Thai Health Sciences Frontiers
วารสารวิทยาศาสตร์สุขภาพไทยก้าวหน้า
THSF

RESEARCH ARTICLE

Results of Developing a Community Communicable Disease Surveillance Network in Khamin Subdistrict, Mueang Kalasin District, Kalasin Province

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☐ **Received:** 14 October 2026 ✓ **Revised:** 17 October 2026 ☑ **Accepted:** 31 October 2026

Citation: Anosri C. Results of developing a community communicable disease surveillance network in Khamin Subdistrict, Mueang Kalasin District, Kalasin Province. Thai Health Sciences Frontiers. 2026;1(3):16-30.

Abstract

This quasi-experimental one-group pretest-posttest study aimed to compare knowledge, attitudes, behaviors, disease control efficiency, and emergency response capability before and after developing a community communicable disease surveillance network, and to assess participant satisfaction, in Khamin Subdistrict, Mueang Kalasin District, Kalasin Province, from June to December 2024. The sample comprised 47 network members: village health volunteers (VHVs), Subdistrict Health Promoting Hospital officers, Local Administrative Organization disease control officers, and community leaders. Instruments included a 5-stage network development program and questionnaires on demographics, knowledge, attitudes, behaviors, disease control efficiency, emergency response capability, and satisfaction. Data were analyzed using descriptive statistics and the paired t-test.

Most participants were female (61.70%), with a mean age of 49.00±12.23 years; 53.19% were VHVs. After the intervention, all mean scores increased significantly ($p<0.001$) from moderate to good levels: knowledge (10.19±2.73 to 13.72±1.45), attitudes toward network collaboration (34.61±5.24 to 43.69±3.78), surveillance practice behaviors (32.38±6.47 to 42.77±4.29), disease control efficiency (25.95±4.83 to 34.02±3.47), and emergency response capability (21.35±4.72 to 29.36±3.28). Satisfaction was high (43.22±4.57 out of 50; 86.44%), particularly regarding benefits received. Developing a community surveillance network based on Social Network Theory and community participation, integrating knowledge and skill development, positive attitudes, communication and reporting systems, emergency simulations, and continuous follow-up, strengthened partners' capacity to monitor, prevent, and control communicable diseases and may serve as a model for primary care units in similar contexts.

Keywords: Communicable disease surveillance network, network development, community participation, village health volunteers

Introduction

The communicable disease surveillance system is a key component of the public health system, playing a vital role in preventing and controlling disease transmission at the population level, particularly following the COVID-19 pandemic, which severely affected health systems worldwide. The World Health Organization has therefore prioritized the development of surveillance systems capable of detecting outbreaks at an early stage.[1] Meanwhile, major communicable diseases such as dengue hemorrhagic fever, influenza, and emerging infectious diseases continue to impose a burden on the health system. Successful control of these diseases depends on the efficiency of the surveillance system and the speed of response to emergencies. Developing a surveillance network that integrates inter-agency collaboration and fosters community participation is therefore a key strategy for addressing public health threats.

Thailand has continuously developed its epidemiological surveillance system since 1969.[2] The 506 reporting system, the country's principal system for communicable disease surveillance, was upgraded to a digital platform (D506) and became fully operational on 1 January 2023.[3] The success of Thailand's communicable disease surveillance system stems from the collaboration of a network spanning the Ministry of Public Health, Provincial Public Health Offices, and Subdistrict Health Promoting Hospitals (SHPHs) down to village health volunteers (VHVs) at the community level. There are more than one million VHVs nationwide, each responsible for approximately 20 households, and they played a crucial role in surveying, screening, and referring at-risk groups during the COVID-19 pandemic.[4]

Social Network Theory explains that relationships among members, communication patterns, and the flow of information within a network are factors that determine the effectiveness of collaborative work.[5] The researcher therefore applied this theory together with the concept of Community Participation, in which the community takes part in planning, implementation, monitoring, and evaluation, and the concept of an Integrated Health System, which emphasizes linking information systems, coordinating plans, and sharing resources, as the conceptual framework for network development. International empirical evidence also indicates that community-based surveillance enables earlier detection of public health events and faster outbreak

response, particularly in areas with limited access to services.[6,7]

Khamin Subdistrict, Mueang Kalasin District, Kalasin Province, comprises both urban and rural communities with differing communicable disease surveillance needs. Data from 2024 show that the area continues to experience major communicable diseases, namely dengue hemorrhagic fever, diarrhea, and respiratory tract infections, with morbidity rates of approximately 15.40, 89.20, and 234.60 per 100,000 population, respectively. Surveillance in the area is carried out by the SHPH in collaboration with approximately 58 VHVs across 12 villages.[8] However, a preliminary assessment revealed that the network still had limitations in coordination, information flow, and emergency response, including a lack of data linkage between agencies, delayed reporting, a lack of systematic monitoring and evaluation, inequitable access to surveillance services in remote areas, and VHVs' limited ability to use information technology for reporting.

