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## Developing and using a dengue patient care guideline for patients admitted from households to primary care units and the district hospital: A community participatory approach in Southern Thailand

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## ABSTRACT

**Background:** Dengue has been an important health issue in southern Thailand. However, this area has only a surveillance-prevention system, without step-by-step guidelines on dengue treatment for patients admitted from households to primary care units (PCUs) and district hospitals. Therefore, this study were to develop and use a dengue patient care guideline (DPCG), and to evaluate knowledge, attitude, practice (KAP) of dengue patient care.

**Methods:** 26 health care providers (13 nurses, and 13 public health officials) from eight PCUs and the district hospital developed the DPCG. The study design was based on the community participatory action research that integrated the Iowa model involving the following steps: preparation, guideline development, use and monitoring, evaluation and conclusion, and referring technology. We assessed the improvement between before and after using the DPCG regarding the participants' KAP on patient care and preparedness of equipment. McNamara's test was used to compare the changing results before and after using the DPCG. Qualitative data collection was performed in two meeting discussions with six open-end items. Using a thematic analysis technique, we extracted conclusions and suggested solutions.

**Results:** The guideline included four steps for patients' care provision at households, PCUs, outpatient departments, emergency rooms, and inpatient departments. After using the DPCG in 39 dengue patients of which 30

**Abbreviations:** CBC, Complete blood count; CPAR, Community participatory action; CVI, Content validity index; DALY, Disability adjusted life year; DAR, Dextrose acetate ringer; DPCG, Dengue patient care 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; ER<sup>1</sup>, Guideline of DPCG at emergency room for hospital discharge for observing at home; ER<sup>2</sup>, Guideline of DPCG at emergency room for admission to in patient department; ER<sup>3</sup>, Guideline of DPCG at emergency room for serious dengue to province hospital; HCT, Hematocrit; HGT/DTX, Haemogluco test/Dextrostix; IPD, Inpatient department; IPD<sup>1</sup>, DPCG at inpatient department for dengue patient grade I and II; IPD<sup>2</sup>, DPCG at inpatient department for severe dengue and send to province hospital 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, Outpatient department; OPD<sup>1</sup>, DPCG at outpatient department for continuous observation at home; OPD<sup>2</sup>, DPCG at outpatient department for admission to inpatient department, district hospital; OPD<sup>3</sup>, DPCG at outpatient department for serious dengue case and send to province hospital; PCUs, Primary care units (PCUs); PCU<sup>1</sup>, DPCG at primary care unit for dengue case with fever > 48 h and send to district hospital; PCU<sup>2</sup>, DPCG at primary care unit for dengue case with fever < 48 h for observation at home/community; 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, BT (Body temperature), PR (Pulse), RR (Respiratory rate), and BP (Blood pressure); WA, Warning signs; WBC, White blood count (Dengue infection WBC ≤ 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)

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patients were admitted to the inpatient department<sup>1</sup> and two patients were referred to the tertiary care hospital without mortality. The overall participants' knowledge and attitude, two of six aspects of patients' care, and three of eight types of equipment management were significantly improved ( $p < 0.05$ ). Eleven themes were evaluated which were associated with the quantitative data.

**Conclusion:** The DPCG instructed dengue patient's care for health care providers from households to the PCUs and district hospital. All participants improved KAP, and equipment management. Step-by-step of DPCG use and participation of all stakeholders are needed.

## 1. Introduction

There have been more than 100 countries of dengue outbreaks in the tropical and subtropical zones. It is estimated that approximately 2.5 billion individuals are at high risk of infection; while 50 million dengue infection symptoms occur worldwide annually. Approximately 1 in 5 cases of dengue are fatal [1–3]. Dengue can lead to death due of nonspecific treatment following observation of symptoms. However, 44% of patients with dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS) have a shock stage and a mortality rate of 1–5% caused by intravascular fluid overload [1]. The pathology of dengue is mainly focused on two factors: i) increased vascular permeability resulting in plasma leakage, hypervolemia, and shock, and ii) abnormal hemostasis due to vasculopathy, thrombocytopenia, and coagulopathy leading to various hemorrhagic manifestations. There are four serotypes of dengue viruses (DEN), DEN 1, 2, 3, and 4, which are transmitted by *Aedes aegypti* mosquitoes [4].

The World Health Organization (WHO) [4] sets the guidelines for dengue diagnosis and treatment and classified patients according to the presence of dengue fever (DF), DHF, and DSS [4]. These guidelines were almost always used for in children, and there were some limitations to adult patient classification in primary care settings, including the hematocrit levels [5]. Actually, some PCU do not have sufficient equipment or cannot perform repeat testing, while some tourniquet tests do not identify the status of plasma leakage and bleeding [6,7]. In 2009, WHO [1] suggested new guidelines and treatments that classify the disease into three groups: i) Group A, corresponding to dengue infection (probable dengue) such as travel in a dengue outbreak area, two signs, and confirmed laboratory test results; ii) Group B, corresponding to dengue with warning signs (DW): DW has risk signs, such as abdominal pain, continuous vomiting, increased hematocrit levels, and decreased platelets; iii) Group C, corresponding to severe dengue with leakage of plasma, bleeding, and dysfunction of several organs such as the liver and kidney. After comparing the results of a dengue study it was found that the 2009 WHO guidelines are less complicated than other guidelines due to their easy classification and case management [8]. Moreover, they are an accurate standard that presented a sensitivity of 59–98% and a specificity of 41–99%. Compared with a sensitivity of 24.8–89.9% and a specificity of 25–100% for the 1997 WHO guideline [6]. The guidelines, however, may be inappropriate for poor countries that lack equipment, personnel, and resources. As there are specific criteria for dengue diagnosis at hospital admission, every patient should undergo laboratory tests when warning signs detected. These signs can lead to several patients admitted to hospitals that do not have the appropriate number of health care providers. Additionally, approximately 20–30% of DSS cases have no warning signs [9]. Thus, a study suggested that the dengue guidelines need to be considered in the context of the location and country, and that health care providers should be educated on the health care guidelines (warning signs) [10] to diagnose symptoms of patients with dengue disease [1]. Thus, a guideline needs to be integrated between evidence-based data and the context of the health care system for development, use, and monitoring, which is related to the concept of the Iowa model, and demands the participation of all stakeholders [11].

Health care providers are responsible for diagnosis dengue and the appropriate treatments at the primary and secondary health care level

and the referral system [1]. A study that interviewed 236 patients with dengue found that 83.9% of them were admitted to primary care hospitals, of which the mean length of hospital stay was 1.4 days. Moreover, they visited several health care units before receiving treatment (68.7%), did not receive the required information regarding dengue prevention (96–98%), received the prescribed medication (94.9%), were suggested to drink more water (79.7%), were suspected of having dengue infection in only some cases (51.9%), and underwent blood tests [10]. A related study showed that health care providers needed to develop skills and knowledge regarding the cause of infection, signs and symptoms, and complications of dengue [8] related to its clinical practice to decrease severity and mortality rate [1].

