

# Dengue Clinical Practice Guideline from Household to Hospital: A Case Study of Development and Evaluation in Southern Thailand

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## Research article

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# Abstract

## Background

Dengue is an important health problem in southern Thailand. However, the area has a surveillance-only prevention system, and there are no continuing guidelines for dengue treatment from households to primary care units (PCUs) or district hospitals. The objectives were to develop and evaluate the dengue clinical practice guideline (DCPG) from household to hospital.

## Methods

The study design used community participatory action research that integrated the IOWA model in 44 villages in the Lansaka district of southern Thailand. The DCPG was developed and tested with 26 health providers in five steps: 1) community preparation, 2) development of the guidelines, 3) use and monitoring, 4) evaluation and conclusion, and 5) referring technology. The questionnaires for evaluating opinion, knowledge, and practice contained 84 items. The content validity was verified by three experts (CVI= 0.80), and reliability was verified by 30 participants (Cronbach's alpha = 0.90). The Wilcoxon signed rank test was used to compare the situation before and after the use of DCPG, and guidelines were developed with accompanying diagrams.

## Results

Two results were found: 1) DCPG consisted of four steps: guidelines at households, primary care units, outpatient departments and emergency rooms, and inpatient departments in hospitals. A total of 39 dengue patients were divided into 20 cases admitted for IPD; observation at home, 18 cases; and one patient referred to province hospital; with no deaths during the study period. 2) The 26 health providers from the PCUs and hospital increased their knowledge, and attitude increase was not significantly different ( $P>0.05$ ). The 5 components of practice increased significantly ( $P<0.05$ ), but the practice of only taking intravascular fluid was not significantly different ( $P>0.05$ ).

## Conclusion

DCPG was an appropriate dengue solution from household to hospital. However, all stakeholders need to participate, integrate, and coordinate for continued use, monitoring and evaluation.

## Background

The pathology of dengue is not fully understood; there are two main factors: 1) increased vascular permeability resulting in plasma leakage, hypovolaemia and shock and 2) abnormal haemostasis due to vasculopathy, thrombocytopenia and coagulopathy, leading to various haemorrhagic manifestations. There are four serotypes of dengue viruses, DEN 1, DEN 2, DEN 3, and DEN 4, which are transmitted by *Aedes aegypti* mosquito [1]. There have been more than 200 outbreaks in tropical zones and subtropical zones. An estimated 2.5 billion people are at high risk infection, and signs and symptoms have been

observed in 50-100 million people. A total of 20,000 fatal cases of dengue are found in every 100,000 dengue cases [2, 3]. The severity of dengue could be death because of nonspecific treatment, and its threats followed signs and symptoms. However, dengue patients with dengue haemorrhagic fever (DHF) and dengue shock syndrome (DSS) have a shock stage of 44% and a mortality rate of 1-5% from of overload intravascular fluid [2], respectively.

Although there are serious efforts for dengue prevention, the effects of dengue fever are still very severe. There are many related factors, such as specific treatment, unspecific dengue vaccine development and acceptability [4], insecticide resistance [5], and climate change [6]. Social, demographic and environmental factors strongly influence the transmission patterns of vector-borne pathogens, with major outbreaks of dengue since 2014[7]. Moreover, socioeconomic factors that increase dengue outbreaks include the lifestyle of humans in the community and population density [8]. Then, the cost impact of dengue incidence and mortality rate from populations who had symptomatic dengue cases found 36 million populations per year in the world. There were 12 countries in southeast Asia in 2001-2010 that had dengue morbidity of 2.9 million, and the mortality of 5,906 patients per year results in the loss of 950 million (\$US) per year [9]. Moreover, the disability adjusted life year (DALY) was responsible for 1.14 million (0.73 million–1.98 million) disability-adjusted life-years in 2013 [10]. As such, the dengue solution needs to prevent morbidity and use the appropriate treatment to decrease mortality.

The World Health Organization (WHO 1997) [1] set the guidelines for dengue diagnosis and treatment as the traditional/original classification into 3 types: 1) DF, 2) DHF and 3) DSS[1]. It was almost always used in children, but there are limitations to patient classification in primary care settings, such as HCT [11]. Some units do not have equipment or repeat testing, and some time tourniquet tests do not identify the status of plasma leakage and bleeding [12, 13]. The WHO 2009 [2] then issued new guidelines and treatments that define the three groups: 1) group A is dengue infection (probable dengue): travelling in the dengue outbreak area, two signs, and laboratory tests. 2) Group B is dengue with warning signs: DW has risk signs such as abdominal pain, continuous vomiting, increasing HCT, and decreased platelets. 3) Group C is severe dengue with leakage of plasma, bleeding, and dysfunction of several organs such as liver and kidney. However, a comparison of the guidelines of a dengue study found that the WHO 2009 guidelines are less complicated than other guidelines due to easy classification and case management [14]. Moreover, the 2009 WHO guidelines are an accurate standard that presented a sensitivity of 59-98% and a specificity of 41-99%. However, the 1997 WHO dengue guidelines had a sensitivity of 24.8-89.9% and specificity of 25%-100% [12].

However, the 2009 WHO dengue guidelines may be inappropriate for poor countries that lack equipment, personnel, and resources. Because of the criteria of dengue diagnosis for admission to the hospital, every patient needs laboratory tests when they have warning signs. Then, there were several more cases in the hospital that lacked health care providers in some context. In addition, there was showed 20-30% of DSS cases had no warning signs [15]. A study suggested that the dengue guidelines need to be appropriate in the context, and health care providers should be educated on the guidelines for health care (warning signs)[16]. Health care providers must have the capacity to diagnose signs and symptoms of dengue

patients (Gibson et al., 2013; WHO, 2009b). Thus, the DCPG needs to be integrated between evidence-based data and the context of the health care system for development, use and monitoring, which relates to the concept of the IOWA model and participation of all stakeholders [17].

Health providers have the role of dengue diagnosis and treatment at the primary and secondary health care level and referral system [2]. A research study that interviewed 236 dengue patients found that 83.9% went to primary care hospitals, with a mean length of stay of 1.4 days; they visited several health care units (68.7%), received the education regarding dengue prevention (96-98%), described with drug use (94.9%), drank water (79.7%), dengue infection (51.9%), and had blood tests [16]. A related study showed that health care providers need to develop skills and knowledge dengue disease, cause of infection, signs and symptoms, and complications of disease [14] related to dengue clinical practice, which can be used for decreasing severity and mortality rate [2].

In Thailand, the clinical dengue classification is based on the WHO 1997 guidelines (DF/DHF/DSS model), and the disease is divided into three phases: 1) fever phase: acute fever onset that is high and continuous and lasts 2 to 7 days; 2) critical /shock phase: 1/3 of patients in the fever decreasing range. The shock stage is characterized by rapid and weak pulse with narrowing of the pulse pressure or hypotension, cold, clammy skin and restlessness. These signs and symptoms are emerging leakages of plasma into the pleural and peritoneal cavities as hypovolemic shock within 24-48 hours (hrs.). In this phase, there is thrombocytopenia and haemoconcentration from decreasing platelets. Then, 3) the leakage of plasma stops in the convalescent phase, and it enters the vascular vessels, and pulse and blood pressure revert to normal, urine production increases, and pleural effusion occurs if the patient has severe shock [3, 18]. Based on these signs and symptoms, health providers need to correctly assess, diagnose, and treat dengue to decrease the length of stay and complications [16] because the death rate of dengue patients is 30% [14]. A study showed the necessity of appropriate health provider treatment and/or evidence-based management guidelines [19]. Then, the area needs to develop the appropriate DCPG.

The Lansaka district area is 342.90 km<sup>2</sup> ([https://tools.wmflabs.org/geohack/geohack.php?pagename=Lan\\_Saka\\_District&params=8\\_22\\_18\\_N\\_99\\_48\\_18\\_E\\_type:adm2nd\\_region:TH](https://tools.wmflabs.org/geohack/geohack.php?pagename=Lan_Saka_District&params=8_22_18_N_99_48_18_E_type:adm2nd_region:TH)). The Lansaka district is one of 23 districts of Nakhon Si Thammarat province, southern Thailand, consisting of 5 sub-districts, 44 villages, 11,427 households, and 43,056 populations. There are 8 primary care units and a hospital. This area was identified as a high-dengue risk area because there were higher dengue morbidity rates than the standard rate of 50 cases/100,000 people and a mortality rate higher than 0.2 cases per dengue cases [11]. The results showed that the morbidity rates in 2009, 2010, 2011, 2012, and 2013 were 209.1, 833.9, 52.4, 209.8, and 467.9 cases/100,000 peoples, respectively. The dengue mortality rates in 2010 and 2012 were 1.15% [20]. Then, for three years, they used a larval indices surveillance system (Lansaka model) for dengue prevention in the community [21] and found that decreasing dengue morbidity in 2014, 2015 and 2016 resulted in 164.9, 64.5 and 135.4 cases/100,000 peoples, respectively, and no case deaths [22].