Given this background and significance, the researcher recognized that systematically developing a community communicable disease surveillance network, based on Social Network Theory and community participation, through the development of knowledge, attitudes, skills, communication and reporting systems, and emergency response drills, is an important approach to strengthening the surveillance, prevention, and control of communicable diseases at the primary care level. It would also provide information for establishing communicable disease surveillance guidelines in areas with similar contexts. The researcher therefore developed a community communicable disease surveillance network in Khamin Subdistrict and studied the effects of this development.

Research Objectives

1. To compare knowledge, attitudes, behaviors, disease control efficiency, and emergency response capability before and after the development of a community communicable disease surveillance network in Khamin Subdistrict, Mueang Kalasin District, Kalasin Province.

2. To assess satisfaction after the development of the community communicable disease surveillance network in Khamin Subdistrict, Mueang Kalasin District, Kalasin Province.

Methods

This study employed a quasi-experimental, one-group pretest-posttest design and was conducted from June to December 2024, for a total duration of 7 months. The study was divided into 3 phases:

Phase 1, preparation, sample selection, and pretest data collection (June 2024); Phase 2, implementation of the communicable disease surveillance network development program and follow-up (July–November 2024); and Phase 3, posttest data collection (2 weeks after program completion) and data analysis (December 2024).

Population: The population consisted of 54 members of the community communicable disease surveillance network in Khamin Subdistrict, Mueang Kalasin District, Kalasin Province, comprising village health volunteers (VHVs), SHPH public health officers, Local Administrative Organization (LAO) disease control officers, and community leaders.

Sample: The sample size was calculated using G*Power for the paired t-test (Means: Difference between two dependent means), with a medium effect size (effect size = 0.50),[9] a significance level of α = .05, a power of 0.80, and a two-tailed test, yielding a sample size of 34. This was increased by 30% to compensate for attrition, as the study was lengthy and required continuous participation, resulting in a sample size of 49: 27 VHVs, 5 SHPH public health officers, 5 LAO disease control officers, and 12 community leaders. Participants were selected from the network member registry using proportional stratified random sampling according to the inclusion criteria. During the study, 2 participants (4.08%) withdrew because they did not complete 2 training sessions, leaving 47 participants for data analysis, which exceeded the calculated minimum sample size.

Inclusion Criteria: Personnel working in the communicable disease surveillance system in Khamin Subdistrict, aged 18 years or older, having held their position for at least 6 months, able to attend all activities, and voluntarily consenting to participate in the study.

Exclusion Criteria: Plans to transfer or retire during the study period, inability to read or write Thai, health problems preventing continuous participation in activities, or withdrawal during the study.

Research Instruments: The research instruments consisted of the intervention instrument and the data collection instruments, as follows.

1. Intervention instrument: The community communicable disease surveillance network development program, developed by the researcher based on a literature review, focus group discussions with experts, and a study of the community context. The program comprised 5 stages. Stage 1, Building the knowledge base (July 2024), included a 1-day orientation to build shared understanding and a 2-day training on basic knowledge of communicable diseases, the surveillance system, and the D506 reporting system. Stage 2, Attitude development (August 2024), included a 1-day workshop to build positive attitudes toward

network collaboration and 2 days of developing communication and reporting systems via applications and LINE groups. Stage 3, Skill development (September 2024), included 2 days of hands-on practice in community surveys and data collection, 1 day of screening and referral skill development, and 1 day of emergency simulation and response. Stage 4, Implementation and monitoring (October 2024), included fieldwork with weekly follow-up for 4 weeks and 2 network meetings to exchange experiences. Stage 5, Evaluation and conclusion (November 2024), included an assessment of achievements and a summary of results to plan continued operations.