In Thailand, the dengue classification is based on the 1997, and 2011 WHO guidelines and is divided into the following phases: 1) fever phase: acute fever onset that is high and continuous, lasting 2–7 days; 2) critical/shock phase: 1/3 of patients in the decreasing fever range. The shock stage is characterized by rapid and weak pulse with narrowing of the pulse pressure or hypotension, chills, clammy skin, and restlessness. These symptoms caused by emerging leakages of plasma into the pleural and peritoneal cavities resulting in hypovolemic shock within 24–48 h. In this phase, there is thrombocytopenia and hemocoagulation from decreasing platelets. 3) The plasma leakage stops in the convalescent phase, and blood enters the vascular vessels, while the heart rate and blood pressure revert to normal, urine production increases, and pleural effusion occurs when the patient has severe shock [2,3,12,13]. Based on these signs and symptoms, health care providers need to correctly assess, diagnose, and treat dengue to decrease the length of hospital stay and complications [10], as the death rate of such patients is approximately 30% [8]. An appropriate treatment and/or evidence-based management guidelines needs to be developed [14]. Therefore, we also considered the development of an appropriate dengue patient care guideline (DPCG) in our area, to aid prevention or provide basic care in the community, primary care units (PCUs), or district hospitals.

Lansaka, a district of Nakhon Si Thammarat province in southern Thailand has been identified as a high-dengue risk area because there were higher dengue morbidity rates than the standard of 50 cases/100,000 individuals while the mortality rate was  $> 0.2$  incidents per dengue case [5]. 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 individuals, respectively. The dengue mortality rates in 2010 and 2012 were 1.15% [15]. For 3 years, the Lansaka health leaders used a larval indices surveillance system (Lansaka model) for dengue prevention in the community [16] and decreased dengue morbidity in 2014, 2015, and 2016 to 164.9, 64.5, and 135.4 cases/100,000 individuals, respectively, with no deaths [17]. According to these studies, although dengue is an important health issue in the Lansaka district, the local authorities have adopted only the surveillance- prevention system and do not follow the step-by-step guidelines on dengue treatment from households to PCUs or district hospitals. Therefore, our aim was to develop and use the DPCG from household to PCUs and the district hospital.

## 2. Materials and methods

The study design used an integrated community participatory action

and the Iowa model of evidence-based practice to promote quality care approach [11] that was implemented in eight PCUs, the district hospital (Lansaka hospital, 60 beds), and the District Official Public Health. The development and use of the DPCG were divided into five steps: preparation, developing DPCG and questionnaires, using DPCG, evaluation and conclusion, and transferring knowledge to all stakeholders. The draft DPCG was developed by 26 health providers, and validated by five experts included two physicians, two registered nurses, and an academic in a university. The research was supported by Walailak University. Moreover, the Thai Research Fund (WU-TRF\_ABC5905) also supported the research 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 collecting data followed the guidelines of the Helsinki Declaration.

In our work, Lansaka district was the setting area (342.90 km<sup>2</sup>). It is one of the 23 districts of Nakhon Si Thammarat province in southern Thailand, consisting of five sub-districts, 44 villages, 11,427 households, and 43,056 residents. There are eight PCUs and one district hospital in this area (Fig. 1).

The participants and the health care providers representing the eight PCUs and departments in the district hospital were divided as follows: i) the supportive group included the director of the district hospital, the head district public health official, the director of the PCUs, and community leaders; ii) the 26 health care providers who were representatives of the government in the district, (e.g., 13 public health officials and 13 registered nurses who represented the PCUs, outpatient departments (OPD), emergency rooms (ER), and inpatient departments (IPD) in the district hospital, and iii) 39 patients with dengue who received health care service following the DPCG for 16 weeks.

### 2.1. Questionnaire for assessing before and after used DPCG

For evaluation before and after using the DPCG, the questionnaires were divided into two parts including the quantitative (personal information, knowledge, attitude and practice: KAP from six aspects, and availability of equipment, medical supplies, and supports) and qualitative questionnaires consisting of six questions. The validity index and measure of internal consistency reliability (Cronbach's alpha) [18] of the questionnaire were 0.93 and 0.87, respectively. Three experts validated the content validity index. The reliability testing of the questionnaire were conducted on a sample of 30 health providers.

Knowledge about care of patients with dengue included 14 themes, such as causes, signs, and symptoms. The health care provider's knowledge was divided into correct, incorrect, and unknown. Each correct answer corresponded to 1 point, and each incorrect or unknown answer to no scoring. The knowledge level was classified into two levels using Bloom's cut-off score criteria of 80% [19,20]. Good knowledge corresponded to a percentage of correct answers  $\geq 80\%$  ( $\geq 11$  points); poor knowledge corresponded to  $< 11$  points.

Attitudes regarding the care of patients with dengue consisted of 10 items regarding the opinion or viewpoints of the severity, prevention, and primary care of dengue disease. The opinions were divided into positive, negative or unknown when the participants answered "yes," "no," or had no opinion, respectively. The attitude level classification regarding the patients' care was similar to that of the knowledge level cut off point (80%). Positive and negative attitudes corresponded to mean scores  $\geq 8$  and  $< 8$  points, respectively.

The practice in care of patients with dengue comprised 47 questions (practices) that were divided into six aspects. The rating scale consisted of five levels with answers of every time, almost, sometime, no action, and N/A, corresponding to 5, 4, 3, 2, and 1 points, respectively. The

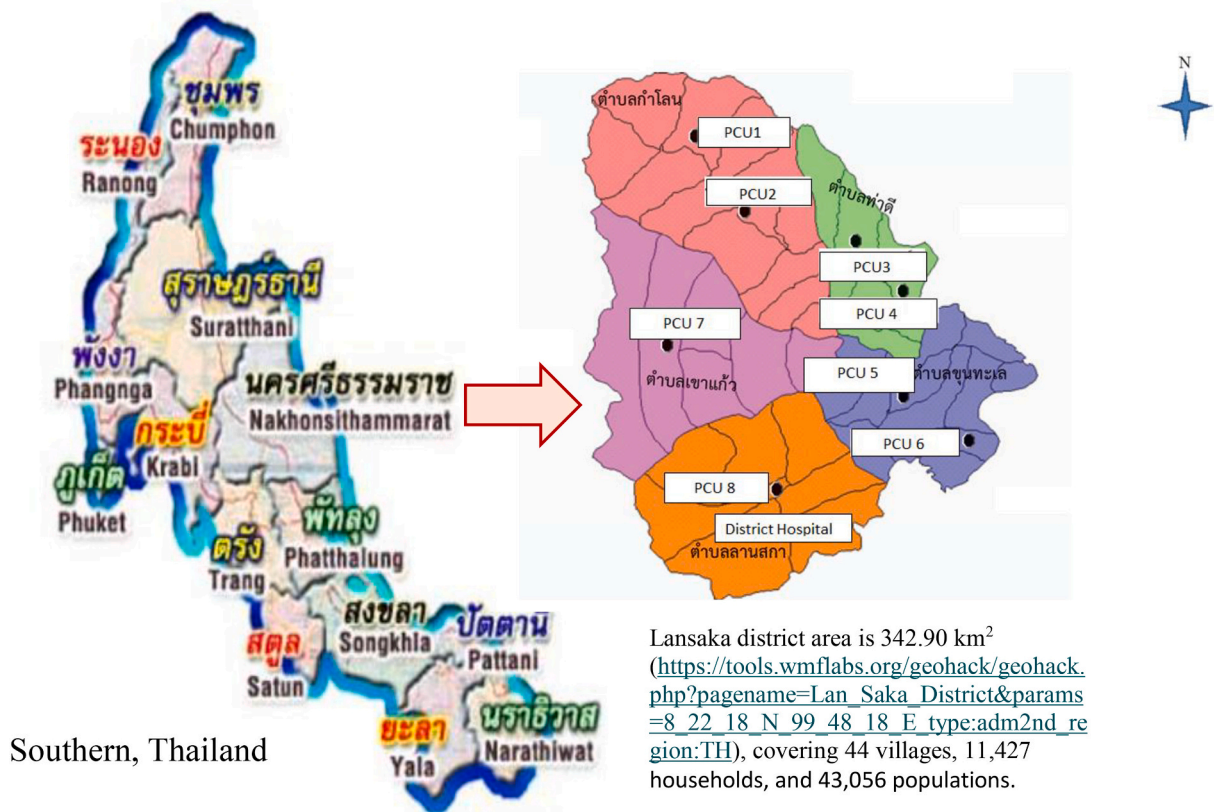


Fig. 1. Setting areas for developing and using DPCG. In our work, Lansaka district was the setting area (342.90 km<sup>2</sup>) DPCG, dengue patient care guideline; PCU, primary care unit.