According to the above mentioned studies, dengue is an important health problem in the Lansaka district. However, the area has had the surveillance-only prevention system, and they do not have the continuing guidelines for dengue treatment from households to PCUs or district hospitals. To address the dengue problem solution, this research study had two objectives: 1) to develop and 2) to evaluate a DCPG connecting households, PCUs and district hospitals.

## Methods

The study design used an integrated IOWA model and community participatory action (CPAR) approach that was implemented in eight PCUs, Lansaka Hospital (District hospital/secondary care hospital), and the Lansaka District Official Public Health. The research was supported by Walailak University, and the Thai Research Fund supported this research (WU-TRF\_ABC5905) from October 2016 to September 2017. Approval from the Ethical Review Committee for Research Subjects was received from the Health Science Group of Walailak University, Thailand (protocol number 59/068).

The population and participants were divided into three groups as follows:

- 1) The supportive group included the director of community hospital, head official in district public health, director of the PCUs, and community leaders.
- 2) The health provider group included government officials in primary care related to dengue solutions in the district, such as public health officials of health promotion hospitals, nurse practitioners, and registered nurses.
- 3) The dengue patient group included dengue patients who received care service with the dengue clinical practice guideline.

The process of developing the DCPG showed that the conceptual framework of the study used the IOWA model of evidence-based practice to promote quality care) [17] and was divided into 5 phases:

- 1) The preparation phase identified the situation of practice and knowledge in the organization. The assessment consisted of (1) problem-focused triggers related to dengue issues, such as dengue problems, risk of dengue patient care management, dengue clinical practice guidelines, dengue patient referral systems, and standards for nursing care of dengue patients. (2) The knowledge-focused triggers were assessed with new knowledge of dengue treatment in the primary care unit and knowledge of the dengue clinical practice guidelines of the WHO and Thai Ministry of Public Health.
- 2) The literature review of evidence-based phase consisted of a review of dengue diagnosis treatment prevention and control (WHO, 1997, 2009, 2012a) and participation of health providers for developing DCPG. The draft DCPG was validated by five experts, including two medical doctors (children, adult medical doctors), two registered nurses, and an academic expert in dengue solutions.

- 3) The testing and monitoring phase included the participation of all health professionals using the DCPG of 8 PCUs in the district.
- 4) The evaluation and conclusion of the DCPG phase included the routine work in 8 PCUs and connected the referral system from household to PCU and district hospital.
- 5) The technology phase consisted of referring the DCPG to health providers in other districts that are interested. All five steps are shown in Fig. 1.

## **Questionnaire for measurement before and after using DCPG**

The validity index and measure of reliability (Cronbach's alpha) from the questionnaire were 0.93 and 0.87, respectively. The content validity was checked by 3 experts. The measure of reliability was conducted on a sample of 30 nurses in Nakhon Si Thammarat province. The components of the questionnaire included 1) sociodemographic characteristics, 2) opinion, 3) knowledge, 4) practice from 6 perspectives, and 5) availability of equipment, medical supplies and support.

Dengue opinion components consisted of ten questions about viewpoints of the severity, prevention and primary care of dengue fever. The opinion was divided into positive opinions when answering "yes" and negative opinions when answering "no", and they could answer "unknown" if they had no opinion. Dengue's knowledge components included 14 questions about dengue patient care as causes, signs and symptoms. The health provider's knowledge was divided into correct, incorrect, and unknown. The basic practice if they met dengue patients comprised 47 questions that were divided into 6 aspects. The rating scale consisted of 5 levels in which every time (100% practices if met dengue patient), almost time (60–99% practices if met dengue patient), sometime (1–50% practices if met dengue patient), no action (0% practice if met dengue patient), and N/A (no appearance of meeting dengue patient). The aspects of dengue patient care were as follows: 1) initial assessment of primary care, 2) practices in the first 2 days of fever, 3) practice in diagnosing dengue fever shock patients, 4) practice in intravenous infusion, 5) practice in referring patients, and 6) guidance practice to prevent dengue fever.

## **Data analysis**

Data were analysed, and the personal information with descriptive statistics (frequencies, percentages) and the scores of opinion, knowledge, and practices before and after using dengue clinical practice guidelines were compared with the Wilcoxon signed rank test. The steps of the dengue solution guidelines were developed and accompanied by diagrams.

## **Results**

# 1. The dengue clinical practice guideline (DCPG) from household to hospital

DCPG was used for 12 weeks (June-August 2017), with 39 dengue patients who were admitted to Lansaka Hospital (72%) from the total dengue patients (54 cases) reported in the area by Nakhon Si Thammarat province's public health officials. They were divided into 16 males and 23 females, with ages ranging from 3 to 66 years and an average age of 23 years. The signs and symptoms of 39 cases were fever (39 patients), weakness (8 patients), nausea (5 patients), headache (5 patients), stupor (3 patients), and eating less than normal (5 patients). The 39 dengue patients admitted to the IPD were divided into 30 cases visiting directly to the OPD, 4 cases visiting the ER of the district hospital, and 5 cases visiting the PCU<sup>2</sup>.

All 30 dengue patients visited the OPD and were divided into the OPD<sup>1</sup> (go back home for continuous observation) (9 cases) and OPD<sup>2</sup> (admitted to IPD<sup>1</sup>) (20 cases), and one patient was referred to the province (tertiary) hospital. For the 20 patients who visited the IPD<sup>1</sup>, a care map plan and DCPG grades I and II and fluid replacement guidelines were used based on disease severity. The implementation of DCPG covered eight PCUs and Lansaka Hospital. The dengue morbidity rate at 12 weeks was 124 cases/100,000 populations (54 cases), and there was no mortality rate or severe complications, such as prolonged shock. However, the DCPG's record form of the PCUs needs to be completed. Finally, the new lines of dengue patient care are from the household to the district hospital, and they can possibly go to province hospital. Then, the conclusion of DCPG consisted of four steps of the guidelines related from household to hospital.

**The first step was dengue prevention and control in the community.** The step was self-care with dengue prevention in the community. This step focused on dengue prevention with the larval indices surveillance system in the "Lansaka model", which consisted of seven steps in 44 villages [23]. The system focused on the householder clearing their house and garbage management. Mosquito breeding site-village health volunteer surveys larval indices were performed on the 25<sup>th</sup> of every month, sent to the group's leader on the 28<sup>th</sup>, then sent to the village leader on the 30<sup>th</sup> of month, who analysed them with a computer program (<http://Nakhonsi.denguelim.com>). PCUs use training dengue knowledge and larval indices to eliminate mosquito breeding sites and avoid non-steroidal anti-inflammatory drugs (NSAIDs) such as ibuprofen and aspirin. The dengue solution policy of sub-district organization was conducted in communities and schools. There was communication for dengue outbreak control information that showed a dengue case index in the community as the Surveillance and Rapid Response Team (SRRT).

**The second step was dengue clinical practice guidelines at the PCUs.** If fever lasted > 48 hrs. and/or weakness, nausea, and vomiting were present, the patient needed to go to the primary care unit. There were two patterns: 1) PCU<sup>1</sup> refers to a district hospital if fever  $\geq$  48 hr. Health care providers need to test (1) HCT. If weakness increased, and there was no fever, (2) the haemogluco test (HGT/DTX) was performed; if the patient showed signs of shock, (3) the tourniquet test  $\geq$  10 points/in<sup>2</sup> was performed; (4)

assess signs of hypovolemic shock and bleeding, (5) fluid replacement following DCPG, and (6) practice following PCU<sup>2</sup>. 2) PCU<sup>2</sup> needs continuous observation if fever <48 hrs., (1) give only paracetamol 10-15 mg/kg/dose, may be repeated every 4-6 hrs., (2) demonstration with tepid sponge, drinking fluid juice, electrolyte solution and voiding red or black food, and 3) avoiding mosquito bite, using lotion, and destroying mosquito breeding site.

