DEVELOPMENT OF AN INTEGRATED MHEALTH APP IN IMPROVING KNOWLEDGE, ATTITUDE AND PRACTICES TO REDUCE RISK FOR DENGUE FEVER AND ITS PSYCHOLOGICAL SYMPTOMS

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Advisor: Professor Kozo Watanabe

CERTIFICATION

This is to certify that the dissertation entitled, **"DEVELOPMENT OF AN INTEGRATED MHEALTH APP IN IMPROVING KNOWLEDGE, ATTITUDE AND PRACTICES TO REDUCE RISK FOR DENGUE FEVER AND ITS PSYCHOLOGICAL SYMPTOMS"** presented by Mr. Von Ralph Dane Marquez Herbuela in partial fulfillment of the academic requirement of the degree of doctor has been examined and accepted by the evaluation committee at Graduate School of Science and Engineering of Ehime University.

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Abstract

Dengue fever (DF), the world's fastest spreading mosquito-borne viral disease that causes approximately 390 million cases per year and puts an estimated 3.9 billion people at risk in 128 countries. It was first recognized during a dengue epidemic in the Philippines in 1950, and ever since, it has been a substantial and major public health burden. Although numerous studies have been investigating its continuous prevalence, there are still many aspects of its epidemiology that remain unknown and need to be studied. This dissertation presents how improving knowledge (symptoms, management, prevention), attitude (susceptibility, severity and risk) and practices (preventive measures against DF) or KAP may reduce the risk for DF. DF which has been known to present physical symptoms among patients, has also been reported recently to be neurovirulent which means that they also experience psychological (high levels of depressive and anxiety) symptoms during the infection. Thus, the researches in this dissertation aimed to: a. assess and compare the KAP, identify its predictors, correlation, and protective factors among patients with DF; b. estimate the prevalence and predictors of depressive and anxiety symptoms among patients with DF, and; c. develop and assess Mozzify, an integrated mHealth app for DF case surveillance and KAP-based health communication and behavior modification systems.

In the first chapter, I have introduced the burden of DF by describing its prevalence worldwide and in the Philippines, where DF is endemic. The second chapter introduces the DF symptoms and phases and presented the previous studies

done and the gaps in relation to the topics in focus: knowledge, attitude and practices, depressive and anxiety symptoms and mHealth application development.

The third chapter explains in detail the study done in estimating the levels of knowledge, attitude and practices among patients with DF. In spite of many health programs enacted by the government to control vector mosquitoes and manage DF infection, there is still an increase in the incidence of DF. Community-based studies have been done to assess the KAP of different communities in other countries. However, most of them have included only community-based samples and investigation on samples with clinical or serologically-confirmed DF diagnosis remains inadequate. KAP of in-patients with DF through hospital-based surveillance has not been done. First, I assessed and compared the KAP, identified its predictors, correlation, and protective factors among 233 pediatric and 17 adult patients with DF (clinically or serologically confirmed DF diagnosis) patients and community-based controls in Metro Manila, Philippines using a pretested structured KAP questionnaire. I found out that pediatric and adult patients had significantly lower mean scores in the practice ($p < 0.001$) domain compared with the pediatric and adult controls. Being in senior high school, having had days in hospital, and rash were predictors of KAP among pediatric patients. Knowledge and attitude of patients with DF did not correlate with their practices against DF. Use of mosquito-eating fish, screen windows, and dengue vaccine were protective factors against DF. The study highlights the importance of behavioral change for knowledge and attitude to have significant effect to practices against DF. Thus, I recommend two comprehensive health programs,

Communication for Behavioral Impact (COMBI) and Health Belief Model (HBM).

