helped to transfer the data from paper to the online platform and

combined data from multiple platforms. For the ASMO platform, raw data was transferred to a private telecommunication company, which aggregated data daily before transferring them to the DVBD. The DVBD used aggregated data and published results in

Looker Studio Dashboard. For the SOSM platform, data were sent directly to the PHCD who assessed the completeness and reimbursed VHVs monthly. The PHCD also aggregated and published data to the internal dashboard, which was inaccessible to the public. In the RTVP platform, local officers combined data from the ASMO and SOSM platforms and performed data entry from paper-based record forms into spreadsheets. The local PHOs sent the data to district and provincial public health officers monthly. Provincial PHOs then transformed the data and sent them to the DVBD to be published in Looker Studio Dashboard for the RTVP. This platform was the main data source of larval indices utilized in villages, such as situation feedback to VHVs (Figure 1).

The VHV-LISS was useful in enhancing vector control and village sanitation by reducing mosquito populations during surveys. These surveys incentivize VHVs to actively seek and eliminate larval breeding sources, such as rubbish bins and water-holding containers. Also, surveillance strengthens the bond between VHVs and villagers. VHVs have an opportunity to engage with villagers weekly, enabling the implementation of health promotion activities. Additionally, data from VHV-LISS support risk assessment and local resource allocation. The data assisted public health officers in strategizing effective measures within their areas and supports risk communication with the public. The data was also used to validate VHVs' activities for reimbursement. However, access to VHV-LISS data was limited for stakeholders. Local administrative offices, responsible for equipment, did not use the VHV-LISS due to restricted access. Provincial health officers have limited access to application-based VHV-LISS surveillance platforms, which are usually not assigned to vector control officers. Consequently, these officers favored receiving aggregated data from spreadsheets and disregarding application data. Data exchange among platforms was also limited due to disparate data structures and lack of standardized protocols.

Acceptability

The acceptability of the surveillance system varied among stakeholders. VHVs were satisfied with larval surveys, viewing them as a core community engagement activity. Local PHOs also recognized the value of VHV-LISS data for local risk assessment. However, regional and national PHOs were uncertain regarding VHV-LISS data quality, perceiving it as inferior to the TanRabad survey in terms of sensitivity in detecting larvae and potential chances of underreporting.

Simplicity

VHVs were familiar with paper-based reporting. However, in transitioning to a digital-based platform, many VHVs mentioned challenges due to inconvenience compared to paper-based methods. Issues with the application, such as frequent technical errors, internet connectivity, and lack of capacity handling of incomplete recording, led VHVs to revert to using paper, especially among elderly VHVs, or those who struggled with the application during the survey. There were several different paper-based larval indices record forms, which were also inconsistent with application-based reporting data structure, leading to limitations in data migration from paper to electronic format.

Local PHOs faced difficulty in consolidating data from multiple sources due to the variety of data structure across platforms. As there was no support for the application-based platform when combining larval indices that met the local needs, local PHOs consolidated the data by manually exporting the data from applications into spreadsheets. Nevertheless, local PHOs could not return the validated data to the online application.

Flexibility

VHVs have embraced adaptation in reporting methods for larval indices in recent years. Although some challenges arose, the majority of VHVs managed to adjust within 1–2 months. Those who encountered difficulties in adaptation received assistance from peers and local PHOs. VHVs demonstrated a willingness to accommodate certain alterations in the VHV-LISS reporting process. They showed a preference for changes that supported their larval survey activities, such as the reclassification of container types.

Stability

VHVs showed interchangeability in conducting larval surveys. VHVs are skilled in larvae survey tasks, capable of stepping in for another in case of absence, ensuring continuous data collection. Conventional paper-based larval surveys offered a stability buffer for the VHV-LISS. If any instability was encountered in the application-based platform, VHVs had the alternative of sending data via paper. Local PHOs served as a reliable backup for data collection. In the event of errors within the VHV-LISS platform, higher-level health authorities could rely on local officers to provide the necessary data, ensuring data stability and integrity.