**The third step was dengue clinical practice guidelines at the outpatient department (OPD) and emergency room (ER) in secondary care hospital (Lansaka hospitals).** Patient care at the OPD and ER for assessing signs of hypovolemic shock and bleeding included PE, BT, PR, RR, BP, shock signs, tourniquet test, and CBC (WBC < 5,000 cell/mm<sup>3</sup>). There were two options in OPD and IPD in that each channel was divided into 3 patterns: Dengue patient care at OPD consisted of 1) OPD<sup>1</sup>: for dengue patients, health assessment and screening were needed for advising and continuing observation; 2) OPD<sup>2</sup>: health assessment and DHF diagnosis for admission to IPD in district hospitals; and 3) OPD<sup>3</sup>: health assessment showed severe signs and symptoms as DSS and the patients were sent to tertiary (province) hospital. Dengue patient care occurred in the ER when dengue patients visited the hospital from 16.00 pm. to 8.00 am. There were three patterns: 1) ER<sup>1</sup> pattern was health assessment and discharge to go home for observing dengue signs and symptoms, 2) ER<sup>2</sup>: taking health assessment and diagnostic DHF for admission to the IPD in secondary hospitals, and 3) ER<sup>3</sup> pattern was a health assessment and diagnosis of dengue with severe symptoms and sending them to a tertiary hospital.

**The fourth step was dengue clinical practice guidelines in the patient department (IPD) at the secondary care hospital.** There were two patterns that consisted of 1) IPD<sup>1</sup> treatment with a care team, such as Care Map, as the dengue practice guideline in grades I and II and dengue infection, guideline of fluid replacement in dengue grades I and II, and filling out referral form and recording intake and output of fluid, 2) the IPD<sup>2</sup> pattern was a guideline for severe dengue or dengue grades III and IV, which are referred to province hospital with the referral form. The guidelines for dengue prevention and control in the community and clinical practice guidelines in primary- to the tertiary care (province) hospital (Maharaj nakhon si thammarat hospital) need to be integrated and communicated to all stakeholders. Moreover, SRRT needs to monitor the outbreak situation at the case index of dengue fever in the community as community mobilization and perform outbreak activity as soon as the case index of fever is known.

Figure 2

## **2. The evaluation of health providers' opinions, knowledge, and practices for dengue patients after using DCPG from households to hospitals**

The implementation of DCPG was preparedness for the research team, and 26 participants from eight PCUs consisted of professional nurses and health care officials of district hospitals. However, tertiary level hospitals support fast channels for referring critical cases of dengue. All documents, such as the

DCPG manual, flow chart, and dengue manual, were prepared. DCPG was conducted over three months (June-August 2017). During the testing period, the monitoring and support by the research team was completed one month before and after the opinion, knowledge and practice of DCPG in 12 weeks for the use of DCPG.

## **2.1 Personal information of health providers**

There were 26 health providers who were representative of eight PCUs and district hospitals. There were five phases and testing before and after using DCPG. There were 18 women (69.2%), 13 public health officials (50.0%), 13 registered nurses (50.0%) divided into 8 from Lasaka hospital (30.8%) and 5 from PCUs (19.2%). They were practising in 20 district hospitals (76.9%). The average practice time was 21.74 years (SD. 10.35 years), current role and function average 14.30 years (SD. 8.58 years), and practising in current PCUs 9.96 years (SD. 7.62 years). They experienced dengue prevention in the community, fever stage, shock stage, convalescent stage, performing a tourniquet test, taking intravascular fluid, referral of patients, and case dengue patient death in 19 (73.1%), 16 (61.5%), 4 (15.4%), 13 (50.0%), 8 (30.8%), 6 (23.1%), 5 (19.2%) and 1 (3.8%) patients, respectively.

## **2.2 Dengue's opinion of health providers before and after using the DCPG from household to hospital**

The dengue's opinions mean awareness/perception of the severity and impact of dengue disease. They showed positive opinion in 9 items from a total of 10 items, with almost all answers "yes". Only item number 9 was negative, with "Quick notification of health officials in 72 hrs. as soon as dengue patients were found". Item number 10 showed an increasing positive significant statistic after using DCPG ( $p < 0.05$ ) (Table 1).

## **2.3 Health providers' knowledge of dengue before and after using DCPG from household to hospital**

The comparison of 26 health providers' dengue knowledge for 14 items found that three items, 2, 4, and 10, were significantly different before and after development guidelines were implemented ( $p < 0.05$ ). The differences in 11 items of dengue knowledge were not statistically significant ( $p > 0.05$ ) (Table 2).

## **2.4 Practices for dengue patients before and after DCPG**

**1) Practice to initially assess patient visits to the PCU/hospital for screening dengue infection.** The results showed that most of the practices to initially assess patients were significantly different ( $p < 0.001$ ). It showed frequency of activities after more than before using DCPG, such as (1) vital signs (T, P, R, BP); (2) body weight, length (if children); (3) tourniquet test for investigation platelets; (4) history of related dengue infection, such as friend or family member, and those who were contacted in 2 weeks; (5) assessment sign and symptoms of dengue, such as headache, myalgia, eye pain, positive tourniquet test and CBC, and if fever was more than 2 days (Table 3).

**2) Basic practice if the health care practitioner met dengue patient in 2 days.** There were practices if health care practitioners met dengue patient in first 2 days of the fever phase, and the difference was

statistically significant ( $p < 0.001$ ). The results showed frequency of practice after more than before using DCPG, such as (1) dehydration assessment, (2) force drinking fluid and fruit juice, (3) take paracetamol 10-15 mg/kg/dose repeated every 4-6 hr, (4) take antipyretic drug if high fever  $\geq 38^\circ\text{C}$ , (5) caution invasive of treatment and fall, (6) drink fruit juice or mineral fluid if patient was dehydrated, and (7) do not take aspirin (Table 4).

**3) Practice guidelines for dengue diagnosis with the dengue shock phase, with drowsy sign after 3 days,** showed the 12 practices if health providers met patients on after more than before using DCPG was statistically significant for every item ( $p < 0.001$ ), such as (1) assess decreasing of fever and no alert, (2) bleeding status such as petechial, (3) severe vomiting and abdominal pain, (4) continuous severe thirst, (5) drowsy and not drinking water, (6) fidgeting or fumbling if the child cries, (7) cold hands and feet sweating, (8) little urine or no urination for more than 4-6 hours, (9) measure body temperature  $39^\circ\text{C}$ , (10) diastolic and systolic blood pressure were narrow at 20 mmHg, (11) evaluate the wrist pulse for light, fast, or not catching, and (12) evaluate immediately whether cold or striped body and test HCT., deliver blood sugar intravenously, and ready to be delivered to the hospital immediately (Table 5).

**4) Practice guidelines for administering intravascular fluid for initial resuscitated shock.** Three items were different in practice if they met patients ( $p < 0.01$ ) (item 1). A 5% D/NSS IV drip rate of 120 cc/hr was used (30 drop/minute) for adult patients or children  $\geq 6$  years, and they were then referred to the tertiary hospital (item 2). A 5% D/NSS IV rate of 60 cc/hr was used (15 drop/minute) for children  $< 6$  years, and they were then referred to tertiary hospital. A 0.9% NSS IV drip was taken in 5-10 minutes in dengue shock, which did not measure BP (item 3). After that, a pulse should decrease the IV rate to 60 cc/hr, and then the patient should be referred to a tertiary hospital. Referral to the tertiary hospital stat, if dengue was found in a patient with weakness and blood pressure was not different before and after DCPG (item 4) (Table 6).

**5) Practice if health care provider met the patient following the practice guideline for referral to tertiary (province) hospital.** Comparison between before and after using practice if the patient met the practice guideline for referral to province hospital found that the practices were increasing after using DCPG and were statistically significant ( $p < 0.001$ ) in 6 of 8 sub-items of activities in number 3 (criteria for referral a severe dengue patient), and they can increase the practice "Go with patient during referral to province hospital".

**6) Practice if met patient following the guideline of suggestion for dengue prevention.** Participants followed the practice if they met patient every time for all 8 activities both before and after. The differences between before and after for three activities were statistically significant ( $p < 0.001$ ), including item (1) "Suggestion with prevention mosquito bite", (2) "Report dengue case index (Report 506 of Control Disease Centre, Thai Ministry of Public Health)", and (6) "Monitoring BI, HI, and CI in community for dengue outbreak prevention". In addition, three activities increased significantly ( $p < 0.01$ ), including (3) "Communicating the dengue control information for local organization administration such as fogging insecticide radius 100 metre around house index", (4) "Monitoring dengue case in the area around house

of case index in 28 days”, and (5) “Communicating and enhancing the community for destroying mosquito breeding site every 7 days” (Table 8).