2. Data collection instruments: Six instruments were used: 1) a 6-item general information interview form; 2) a 15-item knowledge assessment on the communicable disease surveillance system with yes/no answers, total score 15, interpreted as good (12-15 points), moderate (9-11 points), and low (0-8 points); 3) a 10-item assessment of attitudes toward network collaboration, total score 50 (including 4 negatively worded items, which were reverse-scored before analysis); 4) a 10-item assessment of communicable disease surveillance practice behaviors, total score 50; 5) a disease control efficiency assessment[10] of 8 items (total score 40) and an emergency response capability assessment of 7 items (total score 35); and 6) a 10-item assessment of satisfaction with the network development, total score 50.[11] Instruments 3-6 used a 5-point rating scale and were interpreted according to Bloom's criteria as good (80-100%), moderate (60-79%), and low (below 60%).

3. Instrument quality testing: Content validity was examined by 3 experts, namely 1 physician specializing in epidemiology and 2 public health technical officers with expertise in epidemiology, using the Index of Item-Objective Congruence (IOC); all items scored at least 0.67 (criterion ≥ 0.50). The instruments were then piloted with 30 individuals with characteristics similar to the sample in another subdistrict of Mueang Kalasin District. The reliability of the knowledge assessment (KR-20) was 0.76, and the Cronbach's alpha coefficient of the attitude, behavior, disease control efficiency, emergency response capability, and satisfaction assessments was 0.84 (overall 0.86).

Data Collection: The researcher collected pretest data in June 2024 using the general information interview form and instruments 2–5, implemented the network development program from July to November 2024, and collected posttest data 2 weeks after program completion (December 2024) using instruments 2–6 through self-administered questionnaires.

Data Analysis: Data were analyzed as follows.

1. General characteristics of the sample, including sex, age, education level, position/role, and communicable disease

surveillance experience, were analyzed using frequency, percentage, arithmetic mean, and standard deviation.

2. Mean scores of knowledge, attitudes, behaviors, disease control efficiency, and emergency response capability before and after the network development within the same group were compared using the paired t-test, after the normality of score differences was confirmed with the Shapiro-Wilk test; the Wilcoxon signed-rank test was to be used if the differences were not normally distributed. Mean differences ($\bar{d}$), 95% confidence intervals (95% CI), and effect sizes (Cohen's dz) were reported, with statistical significance set at .05.

3. Satisfaction with the network development was analyzed using means and standard deviations and interpreted according to the criteria for each item and overall; suggestions from open-ended questions were summarized by thematic grouping.

Research Ethics

This study was approved by the Human Research Ethics Committee of the Kalasin Provincial Public Health Office. The researcher protected participants' rights by explaining the objectives, research procedures, and benefits of the study in advance. Participants had the right to accept or decline participation without any effect on the services they received or their work. Data were kept confidential using codes instead of real names, and results were presented in aggregate for academic purposes only. All participants signed informed consent forms before participating in the study.

Results

1. General Characteristics of the Sample

Of the 47 network members in the sample, most were female (29; 61.70%). The largest age group was 50-59 years (18; 38.30%), followed by 40-49 years (15; 31.91%), with a mean age of 49.00±12.23 years (minimum 32, maximum 67 years). The most common education level was upper secondary/vocational certificate (14; 29.79%), followed by primary education (12; 25.53%). Most were VHVs (25; 53.19%), followed by community leaders (12; 25.53%), while SHPH public health officers and LAO disease control officers numbered 5 each (10.64%). The most common communicable disease surveillance experience was 1-5 years (18; 38.30%), followed by 6-10 years (14; 29.79%), with a mean experience of 7.40±2.12 years, as shown in Table 1.

Table 1 General characteristics of participants in the community communicable disease surveillance network development, Khamin Subdistrict, Mueang Kalasin District, Kalasin Province (n = 47)

General characteristics	Number	Percentage
1. Sex		
Male	18	38.30
Female	29	61.70
2. Age (years)		
30-39 years	8	17.02
40-49 years	15	31.91
50-59 years	18	38.30
60 years and over	6	12.77
Age ($\bar{x}$±S.D.) = 49.00±12.23 years (min–max = 32–67 years)		
3. Education level		
Primary education	12	25.53
Lower secondary education	8	17.02
Upper secondary/vocational certificate	14	29.79
Diploma/high vocational certificate	5	10.64
Bachelor's degree	7	14.89
Higher than bachelor's degree	1	2.13
4. Position/role		
Village health volunteer (VHV)	25	53.19
SHPH public health officer	5	10.64
LAO disease control officer	5	10.64
Community leader	12	25.53
5. Communicable disease surveillance experience		
Less than 1 year	5	10.64
1-5 years	18	38.30
6-10 years	14	29.79
11-15 years	7	14.89
More than 15 years	3	6.38
Experience ($\bar{x}$±S.D.) = 7.40±2.12 years		