Quantitative Findings

We explored the VHV-LISS surveillance data via public access. As data from the SOSM were not accessible, only data from the ASMO and RTVP platforms were assessed and analyzed in the remaining part of this study. The larval indices in the ASMO were available at the province, district, and subdistrict levels on a weekly basis whereas data in the RTVP were available at the province and district levels only and on monthly basis. To ensure comparability, weekly ASMO data were aggregated monthly, using district-month as the unit of analysis. ASMO captured household data exclusively, whereas RTVP included public premises, and neither platform reported key container data (Table 2).

Data completeness

Among 11,136 district-months (928 districts over 12 months), the cumulative data completeness yield was 85.4% (9,507/11,136). In the ASMO and RTVP platforms, data completeness was 70% and 41%, respectively, and 26.3% (2,926/11,136) of the data overlapped. We observed between 66.2–95.2% of cumulative data completeness across health regions. The RTVP platform was commonly used to report larval indices data in Bangkok (Health Region 13) while ASMO was the preferred platform in the other regions (Table 3). Almost half of the provinces in Thailand achieved 80% completeness in the ASMO platform compared to less than 40% in the RTVP

platform (Figure 2). Additionally, the ASMO platform had higher completeness in every observed month. There were also differences in completeness between outbreak and non-outbreak months within each platform; ASMO had slightly, but statistically significant, higher completeness in outbreak months (71.8%) compared to non-outbreak months (70.2%, p-value 0.012) while RTVP had higher completeness in non-outbreak months (35.5% vs 43.7%, p-value 0.016, Figure 3).

Table 2. Public dashboard availability and features of VHV-LISS surveillance platforms, 2022.

Dashboard Features		ASMO	RTVP
Public dashboard access		✓	✓
Larval indices	House index	✓	✓
	Container index	✓	✓
Geographical unit	Province	✓	✓
	District	✓	✓
	Subdistrict	✓	-
	Village	-	-
Time unit	Monthly	-*	✓
	Weekly	✓	-
Survey settings	Household	✓	✓
	Public premises	-	✓
Key container		-	-

* Original data in the ASMO platform were collected in weekly time unit but were converted to monthly data for comparison with the RTVP platform. ASMO: AorSorMor Online platform. RTVP: Royal Thai Volunteers Program platform.

Table 3. Completeness of larval indices data among ASMO and RTVP surveillance platforms, 2022.

Region	Area	Number of districts	Number of district-months	District-month (data completeness)			
				ASMO	RTVP	Cumulative	Overlapped
Overall		**928**	**11,136**	**7,867 (70.6%)**	**4,566 (41.0%)**	**9,507 (85.4%)**	**2,926 (26.3%)**
North	HR 1	103	1236	901 (72.9%)	942 (76.2%)	1177 (95.2%)	666 (53.9%)
	HR 2	47	564	444 (78.7%)	193 (34.2%)	494 (87.6%)	143 (25.4%)
	HR 3	54	648	607 (93.7%)	143 (22.1%)	617 (95.2%)	133 (20.5%)
Central	HR 4	70	840	372 (44.3%)	314 (37.4%)	556 (66.2%)	130 (15.5%)
	HR 5	62	744	515 (69.2%)	211 (28.4%)	571 (76.7%)	155 (20.8%)
	HR 6	69	828	513 (62.0%)	225 (27.2%)	603 (72.8%)	135 (16.3%)
Northeast	HR 7	77	924	562 (60.8%)	513 (55.5%)	722 (78.1%)	353 (38.2%)
	HR 8	87	1,044	777 (74.4%)	409 (39.2%)	892 (85.4%)	294 (28.2%)
	HR 9	88	1,056	920 (87.1%)	615 (58.2%)	1005 (95.1%)	531 (50.3%)
	HR 10	70	840	751 (89.4%)	98 (11.7%)	773 (92.0%)	76 (9.0%)
South	HR 11	74	888	707 (79.6%)	38 (4.3%)	710 (80.0%)	35 (3.9%)
	HR 12	77	924	795 (86.0%)	320 (34.6%)	842 (91.1%)	273 (29.5%)
Bangkok	HR 13	50	600	2 (0.3%)	545 (90.8%)	545 (90.8%)	2 (0.3%)