## **2.4 Evaluation of the preparedness of the medical equipment and supplies for dengue treatment in the PCUs and secondary care hospital.**

The medical equipment and supplies for dengue treatment were significantly increased after DCPG was used, such as “Mercury sphygmomanometer and cuff 3 level” and “Blood glucose metre” ( $P<0.01$ ), and “Health care providers were trained with dengue clinical practice guideline” ( $p<0.05$ ). However, “5% D/NSS or 5% DLR or 5% DAR capacity 500 cc”, “Dengue case management manual”, and “Dengue clinical practice guideline in primary care unit” were not significantly increased after DCPG was used. In addition, “Haematocrit centrifuge” and “Set IV fluid, Medicut No. 18, 20, 21, 22, and 23” did not change between before and after (Not Table).

## **Discussion**

The results of the first objective were a DCPG from household to hospital consisting of patient DCPG development and the four steps of DCPG after testing. The DCPG appropriated the context of people in 44 villages in 5 sub-districts because it was developed based on the five steps of the IOWA model [17] and WHO 1997 [3]. Then, guidelines based on dengue knowledge were divided three phases: 1) fever phase: acute fever onset high and continuous lasting 2 to 7 days; 2) critical /shock phase: 1/3 of patients in the fever decreasing range. The shock stage is characterized by rapid and weak pulse with narrowing of the pulse pressure or hypotension and cold, clammy skin and restlessness. These signs and symptoms are emerging leakages of plasma into the pleural and peritoneal cavities as hypovolemic shock within 24–48 hrs. 3) the convalescent phase stops leakage of plasma, but it enters the vascular vessel, and pulse and blood pressure revert to normal, urine production increases, and plural effusion occurs if the patient has severe shock [3, 18].

The DCPG is specific guidelines relating four steps, such as guidelines in households for prevention, eight PCUs, OPD and ER, and IPD in Lansaka hospital. In the following steps of DCPG in 12 weeks, 39 dengue patients were used to follow the treatment steps from household to hospital. It was only 70% of the total patients (54 dengue patients) at this time, and almost all dengue patients directly visited the OPD/ER of the hospital. Because of there were stays near the hospital and easy travel to hospitals by themselves. However, 30% (15 dengue patients) did not participate in the DCPG because they could go to any other clinic/health centre/hospital. This is consistent with the results of a study that found that 83.9% went to primary care hospitals, and 68.7% visited several health care units [16]. However, the signs and symptoms of 39 cases were fever (39 patients), weakness (8 patients), nausea (5 patients), headache (5 patients), stupor (3 patients), and eating less than normal (5 patients). All patients had the signs and symptoms of dengue diagnosis when fever was more than 48 hr. and needed to go to the PCU<sup>1,2</sup>. Then, they were assessed and diagnosed with dengue and admitted to the IPD district hospital, with decreased WBC, platelet and HCT. following the pathology of dengue [1–3].

According to the testing of DCPG with 39 dengue patients in each phase, patients had mild levels of signs and symptoms and then received the initial treatment. Moreover, they directly visited the district hospital, and they did not delay diagnosis or treatment. Then, the DCPG included four steps that integrated the district context, WHO 1997 case classification guidelines, and standard of Thai Ministry of Public Health [3, 18]. The first step of the guidelines for dengue patient care in households consisted of dengue prevention and control based on the “Lansaka model”, which uses the larval indices surveillance system for dengue prevention in the community. [23]. The effectiveness of the system of prevention in the community, such as dengue morbidity, was confirmed in 2014, 2015 and 2016, with 164.9, 64.5 and 135.4 cases/100,000 people, respectively, and no case deaths [22]. The second step was dengue patient care at the PCU consisting of PCU<sup>1</sup> and PCU<sup>2</sup> based on the time of onset fever and the cut-off point at 48 hrs. The dengue patient can be observed at home, monitored or followed from the PCU, and referred to a district hospital. The third and fourth steps of the DCPG were activities at the secondary care level at the district hospital (OPD, ER, and IPD) and referral to the tertiary care level at the province hospital. Clinical practice guidelines and document forms in the district and province hospital were implemented by nurses and physicians. Although the DF/DHF/DSS model of WHO 1997 dengue case classifications was limited to classification by experience because a laboratory is needed for diagnosis [12], health providers in Thailand have been trained using dengue classifications of DF/DHF/DSS since WHO 1997 in Thailand for a long time, and they have accepted and perceived user-friendliness of the local DCPG, which has been integrated and applied in the local context [1, 15].

The local DCPG is an easy guideline for dengue patient understanding but follows Thai Ministry of Public Health guideline, WHO 1997 and 2009 dengue case classifications. A study suggests that the dengue guidelines need be appropriate in the context, and health care providers need to be trained on the new guidelines (warning signs)[16]. All four steps describe the role of health providers in the primary care level in the context.

The second objective was evaluation the results of opinion, knowledge, and practices before and after using DCPG. The 26 health providers increased their dengue opinion and knowledge after testing DCPG, but it did not differ significantly. It may be that the content of dengue knowledge was difficult to understand by 13 public health officials and 13 nurses in the primary care unit. However, the development of DCPG steps involved setting education training for 26 health providers with dengue knowledge and skill for practice one time per month. Health providers need to have dengue knowledge of the natural courses of DF/DHF/DSS and prevention in the community and of the referral system for dengue patients. A related study showed that health care providers need to develop skills and knowledge with dengue disease, cause of infection, signs and symptoms, and complications of disease [14] related to dengue clinical practice, which is used to decrease severity and mortality rate [2]. They increased their dengue knowledge in the after phase, influencing positive opinion consistent with the results from a systematic review of 117 research articles showing good knowledge associated with good attitudes and high dengue prevention practices [24].

Practices for dengue patients before and after using DCPG included 6 perspectives of practice guidelines: 1) initial assessment of patients at the household, 2) basic practice for dengue infection in 2 days of fever at the PCUs/district hospital, 3) shock resuscitation, 4) taking intravascular fluid in initial resuscitated shock, 5) referral to the province hospital, and 6) suggestion for dengue prevention. All perspectives were associated with dengue management of WHO 1997 and 2009 [1–3]. The 26 health providers increasing their practice after testing DCPG in 5 perspectives of practice, and the difference was significant ( $p < 0.05$ ); only taking the intravascular fluid component was not significant ( $p > 0.05$ ). There were a few critical cases of dengue at the primary care level, and half of the health providers (13 of 26 health providers) were public health officials who were experts with dengue prevention in the community. Moreover, almost 13 nurses who participated in the testing step of DCPG were practising in the PCUs.

Health providers play an important role in providing health care services in communities and hospitals. Adequate knowledge can help health providers provide health education to the general public and patients. Primary care providers were more involved in dengue solution in the community [14, 16]. Based on dengue's signs and symptoms, health providers need to correctly assess, diagnose, and treat to decrease the length of stay and complications because they represent 30% of the partial factor for dengue patient death [14]. It showed that the necessity of appropriating knowledge for health provider treatment was consistent with a study of health providers' reflections showing the themes "real knowledge of dengue...and increasing dengue knowledge"[25]. Moreover, PCPs were more confident in managing dengue patients in primary care settings and educated patients on the importance of vector control and dengue warning signs to reduce dengue transmission and burden [26].

## Conclusions

Dengue guidelines need to integrate both evidence-based and health care contexts for dengue prevention and treatment as households to hospitals. The study design used community participatory action research that integrated the IOWA model in 44 villages, Lansaka district, southern Thailand. The five steps were 1) community preparation, 2) development of the guidelines, 3) use and monitoring, 4) evaluation and conclusion, and 5) referring technology. The questionnaires for evaluating opinion, knowledge, and practice included 84 items. The content validity was verified by three experts (CVI = 0.80), and reliability was verified by 30 participants (Cronbach's alpha = 0.90). The Wilcoxon signed rank test was used before and after using DCPG, and the guidelines were supplemented with diagrams.