practice levels in each aspect were also classified according to Bloom's cut-off point of 60–80% [20]. The study was focused on activities of patients with dengue. We considered good practices with a cut-off point of 90% of the total score in each of the following: i) initial assessment primary care (five practices), 22/25 total points; ii) practice in the first 2 days of fever (seven practices), 31/35 total points; iii) practice in diagnosing dengue fever shock in patients (12 practices), 54/60 total points; iv) practice in intravenous infusion (four practices), 18/20 total points; v) practice in referring patients (13 practices), 58/65 total points; and vi) guided practice to prevent dengue fever (six practices), 27/30 total points.

Six qualitative questions were set for the group with dengue disorder and recommended to be completed before and after using DPCG (February and September 2017), respectively. The questionnaires included the following questions: 1) “What is your opinion regarding dengue prevention in the household and district area?”; 2) “What is your opinion regarding dengue assessment and diagnosis in the PCUs and district hospital?”; 3) “What is your opinion regarding the care of patients with dengue in the household and district hospital?” 4) “What is your opinion regarding the ability of patients with dengue to take care of themselves after being discharged from the hospital?”; 5) What is your recommendation regarding the system of referring patients with dengue from the household to PCUs and district hospital?; and 6) “How do you prepare equipment and medical supplies for dengue patients in the PCU or district hospital?”

2.2. Data analysis

As the sample only included 26 participants, we used nonparametric statistical tests. Accordingly, we compared the data before and after using the DPCG for KAP regarding dengue patient care, and the preparation of equipment and medical supplies using by McNemar's test which nonparametric test for analyzing changes that occur in dichotomous variables [21]. The statistically significant level was set at  $p < 0.05$ . Qualitative data were analyzed with thematic analysis, which involved: i) reading the responses to understand the data, ii) coding key words, iii) assigning categories to the key words, iv)

interpreting the meaning of the quotes from participants, and v) determining the themes [22,23].

3. Results

3.1. Developing process of DPCG

The developing process of DPCG consisted of the following five steps (Fig. 2):

- (1) Identifying problem: the research team identified the situation of practice and knowledge in the organization. The assessment that ensured dengue to be a public health issue in the district consisted: (i) problem-focused triggers related to dengue issues, such as dengue incidents, risk of patient care management, dengue clinical practice guidelines, referral systems, and (ii) standards for nursing care of patients with dengue. We discussed our findings with representatives of the PCUs and the district hospital. Then, we analyzed our findings after making literature review and considering knowledge-focused triggers. We assessed their new knowledge of dengue treatment in the PCU and clinical practice guidelines of the WHO and Thai Ministry of Public Health.
- (2) Developing DPCG and questionnaires: The literature review of the evidence-based phase consisted of a review of dengue diagnosis, treatment, prevention, and control (WHO, 1997, 2009, 2012a), and participation of health care providers in the district, including 13 nurses (eight and five nurses from the PCUs and the district hospital, respectively) and 13 public health officials in the PCUs.
- (3) Using DPCG: The application of DPCG was prepared by the research team. The 26 participants from eight PCUs consisted of professional nurses and health care officials of the district hospitals. However, the tertiary level hospitals support fast channels for referring critical cases of dengue. All documents, such as the DPCG manual, flow chart, and dengue manual, were prepared. DPCG was performed for approximately 3 months (June–September 2017). During the testing period, the monitoring and supporting by the research team was completed in one month before and after

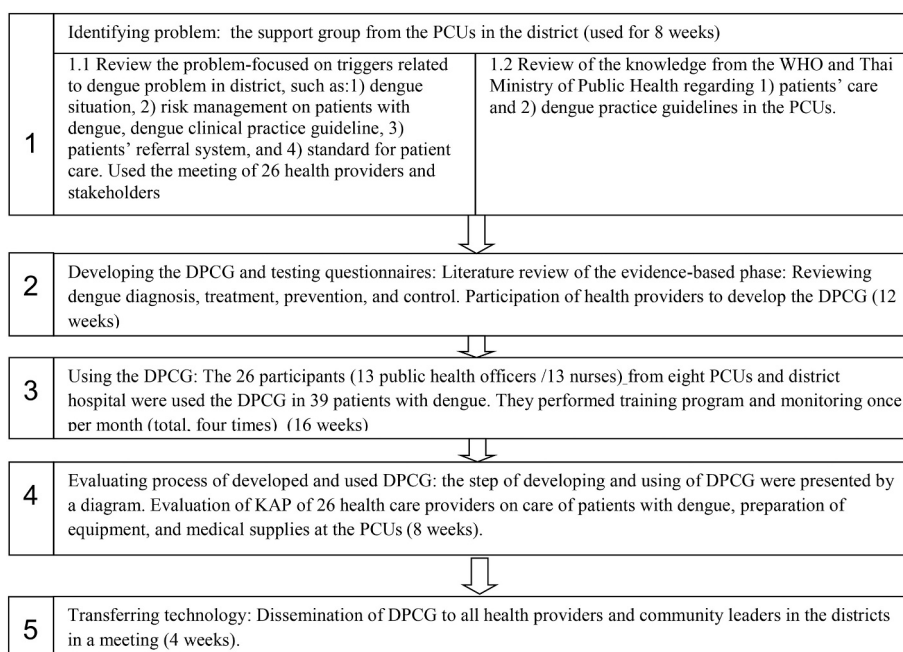


Fig. 2. Development and use of the DPCG in five steps based on the Iowa model and CPAR approach. CPAR, community participatory action research; DPCG, dengue patient care guideline; KAP, knowledge, attitude, practice; PCU, primary care unit; WHO, World Health Organization.



completing the procedure to obtain opinions and knowledge, while practicing on DPCG lasted for 16 weeks. There were training dengue solution and workshop programs for patients' care in household, PCUs, and district hospital.

- (4) Evaluating process of developed and used DPCG: The process of developing and using DPCG was evaluated, considering a diagram of development, the number of participants who presented a developed condition, and the number of patients with dengue. However, the formative evaluation was set scheduled meetings of the participants once per month. The KAP on patients with dengue of 26 participants from the eight PCUs and the district hospital were assessed before and after using DPCG.
- (5) Transferring technology: DPCG was used for the care of patients with dengue from households to the PCUs and the district hospital. After the study was complete, we set a meeting to share the results with other districts that were interested in our outcomes.

3.2. DPCG flow from households to the PCUs and the district hospital

After using the DPCG, the guideline included four steps from households to PCUs and the district hospital.