ASMO: AorSorMor Online platform. RTVP: Royal Thai Volunteers Program platform. HR: health region. Cumulative data completeness: number of district-months which have larval indices data in either ASMO or RTVP platforms divided by total observed district-months; Overlapped data completeness: number of district-months which have larval indices data in both ASMO and RTVP platforms divided by total observed district-months.
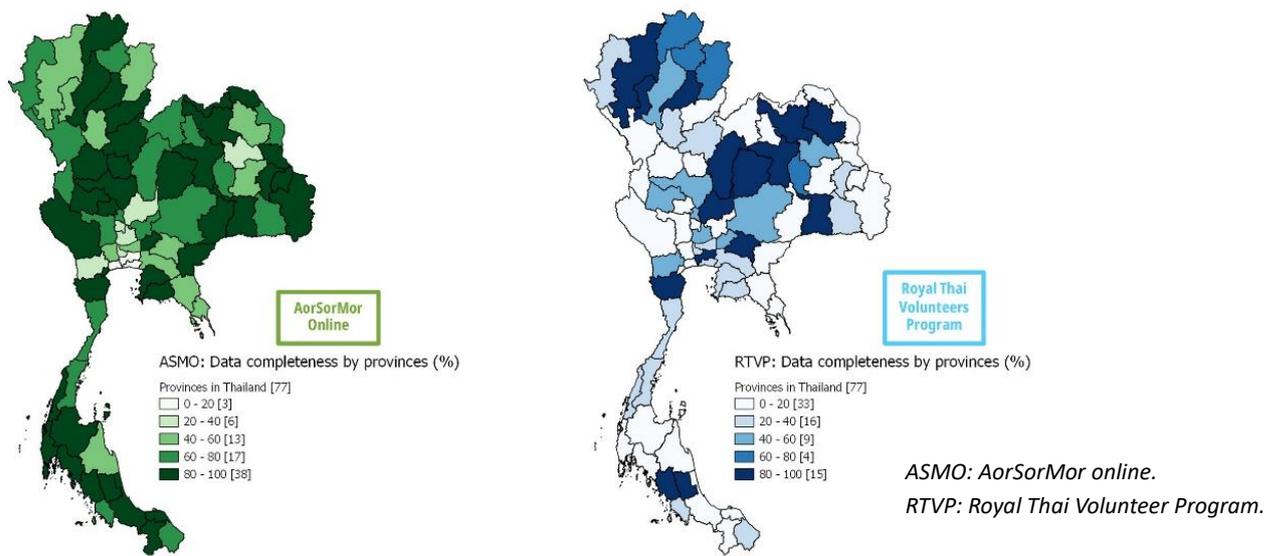
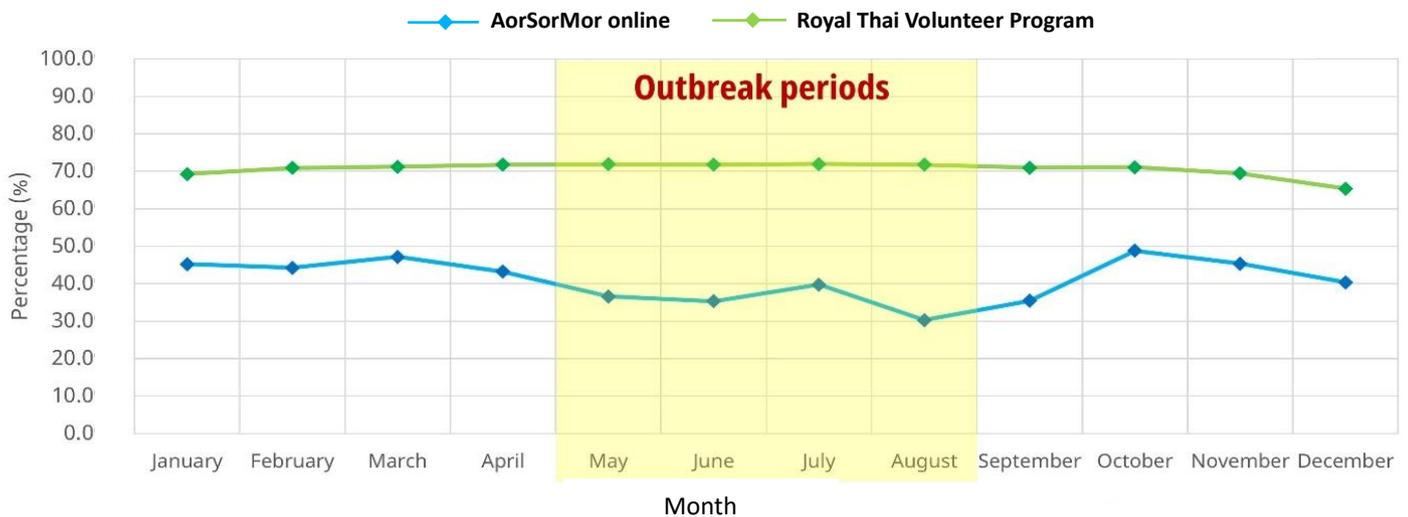**Figure 2. Data completeness among two VHV-LISS surveillance platforms by province, 2022.**