The DCPG was developed and evaluated from households to PCUs and hospitals. 1) The DCPG consisted of four steps: guidelines at households, PCU, OPD and ER, and IPD in the hospital. The 39 dengue patients were divided into 20 cases admitted to the IPD; observation at home, 18 cases; and one patient referred to province hospital; no deaths occurred during the study period. 2) The 26 health providers from the PCU and hospital were educated, and attitude increased was not significantly different. The 5 practice components increased significantly ( $P < 0.05$ ), but only taking the intravascular fluid component showed no significant difference ( $P > 0.05$ ).

The DCPG was an appropriate dengue solution from household to hospital. However, all stakeholders need to participate, integrate, and coordinate for continued use, monitoring and evaluation. Strengthening dengue prevention and control in the community and guidelines for dengue patients start at household to hospital as a key public health service and can be integrated across other sectors in the community. This research focused on developing and evaluating a DCPG that connects households, PCUs and district hospitals based on integrating the concept of the IOWA model and the community participatory action (CPAR) approach that consisted of eight PCUs, district hospitals, and district official public health. The guideline needs to prove the steps for dengue management in more cases and for more than 12 weeks.

## Abbreviations

**CBC:** Complete blood count

**CPAR:** Community participatory action

**CVI:** Content validity index

**DALY:** Disability adjusted life year

**DAR:** Dextrose acetate ringer

**DCPG:** Dengue Clinical Practice Guideline

**DEN:** Dengue virus

**DF:** Dengue fever

**DHF:** Dengue haemorrhagic fever

**DLR:** Dextrose lactate ringer

**DSS:** Dengue shock syndrome

**EC for DRAS:** Excellent Centre for Dengue Research and Academic Service

**ER:** Emergency room

**HCT:** Haematocrit

**HGT/DTX:** Haemogluco test/Dextrostix

**IPD:** In patient department

**IOWA model:** *The Model* was developed at the University of *Iowa* Hospitals and

Clinics in 1990s to serve as a guide for nurses to use research findings

to help improve patient care.

**Lansaka model:** the larval indices surveillance system for a sustainable solution to the dengue problem in southern Thailand

**NSAIDs:** Non-steroidal anti-inflammatory drugs

**NSS:** Normal saline solution

**OPD:** Out-patient department

**PCUs:** Primary care units (PCUs)

**Secondary hospital:** the district hospital that mean secondary care level of health care system in Thailand

**SRRT:** Surveillance and Rapid Response Team

**Tertiary hospital:** the province hospital that mean tertiary care level of health care system in Thailand

**Vital signs:** T (Body temperature), P (Pulse), R (Respiratory rate), and BP (Blood pressure)

**WA:** Warning signs

**WBC:** White blood count (Dengue infection  $WBC \leq 5000$  cells/mm<sup>3</sup>.)

**WHO:** World health organization

**WHO 1997:** Guideline for classification dengue DF/DHF/DSS by WHO regional publication, SEARO No. 29

**WHO 2009:** Guideline for classification dengue, dengue with or without signs (WS) and severe dengue (D, D± WS, SD)

## Declarations

### Ethics approval and consent to participate

The study was approved by the Ethical Review Committee for Research Subjects was received from the Health Science Group of Walailak University, Thailand (protocol number 59/068). Respondents were recruited after giving written informed consent, and written informed consent for participation in the study was obtained where participants are children (under 16 years old) from their parent or guardian.

### Availability of data and material

The table of data described in “evaluation the preparedness the medical equipment and supplies for dengue treatment in PCU and district hospital”. This Data note can be freely and openly accessed via [Appendix A](#).

### **Competing interests**

The authors declare that they have no competing interests.

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### **Availability of data and materials**

The dataset used and/or analysed during the current study are available from the corresponding author on reasonable request.

### **Authors' contributions**

Study design, data acquisition and drafting the work were performed by suwanbamrung, C. revised the manuscript by suwanbamrung C, and Cua Ngoc Le. All authors conducted the research, read and approved the analysis, and interpretation of data.

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## Tables

**Table 1** Dengue’s opinion of the health providers before and after using the DCPG from household to hospital

Dengue’s opinion		Opinion n(%)			Sum of Rank	Z
		Positive (yes)	Negative (no)	Unknown		
(1) Dengue has been a public health problem of tropical countries and Thailand	before	25(96.2)	1(3.8)	0	1.00	-1.000 <sup>a</sup>
	after	26(100)	0	0	.00	
(2) Fever stage of dengue is transmitting virus to other people, then they need to prevent mosquito bites	before	26(100)	0	0	.00	-1.414 <sup>b</sup>
	after	24(92.3)	2(7.7)	0	3.00	
(3) Severity of dengue disease caused death from compound shock and bleeding	before	25(96.2)	1(3.8)	0	1.00	-1.000 <sup>a</sup>
	after	26(100)	0	0	.00	
(4) Drinking and invasive intravascular fluid are important treatments in dengue haemorrhagic fever	before	22(84.6)	3(11.5)	1(3.8)	25.00	-.277 <sup>b</sup>
	after	20(76.9)	6(23.1)	0	30.00	
(5) Wording “prevention is the best treatment of dengue”	before	26(100)	0	0	.00	-2.000 <sup>b*</sup>
	after	22(84.6)	4(15.4)	0	10.00	
(6) Community participation is the strategy for sustainable dengue prevention	before	26(100)	0	0	.00	.000 <sup>c</sup>
	after	26(100)	0	0	.00	
(7) High level of larval indices predict the risk for dengue outbreak	before	25(96.2)	1(3.8)	0	1.00	-1.000 <sup>a</sup>
	after	26(100)	0	0	.00	
(8) All stakeholders are important in participating in dengue prevention and control	before	25(96.2)	1(3.8)	0	1.00	-1.000 <sup>a</sup>
	after	26(100)	0	0	.00	
(9) Quick notification of health official in 72 hrs. as soon as dengue patient is found	before	12(46.2)	11(42.3)	3(11.5)	83.50	-.871 <sup>a</sup>
	after	14(53.8)	12(46.2)	0	52.50	
(10) The probable dengue case needs investigation if they have high fever and red face for more than 2 days	before	21(80.8)	4(15.4)	1(3.8)	15.00	-2.236 <sup>a*</sup>
	after	25(96.2)	1(3.8)	0	.00	

Wilcoxon signed rank test, Asymp. Sig. (one-tailed) \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$

a. after > before; b. after < before; c. after = before

**Table 2** Comparison of dengue's knowledge of health provider before and after using the guideline of DCPG from household to hospital

Dengue knowledge		Frequency (percentage) n(%)			Sum of Rank	Z
		Corrected	Non-corrected	Unknown		
(1) Signs and symptoms of dengue haemorrhagic fever include increasing leakage of plasma and decreased platelets.	before	23(88.5)	3(11.5)	0	2.00	-.577 <sup>b</sup>
	after	22(84.6)	4(15.4)	0	4.00	
(2) Dengue includes 4 types: dengue fever, dengue haemorrhagic fever, dengue shock syndrome, and dengue grade 4.	before	9(34.6)	14(53.8)	3(11.5)	136.00	-1.806 <sup>a*</sup>
	after	15(57.7)	11(42.3)	0	54.00	
(3) A person may have dengue infection more than one time because the dengue virus has 4 serotypes.	before	25(96.2)	1(3.8)	0	1.00	-1.000 <sup>a</sup>
	after	26(100)	0	0	.00	
(4) After 5-8 days, high fever was observed after a bite from a mosquito infected with dengue.	before	15(57.7)	8(30.8)	3(11.5)	73.00	-2.066 <sup>a*</sup>
	after	20(76.9)	5(19.2)	1(3.8)	18.00	
(5) Probable dengue fever case if acute dengue fever with 2 signs in all signs such as headache, muscle and joint pains positive, tourniquet test, WBC <5,000 cell/mm <sup>3</sup> , platelets <150,000 cell/mm <sup>3</sup> , and increasing HCT 5-10%.	before	21(80.8)	3(11.5)	2(7.7)	19.00	-.879 <sup>a</sup>
	after	23(88.5)	3(11.5)	0	9.00	
(6) Almost patient dengue haemorrhagic fever showed high fever 2-7 days with red face, headache, poor appetite, abdominal pain, positive tourniquet test, WBC< 5,000 cell/mm <sup>3</sup> , platelets <100,000 cell/mm <sup>3</sup> , and increasing HCT> 10%.	before	22(84.6)	3(11.5)	1(3.8)	15.00	-1.000 <sup>a</sup>
	after	25(96.2)	1(3.8)	0	6.00	
(7) Dengue shock syndrome patient has important signs such as cold skin, restlessness, cry in children, and increased urine output.	before	10(38.5)	16(61.5)	0	70.00	-1.941 <sup>a</sup>
	after	18(69.2)	8(30.8)	0	21.00	
(8) Dengue patient almost died from delayed diagnosis	before	20(76.9)	5(19.2)	1(3.8)	20.00	-1.134 <sup>a</sup>
	after	23(88.5)	3(11.5)	0	8.00	
(9) Dengue patient with convalescent phase showed decreased fever, convalescent race, itching and good appetite	before	25(96.2)	1(3.8)	0	6.00	-1.000 <sup>b</sup>
	after	22(84.6)	4(15.4)	0	15.00	
(10) <i>Aedes Aegypti</i> is small and black and white in colour	before	21(80.8)	2(7.7)	3(11.5)	19.00	-1.823 <sup>a*</sup>
	after	26(100)	0	0	2.00	
(11) Female <i>Aedes Aegypti</i> bite humans for breeding	before	21(80.8)	2(7.7)	3(11.5)	28.50	-.730 <sup>a</sup>
	after	23(88.5)	2(7.7)	1(3.8)	16.50	
(12) <i>Eggs of Aedes Aegypti</i> remained in dry temperature more than 1 year	before	23(88.5)	3(11.5)	0	9.00	-.333 <sup>b</sup>
	after	24(92.3)	1(3.8)	1(3.8)	12.00	
(13) Secondary infection of dengue virus increased severity of signs and symptoms	before	24(92.3)	2(7.7)	0	10.00	-.107 <sup>a</sup>
	after	23(88.5)	2(7.7)	1(3.8)	11.00	
(14) A human can be infected with dengue virus several times both severe and non-severe	before	22(84.6)	3(11.5)	1(3.8)	20.00	-.302 <sup>a</sup>
	after	23(88.5)	3(11.5)	0	16.00	