2. Comparison of Knowledge, Attitudes, Behaviors, Disease Control Efficiency, and Emergency Response Capability Before and After the Development of the Community Communicable Disease Surveillance Network

2.1 Knowledge of the communicable disease surveillance system: Before the network development, the mean knowledge score was 10.19±2.73 (67.93%), at a moderate level. The items with the fewest correct answers were that VHVs can report communicable diseases directly through the D506 system (38.30% correct), that all communicable disease patients must be isolated in hospital (44.68% correct), and that false or delayed reporting does not affect disease control (51.06% correct). After the network development, the mean knowledge score increased to 13.72±1.45 (91.47%), at a good level. The items with the most correct answers were that wearing a face mask helps prevent the spread of respiratory diseases and that handwashing with soap and clean water helps prevent communicable diseases (97.87% correct), while correct answers on reporting through the D506 system increased to 85.11%.

2.2 Attitudes toward network collaboration: Before the network development, the mean attitude score was 34.61±5.24 (69.22%), at a moderate level. The lowest-scoring items were that network meetings are a waste of time and unnecessary ($\bar{x}$ = 2.72) and that coordinating with various agencies makes work more complicated ($\bar{x}$ = 2.85). After the network development, the mean attitude score increased to 43.69±3.78 (87.38%), at a good level. The highest-scoring item was that information exchange among network members is important ($\bar{x}$ = 4.51), and all items were at a good level.

2.3 Communicable disease surveillance practice behaviors: Before the network development, the mean behavior score was 32.38±6.47 (64.76%), at a moderate level. The lowest-scoring items were coordinating with network members when communicable disease cases are found ($\bar{x}$ = 2.89) and attending network meetings and related activities ($\bar{x}$ = 2.96), both at a low level. After the network development, the mean behavior score increased to 42.77±4.29 (85.54%), at a good level. The highest-scoring item was referring communicable disease patients to appropriate agencies ($\bar{x}$ = 4.43), followed by reporting surveillance data within the specified time ($\bar{x}$ = 4.38).

2.4 Disease control efficiency: Before the network development, the mean disease control efficiency score was 25.95±4.83 (64.88%), at a moderate level. The lowest-

scoring items were continuous monitoring and evaluation of disease control ($\bar{x}$ = 2.98) and timeliness of surveillance data reporting ($\bar{x}$ = 3.06). After the network development, the mean score increased to 34.02±3.47 (85.05%), at a good level. The highest-scoring item was the ability to prevent disease spread ($\bar{x}$ = 4.38), followed by timeliness of surveillance data reporting ($\bar{x}$ = 4.36).

2.5 Emergency response capability: Before the network development, the mean score was 21.35±4.72 (61.00%), at a moderate level. The lowest-scoring items were coordination among network members in emergencies ($\bar{x}$ = 2.72), the ability to mobilize resources to respond to the situation ($\bar{x}$ = 2.87), and monitoring and evaluation of operations in emergencies ($\bar{x}$ = 2.96), all at a low level. After the network development, the mean score increased to 29.36±3.28 (83.89%), at a good level. The highest-scoring item was the ability to communicate with the public in emergencies ($\bar{x}$ = 4.34), followed by the speed of detecting and reporting disease outbreaks ($\bar{x}$ = 4.26).

2.6 Overall difference testing: The paired t-test showed that after the network development, the mean scores for knowledge ($\bar{d}$ = 3.53, 95% CI = 2.71-4.35), attitudes ($\bar{d}$ = 9.08, 95% CI = 7.46-10.70), behaviors ($\bar{d}$ = 10.39, 95% CI = 8.28-12.50), disease control efficiency ($\bar{d}$ = 8.07, 95% CI = 6.51-9.63), and emergency response capability ($\bar{d}$ = 8.01, 95% CI = 6.35-9.67) were significantly higher than before the development in all domains ($p<0.001$), with effect sizes (Cohen's dz) of 1.27, 1.64, 1.45, 1.51, and 1.42, respectively, all of which are considered large, as shown in Table 2.