First: The DPCG at household included: dengue prevention, control, and basic care. This step focused on dengue prevention using the larval indices surveillance system in the "Lansaka model," comprising seven steps in 44 villages [24]. The system focused on cleanliness of their

houses and garbage management. Elimination of mosquito breeding sites using larval indices and a survey of village health volunteers (VHVs) were performed on the 25th day of each month, the data was sent to the group's leader on the 28th day, and sent to the village leader on the 30th day. The later of analyzed the data using a computer program (<http://nakhonsi.denguelim.com/index.php>). Each PCU used the dengue knowledge and larval indices to eliminate mosquito-breeding sites as well as avoiding non-steroidal anti-inflammatory drugs, ibuprofen and aspirin, for treatment of dengue patient. The dengue solution policy of the sub-district organization was conducted in communities and schools. The dengue outbreak control information was showing a dengue case index in the community was communicated as the Surveillance and Rapid Response Team: SRRT.

Second: Using DPCG at the PCUs, when a patient had fever for > 48 h combined with weakness, nausea, and vomiting, he/she needed to be admitted to the PCU. There were two patterns: i) PCU<sup>1</sup>: The patient was referred to the district hospital when he/she had fever for ≥ 48 h. Moreover, in cases where weakness increased without fever symptoms the medical staff examined the hematocrit levels, the hemoglucose test (HGT/DTX) was performed. In addition, when the patient showed signs of shock, the tourniquet test ≥ 10 points/in<sup>2</sup> was performed. Further, they should have assessed the signs of hypovolemic shock and bleeding, fluid replacement following the DPCG, and practice following PCU<sup>2</sup>, and ii) The PCUs [2]: performed continuous observation when the patient had fever for < 48 h. In such cases, the physicians administered

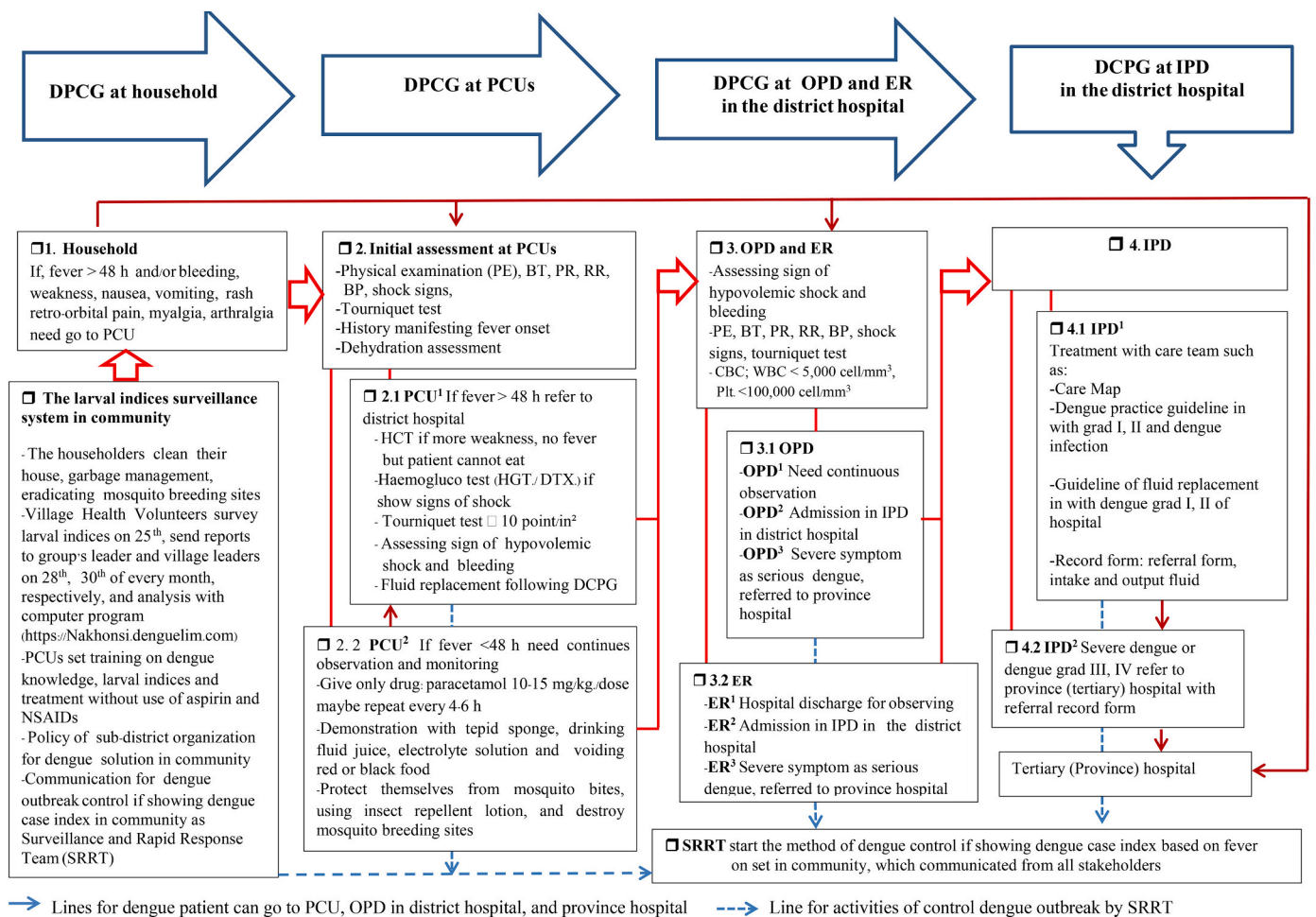


Fig. 3. DPCG after using it for 39 dengue patients from household to PCU, district hospital, and province hospital. The DPCG included four steps from households to PCUs and the district hospital such as: 1) The DPCG at household included, 2) Using DPCG at the PCUs, when a patient had fever, 3) Using the DPCG at the OPD and ER in the district hospital, and 4) Using the DPCG at the IPD of the district hospital and referral to province hospital.

only paracetamol 10–15 mg/kg/dose repeated for every 4–6 h, provided treatment with a tepid sponge, suggested drinking fruit juices, electrolyte solutions, and avoid consumption of red or black foods, and suggested that the patients should protect themselves from avoid mosquito bites, use insect repellent lotion, and destroy mosquito breeding sites.

Third: Using the DPCD at the OPD and ER in the district hospital, patient care at the OPD and ER for assessing signs of hypovolemic shock and bleeding included physical examination, body temperature, respiratory rate, blood pressure, shock signs, tourniquet test, and complete blood count (CBC) (WBC < 5000 cell/mm<sup>3</sup>, platelets < 100,000 cell/mm<sup>3</sup>). There were two options in the OPD and IPD and each channel divided into three patterns. Specifically, the care of patients with dengue at the OPD consisted of the following stages: i) OPD<sup>1</sup>: in patients with dengue, health assessment and screening were needed for advising and continuing observation; ii) OPD<sup>2</sup>: health assessment and DHF diagnosis were made for admission to IPD in the district hospitals; and iii) OPD<sup>3</sup>: health assessment showed severe signs and symptoms, as DSS, and the patients sent to tertiary (province) hospital.

Care of patients with dengue occurred in the ER when they visited the hospital from 16.00 pm to 8.00 am. There were three patterns: i) ER<sup>1</sup>: health assessment and discharge to return to home after observing the dengue signs and symptoms; ii) ER<sup>2</sup>: performing health assessment and DHF diagnosis for admission to the IPD in the district hospitals, and iii) ER<sup>3</sup>: health assessment and diagnosis of dengue with severe symptoms. In such cases, the patients were referred to the province hospital.