Wilcoxon signed rank test, Asymp. Sig. (one-tailed) \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$   
a. after>before; b. after<before

**Table 3** Practice to initially assess patient visits to the PCU/hospital for screening dengue infection before and after using DCPG

Practice to initial assesses patient visiting to PCU/hospital for screening dengue infection	Time	Practice if have dengue patient					Sum of Rank	Z
		Every time	Almost	Some time	No action	Not sure		
(1) Vital signs (T, P, R, BP)	before	22(84.6)	3(11.5)	0	0	1(3.8)	207.00	-4.009 <sup>a***</sup>
	after	25(96.2)	0	1(3.8)	0	0	3.00	
(2) Body weight, length (if children)	before	25(96.2)	0	0	0	1(3.8)	189.00	-3.974 <sup>a***</sup>
	after	22(84.6)	4(15.4)	0	0	0	1.00	
(3) Tourniquet test for investigation of platelets	before	9(34.6)	3(11.5)	8(30.8)	5(19.2)	1(3.8)	167.00	-2.346 <sup>a***</sup>
	after	19(73.1)	6(23.1)	1(3.8)	0	0	43.00	
(3) History taking related dengue infection such as friend or family member and who was contacted in 2 weeks	before	23(88.5)	2(7.7)	0	1(3.8)	0	210.00	-4.055 <sup>a***</sup>
	after	25(96.2)	1(3.8)	0	0	0	.00	
(4) Assessment sign and symptom of dengue such as headache, myalgia, eye pain, positive tourniquet test and CBC if fever more than 2 days	before	22(84.6)	2(7.7)	0	2(7.7)	0	226.50	-3.949 <sup>a***</sup>
	after	24(92.3)	2(7.7)	0	0	0	4.50	

Wilcoxon signed rank test, Asymp. Sig. (one-tailed) \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$   
a. after>before

**Table 4** Comparison of the basic practice of meeting dengue patients in 2 days before and after using DCPG

Basic practice if met dengue patient in first 2 days of fever phase	Time	Basic practice if met patient					Sum of Rank	Z
		Every time	Almost	Some time	No action	Not sure		
(1) Dehydration assessment	before	20(76.9)	2(7.7)	2(7.7)	1(3.8)	1(3.8)	222.00	-3.789 <sup>b***</sup>
	after	21(80.8)	2(7.7)	2(7.7)	0	1(3.8)	9.00	
(2) Force drinking fluid and fruit juice	before	20(76.9)	4(15.4)	0	2(7.7)	0	231.00	-4.114 <sup>b***</sup>
	after	20(76.9)	3(11.5)	0	0	3(11.5)	.00	
(3) Take paracetamol 10-15 mg/kg. Dose repeated every 4-6 hrs.	before	24(92.3)	1(3.8)	0	1(3.8)	0	190.00	-4.117 <sup>b***</sup>
	after	22(84.6)	2(7.7)	0	0	2(7.7)	.00	
(4) Taking antipyretic drug if high fever $\geq 38^\circ\text{C}$	before	22(84.6)	2(7.7)	0	2(7.7)	0	188.00	-3.892 <sup>b***</sup>
	after	21(80.8)	2(7.7)	0	0	3(11.5)	2.00	
(5) Caution invasive of treatment and fall	before	17(65.4)	2(7.7)	1(3.8)	3(11.5)	3(11.5)	165.50	-2.892 <sup>b***</sup>
	after	18(69.2)	2(7.7)	0	2(7.7)	4(15.4)	24.50	
(6) Drink fruit juice or mineral fluid if patient was dehydrated	before	23(88.5)	1(3.8)	0	2(7.7)	0	210.00	-4.087 <sup>b***</sup>
	after	21(80.8)	3(11.5)	1(3.8)	1(3.8)	0	.00	
(7) Do not take aspirin	before	25(96.2)	0	1(3.8)	0	0	190.00	-4.184 <sup>b***</sup>
	after	25(96.2)	1(3.8)	0	0	0	.00	

Wilcoxon signed rank test, Asymp. Sig. (one-tailed) \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$

b. after>before; c. after<before; d. after=before

**Table 5** Comparison of practice for dengue diagnosis with dengue shock phase with drowsy sign after 3 days before and after using DCPG

Practice guideline for dengue diagnosis with dengue shock phase with drowsy sign after 3 days	Time	Practice if met patient					Sum of Rank	Z
		Every time	Almost	Some time	No action	Not sure		
(1) Assess decrease of fever and no alert	before	25(96.2)	0	0	1(3.8)	0	210.00	-4.176 <sup>a***</sup>
	after	23(88.5)	3(11.5)	0	0	0	.00	
(2) Bleeding status such as petechial	before	25(96.2)	0	0	1(3.8)	0	210.00	-4.089 <sup>a***</sup>
	after	21(80.8)	5(19.2)	0	0	0	.00	
(3) Severe vomiting and abdominal pain	before	25(96.2)	0	0	1(3.8)	0	210.00	-4.068 <sup>a***</sup>
	after	20(76.9)	6(23.1)	0	0	0	.00	
(4) Thirsty for water all time	before	25(96.2)	0	0	1(3.8)	0	210.00	-4.026 <sup>a***</sup>
	after	20(76.9)	6(23.1)	0	0	0	.00	
(5) Drowsy and will not drink water	before	22(84.6)	2(7.7)	1(3.8)	1(3.8)	0	227.00	-3.970 <sup>a***</sup>
	after	21(80.8)	5(19.2)	0	0	0	4.00	
(6) Fidgeting or fumbling if the child will cry and annoy	before	23(88.5)	1(3.8)	1(3.8)	1(3.8)	0	27.00	-4.008 <sup>a***</sup>
	after	22(84.6)	4(15.4)	0	0	0	3.50	
(7) Cold hands and feet sweating	before	23(88.5)	1(3.8)	1(3.8)	1(3.8)	0	229.00	-4.066 <sup>a***</sup>
	after	20(76.9)	6(23.1)	0	0	0	2.00	
(8) Little urine or no urination for more than 4-6 hours	before	22(84.6)	1(3.8)	2(7.7)	1(3.8)	0	227.50	-3.987 <sup>a***</sup>
	after	21(80.8)	5(19.2)	0	0	0	3.50	
(9) Measure body temperature 39 °C	before	21(80.8)	2(7.7)	0	1(3.8)		207.50	-3.909 <sup>a***</sup>
	after	19(73.1)	7(26.9)	0	0	0	2.50	
(10) Systolic and diastolic blood pressure were narrow at 20 mmHg	before	23(88.5)	2(7.7)	0	1(3.8)	0	229.00	-4.091 <sup>a***</sup>
	after	23(88.5)	3(11.5)	0	0	0	2.00	
(11) Evaluate the wrist pulse for light, fast, or not catching	before	24(92.3)	0	1(3.8)	1(3.8)	0	227.50	-4.070 <sup>a***</sup>
	after	22(84.6)	3(11.5)	1(3.8)	0	0	3.50	
(12) Evaluate whether cold or striped body and test for HCT.; deliver blood sugar intravenously, ready to be delivered to the hospital immediately.	before	19(73.1)	1(3.8)	2(7.7)	4(15.4)	0	227.00	-3.306 <sup>a***</sup>
	after	20(76.9)	6(23.1)	0	0	0	26.00	