Table 2 Comparison of mean scores of knowledge, attitudes, behaviors, disease control efficiency, and emergency response capability before and after the development of the community communicable disease surveillance network (n = 47) (paired t-test)

Variable (total score)	Before development		After development		95% CI	t	p-value
	$\bar{x}$	S.D.	$\bar{x}$	S.D.			
Knowledge (15)	10.19	2.73	13.72	1.45	2.71-4.35	8.74	< 0.001*
Attitudes (50)	34.61	5.24	43.69	3.78	7.46-10.70	11.26	< 0.001*
Behaviors (50)	32.38	6.47	42.77	4.29	8.28-12.50	9.95	< 0.001*
Disease control efficiency (40)	25.95	4.83	34.02	3.47	6.51-9.63	10.38	< 0.001*
Emergency response capability (35)	21.35	4.72	29.36	3.28	6.35-9.67	9.72	< 0.001*

*Statistically significant at p-value <.05

Note: All variables were at a moderate level before development and at a good level after development; $\bar{d}$ = mean difference (after – before); df = 46

3. Satisfaction After the Development of the Community Communicable Disease Surveillance Network

Network members' overall satisfaction with the network development had a mean score of 43.22±4.57 out of 50 (86.44%), at a good level. By item, the highest-scoring item was benefits received ($\bar{x}$±S.D. = 4.45±0.62), followed by overall satisfaction ($\bar{x}$±S.D. = 4.41±0.64) and appropriateness of the speakers ($\bar{x}$±S.D. = 4.38±0.65). The lowest-scoring items, though still at a good level, were appropriateness of the duration ($\bar{x}$±S.D. = 4.19±0.76) and support and follow-up ($\bar{x}$±S.D. = 4.23±0.74), as shown in Table 3.

Table 3 Satisfaction with the development of the community communicable disease surveillance network, Khamin Subdistrict, Mueang Kalasin District, Kalasin Province (n = 47)

Satisfaction with network development	$\bar{x}$	S.D.	Level
1. Appropriateness of program content	4.34	0.68	Good
2. Appropriateness of activity format	4.28	0.71	Good
3. Appropriateness of duration	4.19	0.76	Good
4. Appropriateness of media and tools	4.26	0.73	Good
5. Appropriateness of venue	4.32	0.69	Good
6. Appropriateness of speakers	4.38	0.65	Good
7. Support and follow-up	4.23	0.74	Good
8. Benefits received	4.45	0.62	Good
9. Overall satisfaction	4.41	0.64	Good
10. Willingness to recommend to others	4.36	0.67	Good
Total (maximum score 50)	**43.22**	**4.57**	**Good**

Discussion

Most participants in the network development were female, with a mean age of approximately 49 years; more than half were VHVs, and their mean communicable disease surveillance experience was 7.40 years. These characteristics are consistent with lessons learned from COVID-19 surveillance, prevention, and control by VHVs in northeastern Thailand, which found that most VHVs were female and played a key role in community communicable disease surveillance.[12] The relatively high age and experience of the participants reflect an understanding of the community context, which is an important asset in driving the network; at the same time, this may be a limitation in the use of digital technology. Activities therefore need to emphasize hands-on practice alongside knowledge provision.

Regarding knowledge of the communicable disease surveillance system, participants' knowledge scores increased significantly from a moderate to a good level after the network development. This may be because the program provided basic training on communicable diseases, the surveillance system, and the D506 reporting system combined with hands-on practice, consistent with a study finding that developing the knowledge of VHVs and communities in communicable disease prevention and surveillance significantly improved operational efficiency.[13] In particular, reporting through the D506 system, the lowest-scoring item before the development, increased markedly afterward, reflecting the importance of building capacity to use digital information systems. This is consistent with the approach of developing digital tools for displaying the situation of notifiable diseases under epidemiological surveillance.[14] Knowledge of basic disease prevention, such as handwashing and wearing face masks, was answered correctly by nearly all participants after the development (97.87%), which may reflect a good baseline knowledge of disease prevention.