The fourth chapter describes the study done to investigate the psychological symptoms among the pediatric patients with DF. Recently, the number of studies reporting DF virus to be neurovirulent has increased, associating it with neurological complications in patients with DF. Depression and anxiety have been investigated in children with chronic conditions like cancer, and HIV, yet information among pediatric patients with DF remain inadequate. Thus, this second study aimed to estimate the prevalence, explore the predictors and identify the symptoms of depressive and anxiety symptoms among 225 pediatric in-patients with clinical or serologic-confirmed DF and compare it with that among 260 healthy school-based controls, using the Revised Child Anxiety and Depression Scale (RCADS). The prevalence of depressive (13.3%) and anxiety (34.2%) symptoms among pediatric patients with DF was significantly ($p < 0.001$) higher than that among controls (3.5% and 16.2%, respectively). Multiple linear regression analysis found that age, family history of DF, ≤2 days of hospitalization, myalgia and arthralgia were predictors of increased depressive and anxiety symptoms among the patients. Further, 26.7% of the patients reported irritability, agitation, visual hallucinations and aggressiveness. Therefore, this study concluded that pediatric patients present depressive and anxiety symptoms; which levels were associated with social and clinical factors. However, whether these symptoms are present only during the infection or may still persist after recovery, or are brought by children's adverse reactions to hospitalization are unknown.

The development and assessment of Mozzify, an integrated mHealth app for DF case surveillance, health communication and behavior modification were described in chapter five. For the last 10 years, mobile phones have provided the global health community with innovative and cost-effective strategies to address the challenges in the prevention and management of DF. Mobile health (mHealth) is a concept that uses mobile communication devices, such as mobile phones, to deliver services through mobile apps. Apps are specialized software programs that are often equipped with the capability to link to internet sources and services, including health care providers. However, there is a lack of apps that address the prevention and control of DF with relevant studies and to lessen the risk for acquiring DF and its psychological complications. Thus, this third study aimed to develop an integrated mHealth app for DF cases reporting and mapping, health communication, and behavior modification. I also assessed it in terms of engagement and information-sharing abilities, functionality, aesthetics, subjective quality, and perceived impact among the participants. It was developed for the iOS mobile phone platform using Xcode (versions 10.1 to 11.0) software in Swift (versions 4.2 to 5) programming language. Mozzify has three components: (1) real-time dengue fever cases reporting and mapping, (2) health communication, and (3) behavior modification. These components were matched to three main goals: (1) increase awareness, improve knowledge, and change attitude about dengue fever; (2) increase health care-seeking behavior; and (3) increase intention-to-change behavior on preventive practices against dengue fever. I tested it among purposively sampled public health experts

(n=5), environment and health-related researchers (n=23), and (3) nonclinical users (n=22) using the Mobile Application Rating Scale (MARS). High acceptability and excellent satisfaction ratings (mean scores ≥4.0 out of 5) based on the MARS subscales indicate that the app has excellent user design, functionality, usability, engagement, and information among the participants. The app's subjective quality (recommending the app to other people and the app's overall star rating), and specific quality (increase awareness, improve knowledge, and change attitude about DF; health care-seeking behavior; and intention-to-change behavior on preventive practices for DF) also obtained excellent satisfaction ratings from the participants. Some issues and suggestions were raised during the focus group and individual discussions regarding the availability of the app for Android devices, language options limitations, provision of predictive surveillance, and inclusion of other mosquito-borne diseases. It may be a promising integrated strategic health intervention system for reporting and mapping DF cases, increasing awareness, improving knowledge, changing attitude about DF, and disseminating and sharing information on DF successfully translating knowledge to practice.

The sixth chapter presents the testing and assessment of the Mozzify app in Metro Manila, Philippines which had recently declared a national DF epidemic. Yet, to my knowledge, there is no available integrated mhealth app for DF that includes all the appropriate surveillance methods in early detection of disease outbreaks in the country. This fourth study aimed to test and assess the Mozzify app in terms of the MARS subscales and conduct individual interviews and focus group discussions

among 979 participants (health experts n = 94; general public n = 885). Results indicate high participation rate and Mozzify also had high acceptance rate among the participants as indicated by the high mean score ratings (>4 out of 5) MARS' app quality, subjective and specific scales, with the highest mean score ratings in information and functionality subscales, recommending app to others, and improving knowledge and awareness regarding DF and help-seeking items. Mean difference analyses revealed that total app mean score ratings were the same across ages, income categories, DF history and gender (but not among general public) among the participants. Content analyses of the topics discussed in the individual interviews and focus group discussions revealed eight major themes: positive comments regarding the app's concept, design, information and features; suggestions on adding features like multi-language options and including other diseases; Android version availability; improvements on the app's content, design and engagement; inclusion of users from low-income and rural areas; Wi-Fi connection and app size concerns, and; data credibility, and user security and privacy issues.