Wilcoxon signed rank test, Asymp. Sig. (one-tailed) \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$   
a. after>before; b. after<before; c. after=before

**Table 6** Comparison between before and after using practice if met patient following the guideline for taking intravascular fluid for initial resuscitated shock

Practice guideline for taking intravascular fluid for initial resuscitated shock	Time	Practice if met patient					Sum of Rank	Z
		Every time	Almost	Some time	No action	Not sure		
(1) Taking 5% D/NSS IV drip rate 120 cc/hr. (30 drop/minute) for adult patient or children ≥ 6 years, and then referral to tertiary hospital	before	8(30.8)	2(7.7)	0	7(26.9)	9(34.6)	116.50	-.329 <sup>a</sup>
	after	17(65.4)	4(15.4)	2(7.7)	2(7.7)	1(3.8)	136.50	
(2) Taking 5% D/NSS IV rate 60 cc/hr. (15 drop/minute) for children < 6 years, then referral to tertiary hospital	before	9(34.6)	0	0	7(26.9)	10(38.5)	103.50	-.421 <sup>a</sup>
	after	18(69.2)	6(23.1)	0	1(3.8)	1(3.8)	127.50	
(3) Taking 0.9% NSS IV drip in 5-10 minute in dengue shock with no measurement of BP. After that the pulse should decrease the IV rate to 60 cc/hr, then referral to tertiary hospital	before	10(38.5)	1(3.8)	0	6(23.1)	9(34.6)	59.00	-1.987 <sup>a</sup>
	after	18(69.2)	4(15.4)	1(3.8)	2(7.7)	1(3.8)	172.00	
(4) Refer to tertiary hospital stat if found dengue patient has weakness and no blood pressure	before	20(76.9)	0	0	1(3.8)	5(19.2)	216.50	-2.998 <sup>b</sup>
	after	22(84.6)	2(7.7)	0	2(7.7)	0	36.50	

Wilcoxon signed rank test, Asymp. Sig. (one-tailed) \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$   
a. after>before; b. after<before; d. after=before

**Table 7** Comparison between before and after using practice if health care provider met the patient following the practice guidelines for referral to tertiary (province) hospital

Practice guideline for referral to province hospital	Time	Practice if met patient					Sum of Rank	Z
		Every time	Almost	Some time	No action	Not sure		
(1) Sent to test NS1Ag in 5 first days of fever for threat intravascular solution	before	6(23.1)	1(3.8)	1(3.8)	4(15.4)	12(46.9)	35.00	-2.436 <sup>a**</sup>
	after	17(65.4)	4(15.4)	0	3(11.5)	2(7.7)	155.00	
(2) Sent to repeat complete blood count (CBC) when suspect dengue infection	before	13(50.0)	1(3.8)	0	2(7.7)	10(38.5)	132.50	-1.037 <sup>a</sup>
	after	18(69.2)	4(15.4)	2(7.7)	2(7.7)	0	77.50	
(3) Criteria for referral of a severe dengue patient when:								
◦ Low fever but no improvement in clinical sign	before	21(80.8)	0	0	1(3.8)	4(15.4)	146.50	-1.037 <sup>a***</sup>
	after	23(88.5)	2(7.7)	1(3.8)	0	0	6.50	
◦ More bleeding points such as skin of arms and legs	before	20(76.9)	1(3.8)	0	1(3.8)	4(15.4)	130.00	-3.332 <sup>a***</sup>
	after	25(96.2)	1(3.8)	0	0	0	6.00	
◦ Severe vomiting and abdominal pain	before	20(76.9)	1(3.8)	0	1(3.8)	4(15.4)	117.00	-2.633 <sup>a**</sup>
	after	24(92.3)	2(7.7)	0	0	0	19.00	
◦ Very thirsty all the time	before	20(76.9)	1(3.8)	0	1(3.8)	4(15.4)	145.50	-3.377 <sup>a***</sup>
	after	19(73.1)	6(23.1)	1(3.8)	0	0	7.50	
◦ Stupor and no drinking	before	20(76.9)	1(3.8)	0	1(3.8)	4(15.4)	145.50	-3.407 <sup>a***</sup>
	after	24(92.3)	1(3.8)	1(3.8)	0	0	7.50	
◦ Pale, cold clammy hands and feet	before	20(76.9)	1(3.8)	0	1(3.8)	4(15.4)	146.00	-3.433 <sup>a***</sup>
	after	24(92.3)	1(3.8)	1(3.8)	0	0	7.00	
◦ Oliguria, no urine more than 4-6 hr	before	20(76.9)	1(3.8)	0	1(3.8)	4(15.4)	145.00	-3.350 <sup>a***</sup>
	after	23(88.5)	1(3.8)	1(3.8)	1(3.8)	0	8.00	
◦ Restlessness and behavioural changes	before	20(76.9)	1(3.8)	0	1(3.8)	4(15.4)	129.00	-1.951 <sup>a*</sup>
	after	18(69.2)	5(19.2)	2(7.7)	0	1(3.8)	42.00	
(4) Check HCT and blood sugar level before taking intravascular fluid and refer to province hospital	before	7(26.9)	2(7.7)	2(7.7)	8(30.8)	7(26.9)	111.50	-.670 <sup>a</sup>
	after	25(96.2)	0	1(3.8)	0	0	78.50	
(5) If patient has itching after fever for more than 7 days you must be assess for hypervolemia	before	14(53.8)	1(3.8)	1(3.8)	5(19.2)	5(19.2)	140.50	-1.852 <sup>a</sup>
	after	24(92.3)	1(3.8)	1(3.8)	0	0	49.50	
(6) Go with patient during referral to province hospital	before	17(65.4)	0	3(11.5)	2(7.7)	4(15.4)	244.00	-3.284 <sup>a***</sup>
	after	26(100)	0	0	0	0	32.00	

Wilcoxon signed Rank rank test, Asymp. Sig. (one-tailed) \*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$