Fourth: Using the DPCG at the IPD of the district hospital, the following patterns were followed: i) IPD<sup>1</sup> treatment with a care team, such 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, and ii) the IPD<sup>2</sup> pattern was a guideline for cases of severe dengue or those of dengue grades III and IV, which were referred to the province hospital with the referral form. The guidelines for dengue prevention and control in the community and the practice guidelines in primary to tertiary-care (province) hospitals (Maharaj Nakhon Si Thammarat hospital) needed to be integrated and administered to all stakeholders. Moreover, SRRT was required to monitor the outbreak situation at the case index of dengue fever in the community, and perform outbreak activities as soon as the case index of fever was known.

The application of DPCG covered eight PCUs and the district hospital. The dengue morbidity rate in the district during the DPCG development (16 weeks) was 124 cases/100,000 individuals, without any death. However, the DPCG's record form of the PCUs needs to be

completed. Finally, the new lines of patient care included the admission from the household to the PCU and the district hospital, and they could be further expanded to the admission to the province hospital (Fig. 3).

### 3.3. Results of using dengue Patient Care Guideline: DPCG

DPCG was used for 16 weeks (June–September 2017) in 39 (62.9%; sex, 16 male; mean age, 23 years [range, 3–66 years]) out of 62 patients with dengue who were admitted to the district hospital, as reported by the Nakhon Si Thammarat province's public health officials. The signs and symptoms of 39 patients were fever, weakness, nausea, headache, stupor, and eating less than normal in 39, 8, 5, 5, 3, and 5 cases, respectively. These patients visited the PCUs<sup>2</sup> for fever with a duration < 48 h (six cases), OPD<sup>1</sup> (three cases), OPD<sup>2</sup> (27 cases), and OPD<sup>3</sup> (one case). The guideline of the emergency room (ER<sup>2</sup>) at admission indicated that two patients with DHF should be admitted to the IPD<sup>1</sup>. At the OPD<sup>3</sup>, an 11-year-old girl with fever on day 3, had narrow blood pressure (Systolic blood pressure level deleted by Diastolic blood pressure < 20 mmHg.) and diagnosed as having DHF, while waiting the physician's assessment. Then, she was admitted to the ER<sup>3</sup> (whole blood cells [WBC], 4000 cell/mm<sup>3</sup>, platelets < 86,000 cell/mm<sup>3</sup>) and referred to the province hospital. As per the IPD guidelines, 30 patients were admitted to IPD<sup>1</sup> and one patient's disease severity progressed (Refer IPD<sup>1</sup> to IPD<sup>2</sup>). Dengue diagnosis based-on the guideline found that 6, 15, and 18 patients who visited the PCU<sup>2</sup> only had fever, DF, and DHF, respectively. In IPD, the dengue management was based on a map plan, and DPCG for grades I and II, and fluid replacement guidelines were used according to the disease severity in each case. There were two patients referred to the tertiary care hospital. All cases were treated by the Surveillance and Rapid Response Team (SRRT) following the dengue control method of the Thai MoPH guideline, which was a routine work performed in the PCU and district hospital (Table 1).

### 3.4. KAP regarding dengue patient care before and after using the DPCG from households to PCUs and the district hospital

#### 3.4.1. Participant characteristics

There were 26 health care providers (eight men [30.8%], 18 women [69.2%]) who represented eight PCUs and the district hospital. The average time of practice, current role and function, and practice in the current PCUs of the health care providers were 21.74 (standard deviation [SD], 10.35 years), 14.30 (SD, 8.58 years), and 9.96 years (SD, 7.62 years), respectively. They experienced dengue prevention in the community, fever stage, shock stage, convalescent stage, performing a

**Table 1**  
Admission of 39 patients following the DPCG from households to the PCUs and the district hospital.

Month	Number	DPCG from households to PCUs and the district hospital										Refer	Classification			SRRT
		PCU (n = 6)		OPD (n = 31)			ER (n = 2)			IPD (n = 30)			Fever	DF	DHF	
		PCU <sup>1</sup>	PCU <sup>2</sup>	OPD <sup>1</sup>	OPD <sup>2</sup>	OPD <sup>3</sup>	ER <sup>1</sup>	ER <sup>2</sup>	ER <sup>3</sup>	IPD <sup>1</sup>	IPD <sup>2</sup>					
June	13	0	1	0	9	1*	0	1	1*	11	0	1*	1	4	8*	13
July	12	0	3	0	8	0	0	1	0	9	0	0	3	5	4	12
August	12	0	1	2	10**	0	0	0	0	10**	1**	1**	1	5	6**	12
September	2	0	1	1	0	0	0	0	0	0	0	0	1	1	0	2
Total	39 <sup>a</sup>	0	6 <sup>a***</sup>	3 <sup>a</sup>	27 <sup>a</sup>	1 <sup>a</sup>	0	2 <sup>a</sup>	0	30	0	2	6 <sup>a**</sup>	15	18	39

Then, they received treatment at the PCU and not admitted to the district hospital.

PCU, primary care unit; OPD, outpatient department; IPD, inpatient department; ER, emergency department; DHF, dengue hemorrhagic fever; SRRT, Surveillance and Rapid Response Team.

<sup>a</sup> There were 29 patients in total (6, 4, 27, and 2 patients visited the PCU<sup>2</sup>, OPD [1], OPD [2], and ER [2], respectively.

\* An 11-year-old girl with fever on day 3 while waiting the physician's assessment, showed narrow blood pressure (< 20 mmHg) and was diagnosed as having DHF.

\*\* An 8-year-old girl admitted directly to OPD [2] and in IPD [1] after 4 days. She was referred to the tertiary hospital because she had increased hematocrit levels (> 20%) and narrow pulse pressure. Her diagnosis was DHF.

\*\*\* Fever diagnosis was made when the patients presented only fever for < 48 h at the PCU<sup>2</sup> (six cases).

tourniquet test, taking intravascular fluid, referral of patients, and case dengue patient death in 19, 16, 4, 13, 8, 6, 5, and 1 patient, respectively.

### 3.5. Knowledge regarding dengue patient care before and after using the DPCG from households to PCUs and the district hospital

The comparison of dengue knowledge before and after using DPCG in 26 participants found that 13 of 14 answers were correct, but there was no significant statistic difference ( $p > 0.05$ ). After using the guidelines, the correct answer score significantly improved only in item no. 2 compared to pre-use ( $p \leq 0.001$ ). However, the majority of the answers (14 items) showed that the number of the participants with poor knowledge decreased from 11 to 2, corresponding by those with good knowledge increased from 15 to 24, and there was a statistically significant change for correction ( $p < 0.05$ ) (Table 2).

### 3.6. Attitude regarding dengue patient care before and after using the DPCG from households to PCUs and the district hospital

The attitude corresponds to opinions or viewpoints on the severity and impact of dengue. Almost all participants showed a positive attitude after using the DPCG. Only two items (No. 5 and 6) showed a significantly increased positive attitude ( $p < 0.05$ ). The total number of positive attitude responses significantly increased (Table 3).

### 3.7. Practices regarding patients' care aspect before and after using the DPCG

Aspect 1 corresponded to practice to initial assessment of a patient visiting the PCU/hospital for screening dengue infection. The practice in initially assessing such patients significantly changed ( $p < 0.01$ ). Practices showed an increased changing frequency after higher than before using the DPCG. Only the activity "tourniquet test for investigation platelets" significantly changed ( $p < 0.01$ ).