Figure 3. Data completeness among VHV-LISS surveillance platform by month, 2022 (n=928 districts).

Data consistency

The VHV-LISS reported higher numbers of house surveys compared to the TanRabad survey. The ASMO platform provided larval indices that had a more similar visual pattern to the reference standard than those from RTVP (Table 4). However, when comparing the same larval indices in the same district month among the ASMO, RTVP, and TanRabad survey platforms, correlation coefficients ranged from 0.00 to 0.13 (Figure 4).

Table 4. Summary of larval indices data among VHV-LISS surveillance platforms and comparison with TanRabad, 2022.

Cumulative larvae indices data	TRB	ASMO	RTVP
Houses surveyed	95,439	31,574,712	24,518,701
Containers surveyed	647,525	347,352,609	103,069,883
Average container surveyed per house	6.8	11.0	3.0
Houses infested	13,602	3,235,878	2,178,603
Containers infested	23,403	8,035,944	3,314,500
House Index (%)	13.7	10.2	6.3
Container Index (%)	3.6	2.3	3.2

TRB: TanRabad. ASMO: AorSorMor Online platform. RTVP: Royal Thai Volunteers Program platform.
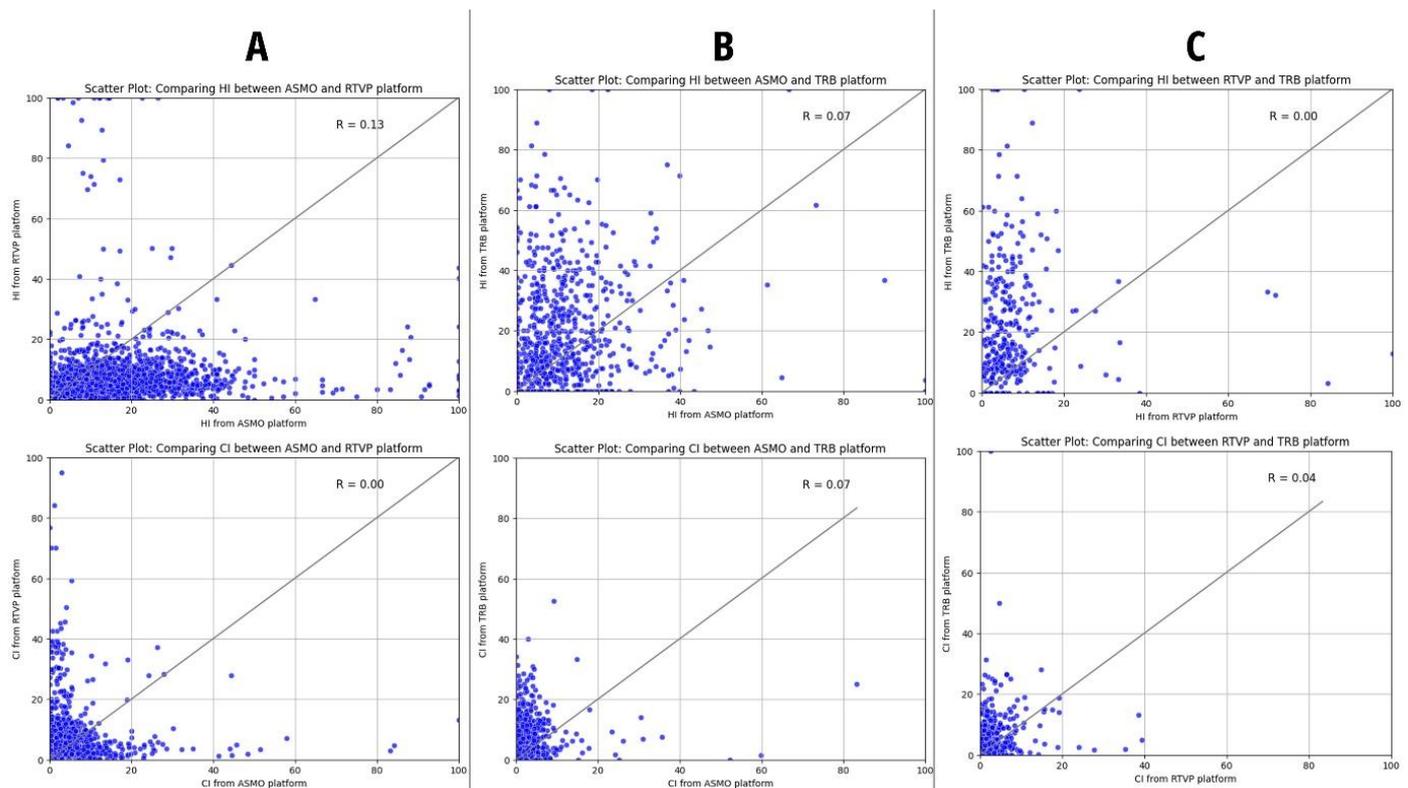
Figure 4. Scatterplots of larval indices between LISS surveillance platforms at the district level, 2022. The panels compare AorSorMor online platform (ASMO) with Royal Thai Volunteers Program platform (RTVP) (A), ASMO with TanRabad (TRB) (B), and RTVP with TRB (C). The top panels are for house index (HI) and the bottom panels are for container index (CI). The correlation coefficients (R) are shown in the top right-hand corners of each panel. One dot represents one district-month.

Discussion

The VHV-LISS serves as a vital community-level surveillance system, facilitating engagement between VHVs and villagers while supporting local disease control efforts. Several studies have examined the development, implementation, and evaluation of the surveillance system in various contexts at the local level.[5–11] Our evaluation complemented the previous literature by focusing on the surveillance system from the national authority perspective. We discovered its usefulness of VHV-LISS in disease prevention and control for local communities. However, its effectiveness was hindered by significant human and structural challenges. VHV limitations in survey techniques and reporting often result in low sensitivity and underreporting, diminishing confidence among regional and national public health offices who consequently prefer surveillance systems run by their own staff.