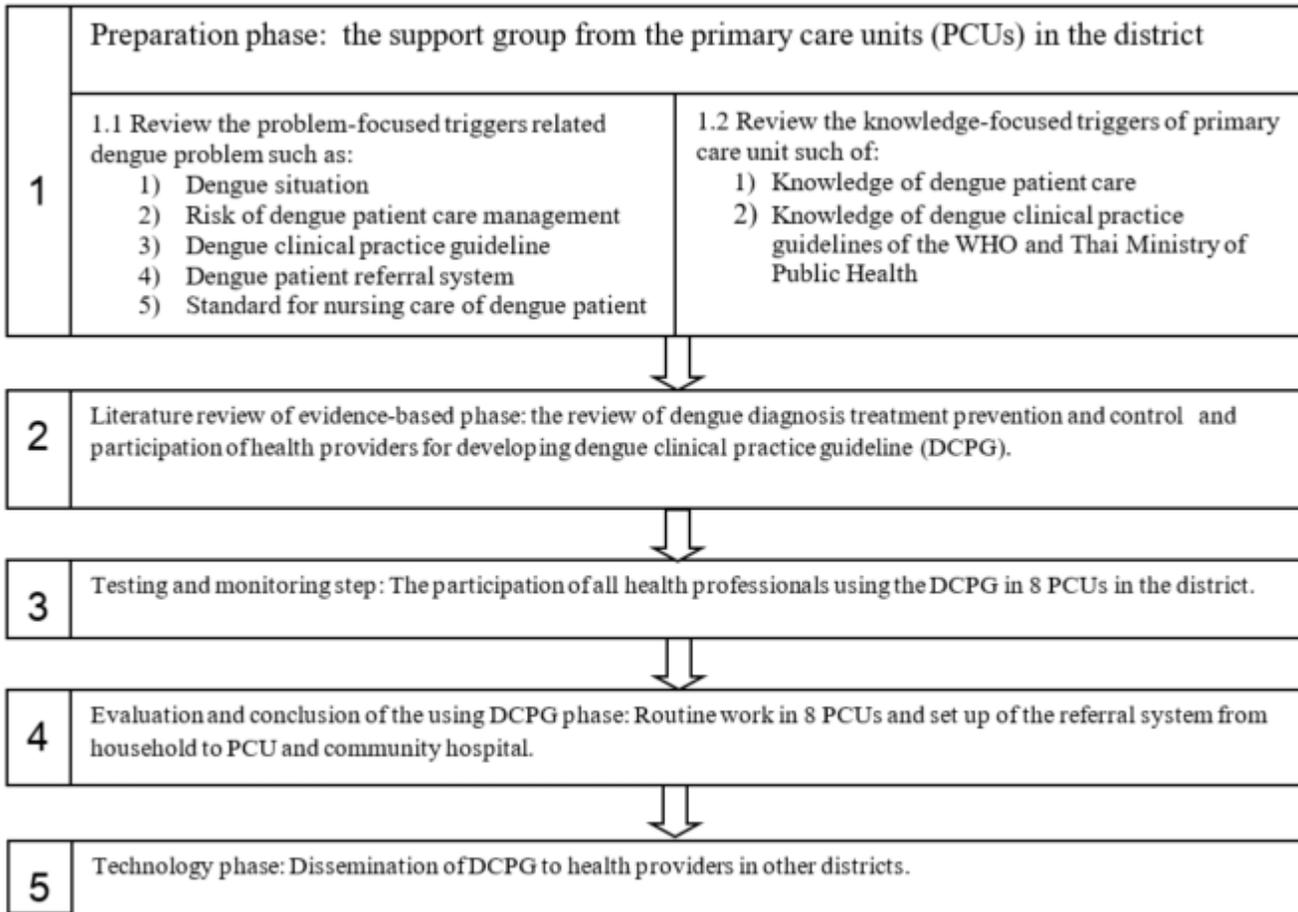
a. after>before; b. after<before; c. after=before

**Table 8** Comparison between before and after using practice if health care provider met patient following the guideline for dengue prevention

Practice guideline for dengue prevention	Time	Practice if meet patient				Not sure	Sum of Rank	Z
		Every time	Almost	Some time	No action			
(1) Suggestion for prevention of mosquito bites	before	25(96.2)	0	1(3.8)	0	0	210.00	-4.233 <sup>a***</sup>
	after	24(92.3)	1(3.8)	1(3.8)	0	0	.00	
(2) Report dengue case index (Thai CDC Report 506)	before	23(88.5)	0	1(3.8)	1(3.8)	1(3.8)	231.00	-3.501 <sup>a***</sup>
	after	21(80.8)	3(11.5)	1(3.8)	1(3.8)	0	22.00	
(3) Communicating the dengue control information for to local organization administration such as fogging insecticide radius 100 metre around house index	before	19(73.1)	1(3.8)	0	1(3.8)	5(19.2)	205.00	-2.601 <sup>a**</sup>
	after	21(80.8)	4(15.4)	1(3.8)	0	0	48.00	
(4) Monitoring dengue case in the area around house of case index in 28 days	before	18(69.2)	1(3.8)	0	1(3.8)	6(23.1)	184.00	-2.415 <sup>a**</sup>
	after	19(73.1)	5(19.2)	1(3.8)	1(3.8)	0	47.00	
(5) Communicating and educating the community to destroy mosquito breeding sites every 7 days	before	19(73.1)	1(3.8)	1(3.8)	0	5(19.2)	203.50	-2.541 <sup>a**</sup>
	after	22(84.6)	2(7.7)	2(7.7)	0	0	49.50	
(6) Monitoring BI, HI, and CI in the community for dengue outbreak	before	18(69.2)	1(3.8)	1(3.8)	1(3.8)	5(19.2)	329.50	-3.979 <sup>a***</sup>
	After	21(80.8)	2(7.7)	2(7.7)	1(3.8)	0	21.50	

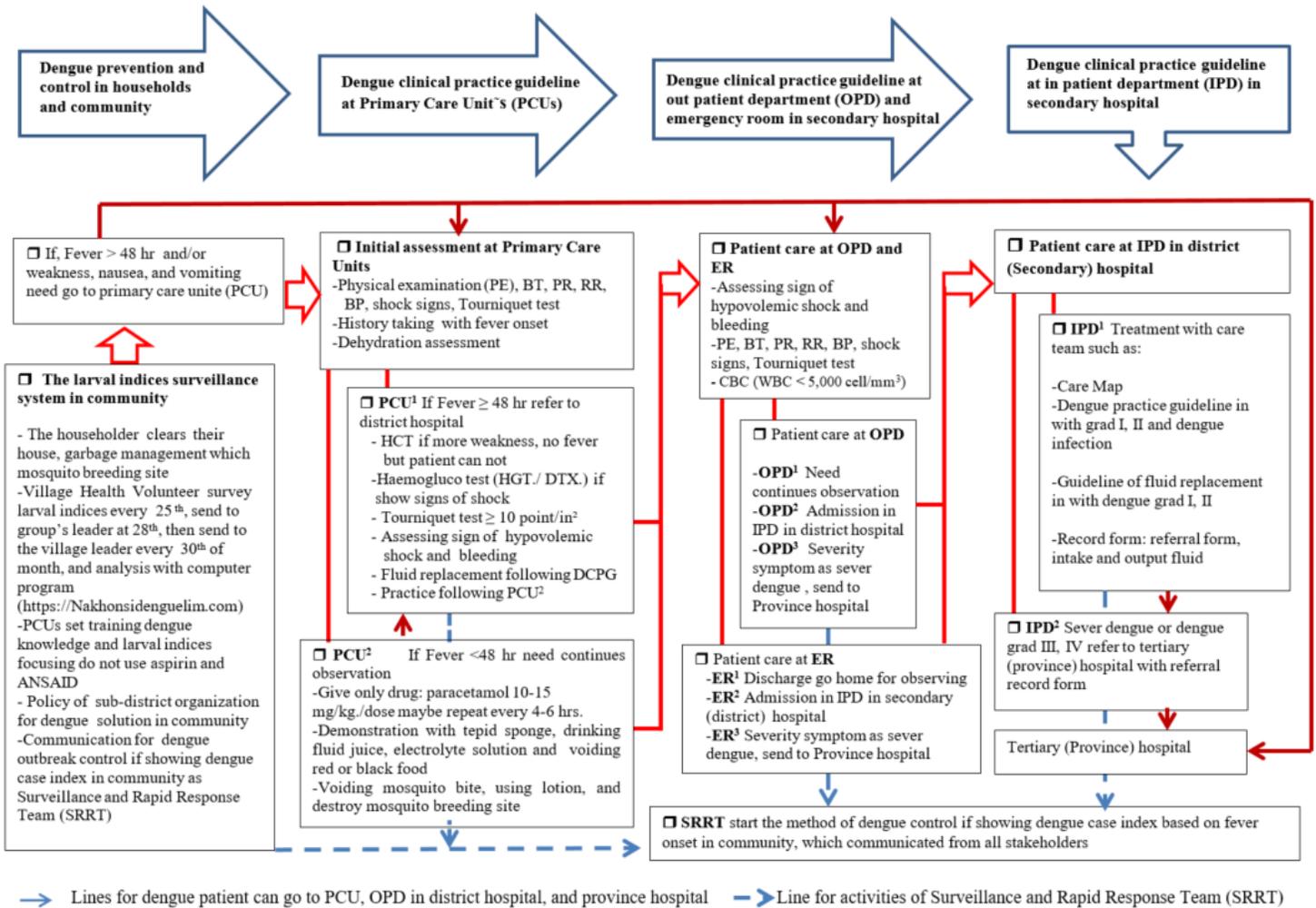
Wilcoxon signed rank test, Asymp. Sig. (one-tailed) \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$   
a. after>before; b. after<before; c. after=before

## Figures



**Figure 1**

The 5 phases of developing DCPG based on applying the IOWA model



**Figure 2**

The DCPG after using with 39 dengue patients from household to PCU, district hospital, and province hospital

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [2AppendixAAvailabilityofdataandeterial130120.docx](#)