Aspect 2 corresponded to the basic practice when the providers met a patient with dengue in the first 2 days of the fever phase. The practices improved in such cases between after using DPCG and before using the DPCG; however, the differences were non-significant ( $p > 0.05$ ). The results showed a percentage of 100% when the practice "do not take aspirin" was followed both before and after using DPCG.

Aspect 3 corresponded to the practice guidelines on dengue diagnosis of patients in the dengue shock phase with drowsy signs after 3 days. The performed practices when the health providers met patients improved after using the DPCG, but not significantly ( $p > 0.05$ ).

Aspect 4 corresponded to the practice guidelines on administering intravascular fluid for initial resuscitated shock. The item "Taking 5% D/NSS IV at a drip rate of 120 cc/h (30 drops/min) for adult patient or children  $\geq 6$  years and, then, referred to the tertiary care hospital" significantly changed after using the DPCG ( $p < 0.01$ ). The performance of this practice improved after using the DPCG, however, not significantly.

Aspect 5 corresponded to the practice performed when the

**Table 2**

Comparison of knowledge regarding care of patients with dengue before and after using the DPCG from household to hospital.

Knowledge regarding dengue patient care	Respond	Number(percentage) n (%) n = 26		p-value
		Before	After	
1. Signs and symptoms of dengue; hemorrhagic fever includes increasing leakage of plasma and decreased platelets	Non-corrected Corrected	4 (15.4) 22 (84.6)	3 (11.5) 23 (88.5)	1.000
2. Dengue includes four types: dengue fever, dengue hemorrhagic fever, dengue shock syndrome, and dengue grade 4 (Negative question)	Non-corrected Corrected	12 (46.2) 4 (53.8)	1 (3.8) 25 (96.2)	0.001***
3. An individual may have dengue infection more than one time because the dengue virus has four serotypes	Non-corrected Corrected	2 (7.7) 1 (3.8)	24 (92.3) 25 (96.2)	1.000
4. After 2 days, high fever was observed after a bite from a mosquito infected with dengue (Negative question)	Non-corrected Corrected	18 (69.2) 15 (57.7)	8 (30.8) 11 (42.3)	0.607
5. Probable dengue fever case when there is acute dengue fever with at least two signs, such as headache, muscle and joint pains positive, tourniquet test, WBC < 5000 cell/mm <sup>3</sup> , platelets < 150,000 cell/mm <sup>3</sup> , and increased hematocrit levels (5–10%)	Non-corrected Corrected	5 (19.2) 21 (80.8)	3 (11.5) 23 (88.5)	0.687
6. Almost all patients' symptoms of dengue hemorrhagic fever included high fever for 2–7 days with red face, headache, poor appetite, abdominal pain, positive tourniquet test, WBC < 5000 cell/mm <sup>3</sup> , platelets < 100,000 cell/mm <sup>3</sup> , and increased hematocrit levels (> 10%)	Non-corrected Corrected	5 (19.2) 21 (80.8)	2 (7.7) 24 (92.3)	0.453
7. Patients with dengue shock syndrome have important signs, such as cold skin, restlessness, cry (in children), and increased urine output (Negative question)	Non-corrected Corrected	10 (38.5) 16 (61.5)	3 (11.5) 23 (88.5)	0.065
8. Patients with dengue almost died from delayed diagnosis	Non-corrected Corrected	6 (23.1) 20 (76.9)	3 (11.5) 23 (88.5)	0.375
9. Patients with dengue with convalescent phase showed decreased fever, convalescent race, itching, and good appetite	Non-corrected Corrected	3 (11.5) 23 (88.5)	1 (3.8) 25 (96.2)	0.625
10. <i>Aedes aegypti</i> is small and black and white in color	Non-corrected Corrected	5 (19.2) 21 (80.8)	1 (3.8) 25 (96.2)	0.219
11. Female <i>Aedes Aegypti</i> bite humans for breeding	Non-corrected Corrected	5 (19.2) 21 (80.8)	1 (3.8) 25 (96.2)	0.219
12. Eggs of <i>Aedes Aegypti</i> remained in dry temperature for > 1 year	Non-corrected Corrected	3 (11.5) 23 (88.5)	2 (7.7) 24 (92.3)	1.000
13. Secondary infection of dengue virus increased severity of signs and symptoms	Non-corrected Corrected	2 (7.7) 24 (92.3)	2 (7.7) 24 (92.3)	1.000
14. A human can be infected with dengue virus several times, both severe and non-severe	Non-corrected Corrected	4 (15.4) 22 (84.6)	3 (11.5) 23 (88.5)	1.000
Total dengue knowledge (14 items) <sup>a</sup>	Poor Good	11 (42.3) 15 (57.7)	2 (7.7) 24 (92.3)	0.012*

McNemar Test, Exact Sig. (two-sided) \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

DPCG, dengue patient care guideline; WBC, whole blood cells.

<sup>a</sup> Cut-off point of good level  $\geq 11$  points.

**Table 3**

Attitude regarding patient care before and after using the DPCG from household to the PCU and the district hospital.

Attitude regarding dengue patient care	Respond	Number (percentage) n (%) n = 26		p-value
		Before	After	
1. Dengue has been a public health problem of tropical countries and Thailand	Negative	3 (11.5)	3 (11.5)	0.625
	Positive	23 (88.5)	23 (88.5)	
2. In fever stage of dengue the virus could be transmitted to other people indicating the need to prevent mosquito bites	Negative	3 (11.5)	2 (7.7)	1.000
	Positive	23 (88.5)	24 (92.3)	
3. Severity of dengue disease caused death from compound shock and bleeding	Negative	3 (11.5)	1 (3.8)	0.625
	Positive	23 (88.5)	25 (96.2)	
4. Drinking and invasive intravascular fluid are important treatments in dengue hemorrhagic fever	Negative	7 (26.9)	7 (26.9)	1.000
	Positive	19 (73.1)	19 (73.1)	
5. Wording "prevention is the best treatment of dengue"	Negative	9 (34.6)	1 (3.8)	0.008**
	Positive	17 (65.4)	25 (96.2)	
6. Community participation is the strategy for sustainable dengue prevention	Negative	3 (11.5)	2 (7.7)	1.000
	Positive	23 (88.5)	24 (92.3)	
7. High levels of larval indices predict the risk for dengue outbreak	Negative	3 (11.5)	1 (7.7)	0.500
	Positive	23 (88.5)	25 (96.2)	
8. All stakeholders are important in participating in dengue prevention and control	Negative	3 (11.5)	1 (3.8)	0.625
	Positive	23 (88.5)	25 (96.2)	
9. Quick notification of a health official within 72 h after a dengue case is found	Negative	14 (53.8)	6 (23.1)	0.021*
	Positive	12 (46.2)	20 (76.9)	
10. The probable dengue case needs investigation when the patient has high fever and red face for > 2 days	Negative	9 (34.6)	3 (11.5)	0.070
	Positive	17 (55.4)	23 (88.5)	
Total dengue attitude (10 items) <sup>a</sup>	Negative	10 (38.5)	1 (3.8)	0.012*
	Positive	16 (61.5)	25 (96.2)	

McNemar Test, Exact Sig. (two-sided) \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .<sup>a</sup> Cut-off point of positive level  $\geq 8$  points.