Regarding attitudes toward network collaboration, attitudes changed from a moderate to a good level. Scores on negative statements, such as network meetings being a waste of time and coordination making work more complicated, improved markedly, reflecting a shift in perspective from fragmented to integrated work. This may result from workshop activities, experience sharing, and the creation of a shared vision, consistent with recommendations emphasizing cross-sector collaboration within communities to strengthen disease surveillance in rural areas,[15] and with Social Network Theory, which explains that information exchange and good relationships among members are at the heart of effective network collaboration.[5]

Regarding communicable disease surveillance practice behaviors, behaviors increased from a moderate to a good level. Notable improvements were seen in

coordinating with network members when cases were found and attending network meetings, both of which were at a low level before the development. This may be the result of developing clear communication and reporting channels, field practice, and weekly follow-up, consistent with a study finding that community-based surveillance detects public health events more effectively when clear reporting and coordination systems are in place.[7]

Regarding disease control efficiency, scores increased from a moderate to a good level, particularly the timeliness of surveillance data reporting, which is a key factor in controlling disease spread. This is consistent with a study finding that developing an integrated communicable disease prevention strategy effectively improved screening and patient care.[16] However, continuous monitoring and evaluation of disease control was the lowest-scoring item before the development; therefore, a simple and continuous monitoring and evaluation system should be further developed.

Regarding emergency response capability, scores increased from a moderate to a good level, particularly in coordination among network members and resource mobilization in emergencies, which were the lowest-scoring items before the development. This increase may result from simulation exercises, role assignments, and communication system testing, consistent with a review finding that people-centred community-based surveillance enables rapid outbreak detection and response.[6]

Regarding satisfaction, network members were satisfied with the network development at a good level, with benefits received scoring the highest, indicating that members valued the development in concrete terms. This is consistent with a study finding that VHVs and communities were satisfied with the developed surveillance system at a good level or higher,[13] and with the concept of community empowerment through participation and capacity building.[17] Appropriateness of the duration and support and follow-up scored the lowest, although still at a good level, reflecting the need to schedule activities in line with network members' workloads and to provide continuous support after the program ends.

This study has several limitations: 1) it was a one-group study without a comparison group, so the results may have been influenced by other factors, such as events in the area during the study (history) and the effect of repeated administration of the same instruments (testing effect); 2) disease control efficiency and emergency response capability were measured by self-assessment and may therefore be subject to social desirability bias; and 3) outcomes were measured only 2 weeks after program completion, so the sustainability of the outcomes cannot yet be determined.

Conclusion

The development of the community communicable disease surveillance network in Khamin Subdistrict, Mueang Kalasin District, Kalasin Province, based on Social Network Theory and community participation through a 5-stage program, was associated with significant increases in network members' knowledge, attitudes, behaviors, disease control efficiency, and emergency response capability from a moderate to a good level, and network members were satisfied with the development at a good level. This program may therefore serve as a guideline for strengthening the communicable disease surveillance capacity of primary care units in similar contexts.

Recommendations

1. Recommendations for Applying the Research Findings

1.1 District and provincial health agencies should establish the development of subdistrict-level communicable disease surveillance networks as a standard practice, shifting from reactive to proactive surveillance, and should promote budget integration among health agencies, local administrative organizations, and health security funds to support continuous operations.

1.2 The capacity of network members should be continuously developed, particularly in using the D506 reporting system and information technology, through monthly experience-sharing meetings and online media, together with incentive and recognition systems for outstanding network members.

1.3 A simple yet effective monitoring and evaluation system should be developed using indicators of knowledge, attitudes, behaviors, disease control efficiency, and emergency response capability, reassessed every 6 months, with the results used to improve operations.

1.4 Primary care units in similar contexts can adapt the program, starting with a joint situation analysis among multidisciplinary teams, local administrative organizations, and community network partners, tailoring activities to the population characteristics and culture of the area, and establishing learning networks and mentoring systems between subdistricts.

2. Recommendations for Future Research

2.1 Future studies should use a research design with a control group, conduct long-term follow-up to assess network sustainability, and examine application to the surveillance of other communicable diseases, such as respiratory, foodborne, and vector-borne diseases.

2.2 Objective indicators, such as the timeliness of reporting through the D506 system and the number of unusual events detected, should be added alongside self-

assessment to confirm disease control efficiency outcomes.

Acknowledgments

The author would like to thank the Director of Ban Non Chai Subdistrict Health Promoting Hospital for permitting the use of the study area and supporting the research; the Kalasin Provincial Chief Medical Officer and the Human Research Ethics Committee of the Kalasin Provincial Public Health Office for granting permission and ethical approval; and the Mueang Kalasin District Chief, village headmen, and all community leaders in Khamin Subdistrict for their support and facilitation. Sincere thanks are also extended to all members of the community communicable disease surveillance network who willingly participated in the research throughout the 7-month period, the multidisciplinary team of Ban Non Chai Subdistrict Health Promoting Hospital, and the 3 experts who kindly reviewed the research instruments and provided valuable suggestions.

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