The transition to application-based reporting has introduced barriers. Issues such as application errors, connectivity requirements, and device incompatibility—particularly for elderly VHVs—often force a reversion to paper-based recording. This necessitates manual data consolidation by local health officers, a burdensome

process prone to data loss due to differences in data structures. The fragmentation of VHV-LISS into multiple platforms (ASMO, RTVP, SOSM) with restricted interoperability prevents effective data sharing and merging. Local administrative offices responsible for providing vector control equipment are often excluded from data access, creating a disconnect between resource allocation and actual need.

Quantitatively, while surveillance platforms demonstrated high completeness, consistency remains a notable weakness. Compared with the reference standard, TanRabad survey, significant discrepancies in larval indices at the district-month level were evident. Consequently, while VHV-LISS succeeds in community mobilization, its low consistency limits its reliability for high-level risk assessment and predictive modeling.

Limitations

This is the first evaluation of the VHV-LISS since its transformation in 2016. Our mixed-methods study, on-ground observations and interviews, and analysis of nationwide data, provide a comprehensive evaluation of the current VHV-LISS. Despite this strength, our study has several limitations. First, the

qualitative analysis was confined to districts with high compliance, potentially overestimating workflow effectiveness and limiting generalizability to areas with low compliance. Second, restricted accessibility to some VHV-LISS databases, particularly SOSM, prevented its inclusion in quantitative assessments. Discrepancies in geographical time units across platforms also hindered direct comparisons. Although we converted the existing data to a comparable unit, some inaccuracies may have remained. Finally, the unavailability of direct methods to assess VHV-LISS data quality with the actual larval indices in nature led us to use the TanRabad survey platform as a proxy for data consistency. Nevertheless, we believe the comparison of VHV-LISS with this reference platform was a pragmatic approach to address data quality.

Public Health Recommendations

We propose that local administrative offices be allowed access to surveillance data to ensure consistent provision of larval control equipment. PHOs should implement regular refresher training courses for VHVs on survey methods and data entry to improve their skills. Protocols must be established to unify data structures across paper and digital platforms. PHOs should be granted rights to input, modify, and audit data to ensure accuracy before aggregation. The Ministry of Public Health, and public health agencies in territories having *Aedes*-borne diseases, should unify current platforms into one standardized larvae indices surveillance system. This system must support more granular geographic data (e.g., village level) and remain compatible with conventional survey methods to minimize redundancies.

Conclusion

VHV-LISS serves as a community-based vector control surveillance system, fostering engagement between village health volunteers and public health officers. However, its potential is constrained by platform fragmentation, technological barriers, and low data consistency. While digital platforms demonstrated improved data completeness, the lack of interoperability limits their utilization. To enhance efficacy, Thailand should move toward a unified surveillance system with standardized data structures and strengthened capacity building for volunteers to improve data accuracy.

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Authors Contributions

Krittinan Boonrumpai: Conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, validation, visualization, writing—original draft. **Tippayarat Plibai:** Formal analysis, investigation. **Pachara Wongprasert:** Formal analysis, investigation. **Darin Areechokchai:** Conceptualization, supervision, validation.

Ethical Approval

This surveillance evaluation was conducted as a usual operational activity of the Division of Epidemiology, Department of Disease Control, Ministry of Public Health. The formal ethical approval was exempted. Nevertheless, the study was conducted according to the ethical standards consistent with the Declaration of Helsinki.

Informed Consent

Informed consent was obtained, either verbally or in writing, from all participants involved in the study.

Data Availability

The data of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The author declares no conflicts of interest.

Funding Support

Declaration of Generative-AI and AI-assisted Technologies in the Writing Process

During the preparation of this work, the authors used grammar, ChatGPT, and Google Gemini to enhance clarity and correct grammatical errors. The content produced by this tool was reviewed and edited by the authors, who accept full responsibility for the final text.

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