DPCG, dengue patient care guideline; PCU, primary care unit.

we need focus the changing of positive attitude from before to after using DPCG

participant met the patient following the practice guideline for referral to the tertiary (province) hospital. The comparison between before and after using the DPCG revealed that the practices "Check the hematocrit and blood sugar levels before taking intravascular fluid and refer the patient to the province hospital" and "Sent the patient to examine the NS1Ag levels in the first 5 days of fever for threat intravascular solution" significantly improved ( $p < 0.01$  and  $p < 0.05$ , respectively). Similarly, the total score also significantly improved after using the DPCG ( $p < 0.001$ ).

**Table 4**

The changing of practice performance regarding patients' care before and after using the DPCG.

DPCG aspect	Level	Number (percentage) n (%) n = 26		p-value
		Before	After	
1. Practice to initial assessment of patients visiting the PCU/hospital for screening dengue infection <sup>a</sup>	Poor	13 (50)	2 (7.7)	0.007**
	Good	13 (50)	24 (92.3)	
2. Basic practice when meeting a patient with dengue within the first 2 days of the fever phase <sup>b</sup>	Poor	8 (30.8)	4 (15.4)	0.219
	Good	18 (69.2)	22 (84.6)	
3. Practice guidelines for dengue diagnosis of patients in the dengue shock phase with drowsy signs after 3 days <sup>c</sup>	Poor	7 (26.9)	2 (7.7)	0.180
	Good	19 (73.1)	24 (92.3)	
4. Practice guideline for taking intravascular fluid for initial resuscitated shock <sup>d</sup>	Poor	18 (69.2)	12 (46.2)	0.210
	Good	8 (30.8)	14 (53.8)	
5. Practice when the participant meets the patient following the practice guideline for referral to the tertiary (province) hospital <sup>e</sup>	Poor	18 (69.2)	2 (7.7)	0.000***
	Good	8 (30.8)	24 (92.3)	
6. Practice guideline for dengue <sup>f</sup>	Poor	8 (30.8)	6 (23.1)	0.774
	Good	18 (69.2)	20 (76.9)	

McNemar Test, Exact Sig. (two-sided) \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

DPCG, dengue patient care guideline; PCU, primary care unit.

<sup>a</sup> Cut-off point of good level  $\geq 22$  points.<sup>b</sup> Cut-off point of good level  $\geq 31$  points.<sup>c</sup> Cut-off point of good level  $\geq 54$  points.<sup>d</sup> Cut-off point of good level  $\geq 18$  points.<sup>e</sup> Cut-off point of good level  $\geq 58$  points.<sup>f</sup> Cut-off point of good level  $\geq 27$  points.

Aspect 6 corresponded to the practice when the health providers met a patient following the guideline to provide suggestions for dengue prevention. The six practices improved after using the guidelines, but not significantly ( $p > 0.05$ ) (Table 4, and Supplementary material 1).

### 3.8. Preparedness of the medical equipment and supplies for dengue management in the PCUs and district hospital

The medical equipment and supply practices for dengue



**Table 5**  
Changing the preparation of equipment and medical supplies before and after using DPCG.

Equipment and medical supplies	Preparation	Number (percentage) n (%) n = 26		p-value
		Before	After	
1. Mercury sphygmomanometer and cuff with three sizes: small, medium, and large	No	23 (88.5)	3 (11.5)	1.000
	Yes	3 (11.5)	23 (88.5)	
2. Blood glucose meter	No	4 (15.4)	4 (15.4)	1.000
	Yes	22 (84.6)	22 (84.6)	
3. Hematocrit centrifuge	No	4 (15.4)	1 (3.8)	0.375
	Yes	22 (84.6)	25 (96.2)	
4. 5% D/NSS or 5% DLR or 5% DAR capacity 500 cc.	No	16 (61.5)	3 (11.5)	0.002**
	Yes	10 (38.5)	23 (88.5)	
5. Manual of the dengue knowledge	No	17 (65.4)	3 (11.5)	0.003**
	Yes	9 (34.6)	23 (88.5)	
6. Set intravascular fluid, medicut size number at 18, 20, 21, 22, and 23	No	7 (26.9)	6 (23.1)	1.000
	Yes	19 (73.1)	20 (76.9)	
7. Care guidelines for patients with dengue	No	12 (46.2)	1 (3.8)	0.003**
	Yes	14 (53.8)	25 (96.2)	
8. Health care providers were trained using the DCPG	No	6 (23.1)	3 (11.5)	0.508
	Yes	20 (76.9)	23 (88.5)	

McNemar Test, Exact Sig. (two-sided) \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ . DPCG, dengue patient care guideline; PCU, primary care unit.

management significantly improved after using the DPCG. The examined items that significantly improved after using the DPCG were the following “5% D/NSS or 5% DLR or 5% DAR capacity 500 cc,” “Dengue case management manual,” and “Dengue clinical practice guideline” ( $p < 0.001$ ). However, “Hematocrit centrifuge,” “Set IV fluid, Medicut No. 18, 20, 21, 22, and 23,” and “Health care providers were trained with dengue clinical practice guideline” did not significantly increase after using the DPCG. In addition, “Mercury sphygmomanometer and cuff 3 level,” “Blood glucose meter,” did not change after using DPCG compared to before (Table 5).

### 3.9. Theme of the problem and suggestions before and after developing and using DPCG

Saturation data analysis of discussion was obtained before and after developing and using the DPCG. Before developing and using the DPCG, there were six problem themes such as; i) “Lack of prevention awareness of the householder”; ii) “Diagnostic limitations must be defined using clear guidelines”; iii) “Limitation of dengue patient care guide”; iv) “Lack of follow-up on patients with dengue at the PCUs”; v) “Lack of dengue referring system monitoring”; and vi) “Unpreparedness of equipment and medical supplies, and limited skills of health provider”. Three suggestions themes were follows: i) “Emphasizing the survey of mosquito breeding sites for dengue prevention”; ii) “Need to develop the appropriate patient care guidelines”; and iii) “Equipment and medical supplies are important for patient care”.

After developing and using the DPCG, there were three problem themes as follows: i) “Retention of lack of awareness and patient care guideline”; ii) “Lack of knowledge regarding patient care”; and iii) “Lack of equipment and medical supplies in some units”. Two suggested themes after developing and using the DPCG were as follows: i) “There is a need for dengue patient care capacity for all stakeholders” and ii) “Provide support on equipment, medical supplies, and dengue guidelines” (Supplementary data 2).

## 4. Discussion

The development of DPCG from household to the PCUs and the

district hospital was complete after being used in patients and included four steps. It was adjusted to the demands of people in 44 villages in five sub-districts of Thailand, and developed based on the five steps of the Iowa model [11] and the 1997/2011 WHO guidelines [2,3]. The DPCG is a specific guideline regarding management of patients with dengue in households, eight PCUs, OPD and ER, and IPD in Lansaka hospital. For the DPCG development (duration, 16 weeks), 39 patients with dengue (62.9% of the total patients [ $n = 62$ ]) were enrolled to follow the treatment steps from household to hospital. Almost all patients directly visited the OPD/ER of the hospital, as they lived near the hospital. However, 37.1% (23 patients with dengue) did not participate because they could visit another private clinic/health center/hospital. This was consistent with the results of a previous study, which found that 83.9% and 68.7% of the participants visited the primary care hospitals and several health care units, respectively [10].

In our study, 39, 8, 5, 5, 3, and 5 patients had fever, weakness, nausea, headache, stupor, and ate less than normal, respectively. All patients had signs and symptoms of dengue when fever lasted  $> 48$  h and needed to be admitted to the PCU [1,2]. They were then assessed and diagnosed with dengue and admitted to the IPD of the district hospital, with decreased WBC, platelet, and hematocrit levels, following the pathology of dengue [1,2,4].

According to the use of DPCG, patients with mild signs and symptoms received the initial treatment. Moreover, they directly visited the district hospital, and the diagnosis or treatment did not delayed. Then, the DPCG included four steps that integrated the district context, the 1997 WHO classification guidelines, and the standards of the Thai Ministry of Public Health [2,12]. The first step of the guidelines for patient care in households consisted of dengue prevention and control guidelines based on the “Lansaka model,” which uses the larval indices surveillance system for dengue prevention in the community [24]. The effectiveness of the system regarding the prevention of the community (e.g., dengue morbidity) was confirmed, as the morbidity rates in 2014, 2015, and 2016 decreased to 164.9, 64.5, and 135.4 cases/100,000 individuals, respectively, and without death incidents [17]. The second step included the patient care at the PCU, consisting of the PCU<sup>1</sup> and PCU<sup>2</sup> based on the time of fever onset and the cut-off point at 48 h. The patients with dengue can be examined at home, monitored or followed from the PCUs, and referred to the district hospital. The third and fourth steps of the DPCG corresponded to activities at the secondary care level at the district hospital (OPD, ER, and IPD) and referral to tertiary care at the province hospital. Nurses and physicians implemented practice guidelines and document forms in the district and tertiary hospitals. Interestingly, the DF/DHF/DSS model of the 1997 WHO dengue case classifications was limited to performing classifications by experience, as a laboratory was needed for diagnosis [6]. Although in Thailand, health care providers have been trained using dengue classifications of the 1997/2011 WHO DF/DHF/DSS model for a long time, they have accepted and perceived the local DPCG, which has been integrated and applied in the local context [3,4,9].

The local DPCG is an easy guideline for understanding the condition of patients with dengue but follows the Thai Ministry of Public Health guidelines, and the 1997 and 2009 WHO dengue case classifications. Dengue guidelines should be adjusted to the corresponding context, and health care providers need to be trained on the new guidelines (warning signs) [10]. After using the DPCG, the total knowledge and attitude regarding patients' care significantly improved. However, the development of DPCG involved training program regarding dengue knowledge and skills for practice (determined once per month). Health care providers should have sufficient dengue knowledge regarding the natural courses of DF/DHF/DSS, the prevention of disease spread in the community, and the referral system for patients with dengue. A related study showed that health care providers needed to develop skills and knowledge regarding dengue disease, cause of infection, signs and symptoms, and complications of the disease [8] related to dengue clinical practice, which is used to decrease severity and mortality rates

[1]. They increased their dengue knowledge after the training phase, which was consistent with the results of a systematic review of 117 research articles showing good knowledge associated with good attitudes and high dengue prevention practices [25].

Likewise, the performed practices for patients with dengue improved after using the DPCG. Especially, in two out of six aspects (i.e., initial assessment of patients at the household and referral to the province hospital) the difference was significant. All perspectives were associated with dengue management of the WHO guidelines of 1997, 2011 and 2009 [1–4]. The participants presented improved practice performance after testing the DPCG in two aspects consistent with the reflection of meeting discussion that theme of problem “Lack of knowledge regarding dengue patient care” and theme of suggestion “There is a need for patient care capacity for all stakeholders.” Moreover, the equipment and medical supplies were not well prepared because of the short time using the guideline and, probably, due the limited available budget. Before using DPCG, the participants reflected on the “unpreparedness of equipment and medical supplies, and skills of health provider.” After using DPCG, they changed their answer to “seriously supportive equipment, medical supplies, and dengue guidelines.” This associated with the results of study with health workers' perceiving several limitations of the sustainable dengue prevention and control in the community [26].

The medical staff provides important services in communities and hospitals. Obtaining adequate knowledge can help them, especially primary care providers, provide health education to the public and patients [8,10]. Based on dengue's signs and symptoms, health providers need to correctly assess, diagnose, and treat the disease to decrease the hospitalization duration and complications, implicated in approximately 30% mortality cases of patients with dengue [8]. The necessity of obtaining the appropriate knowledge for treatment was also highlighted in another study that examined the health providers' reflections showing the themes “real knowledge of dengue...and increasing dengue knowledge” [22]. Moreover, PCPs were more confident in managing patients with dengue in primary care settings and educated patients on the importance of vector control and dengue warning signs to reduce dengue transmission and burden [27].

However, our study had several limitations. This research focused on developing and using the DPCG that connects the households, PCUs, and district hospitals. The procedure consisted of eight PCUs, the district hospital, and public health officials. The guideline involved two specialized physicians: one medical doctor in the tertiary hospital and the director of the district hospital. However, all physicians in the district hospital should be trained. Moreover, further development of the DPCG steps needs the enrolment of more patients and a duration > 16 weeks.

## 5. Conclusion

The developed DPCG from households to the PCUs and district hospital emphasized on community participation and roles of primary care providers, especially, those who practice at the PCUs and OPD/ER levels. The guidelines for dengue patient care in households consisted of dengue prevention, control, and basic care based on the “Lansaka model,” which uses the larval indices surveillance system for dengue prevention in the community. Knowledge, attitude, and practice regarding dengue patient care of these primary care providers improved after using the DPCG. This could be attributed to the information obtained after being trained by an expert physician when developing and using each DPCG step and after using the National guideline of dengue management, which has been distributed and used across the country for almost 20 years. Education and participation of community in the DPCG would help improve dengue prevention and control, and reduce dengue morbidity and mortality rates. However, the DPCG needs all stakeholders to participate, integrate, and coordinate for continued monitoring and use. Strengthening dengue prevention and control in the community and following the guidelines for

managing patients with dengue starting from household to the PCUs and the district hospital would be a key to enhance the public health service and integrate the knowledge across other sectors in the community.

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## Authors' contributions

Study design, data acquisition, and drafting the work was performed by Suwanbamrung, C. revised the manuscript by Suwanbamrung C, and Cua Ngoc Le. All authors conducted the research, read and approved the final study.

## 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.

## Statement

This study, we developed and used the dengue patient care guideline (DPCG) for covering the district. It provided instructions regarding the management of patients with dengue from households to the primary care units (PCUs) and the district hospital. The guideline emphasized community participation and the roles of primary care providers, especially, those of nurse practitioners and nurses who practice at the PCUs and outpatient department/emergency room levels. The DPCG was developed by 26 health care providers (13 nurses, and 13 public health officials) from eight PCUs and the district hospital. We assessed the questionnaires before and after using the DPCG regarding the participants' knowledge, attitude, and practice on patient care. In addition, we used the guidelines in 39 patients with dengue who were admitted to the inpatient department. The results revealed that the participants had improved knowledge, attitude, and practice scores regarding dengue patient care after using the DPCG. Moreover, after using the DPCG in 39 patients with dengue, no deaths occurred. The results present integrated guidelines for dengue treatment for patients admitted from households to the PCUs and the district hospitals. The extracted outcomes are of great importance, as the DPCG was developed in an area highly affected by dengue disease.

## Declaration of Competing Interest

The authors declare that they have no competing interests.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.onehlt.2020.100168>.

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