The last chapter presents the conclusions of all the studies conducted which can be summarized as: Mozzify can help improve the KAP of people and reduce the risk for DF, thus reducing the risk for its psychological symptoms.

CHAPTER 1

Introduction

To date, there is no known cure for dengue fever (DF), the world's fastest spreading mosquito-borne viral disease transmitted mainly by female *Aedes aegypti* mosquitoes. It causes approximately 390 million cases per year and puts an estimated 3.9 billion people at risk in 128 countries [1–3]. Its incidence has increased by 30 times in the last five decades [4]. DF presents flu-like symptoms that include high-grade fever accompanied by headache, myalgia and arthralgia, nausea and vomiting, intense abdominal pain, rash, retro-/peri-orbital pain, bleeding, and low platelet count (thrombocytopenia), which can lead to acute organ failure, cardiomyopathy, encephalitis, profound shock, and death [1].

In 1953, the first dengue hemorrhagic fever (DHF) outbreak was reported in the Philippines [2]. The Department of Health (DOH) reported that from 2010 to 2014, there has been an average 170,503 symptomatic cases (178 per 10,000 population) and 750 deaths (0.44% fatality rate) in the Philippines [5]. Since then, it has been a been a substantial and major public health burden causing hospitalization and deaths among children and adults in all regions of the country, especially Metro Manila [2]. Metropolitan (Metro) Manila, also known as the National Capital Region (NCR), located in the southwestern part of Luzon, is the capital region of the Philippines [6]. In 2015, Metro Manila, was one of the three regions which had the highest number of dengue fever cases (25,208) according to the Weekly Disease Surveillance Report of the Epidemiology Bureau of the Department of Health (DOH) [7]. Three years later, in 2018, where majority (13%) of the 216,190 cases were from NCR,

which accounted for a 42% increase compared with 2017 (152,224 cases) [8]. Moreover, a total of 1,083 deaths were reported last year, of which, 17% were from NCR [8].

This year, approximately 106,630 dengue fever cases and 456 deaths were reported in the Philippines from January 1 to June 29 (morbidity week 1 to week 26) which indicates an 85% increase in DF cases during the same period in 2018 (57, 564 DF cases) [9]. It was found higher than the alert and epidemic thresholds [9]. Thus, the DOH declared a National Dengue Alert on 15th July 2019 [10] which was followed by the declaration of a National Dengue Epidemic on 6th August 2019 [11]. As of August 17, 2019, the cases and deaths continued to rise to 229,736 and 958 respectively, 107% higher than the same period in 2018 [12].

1.1. Objectives

This dissertation presents how improving knowledge (symptoms, management, prevention), attitude (susceptibility, severity and risk) and practices (preventive measures against DF) or KAP may reduce the risk for DF. DF which has been known to present physical symptoms among patients, has also been reported recently to be neurovirulent which means that they also experience psychological (high levels of depressive and anxiety) symptoms during the infection. Thus, to improve the KAP that will reduce the risk for acquiring DF and its psychological symptoms, I developed, Mozzify, an integrated mHealth app for DF case surveillance and KAP-based health communication and behavior modification systems.

Specifically, I sought to:

1. Assess and compare the KAP of pediatric patients with DF and pediatric controls, and adult patients with DF and adult controls.
    a. identify the predictors of KAP domains by socio-demographic profiles, clinical parameters, and symptoms;
    b. analyze the relationship among the KAP domains, and;
    c. identify protective factors against DF.
2. Estimate the prevalence of depressive and anxiety symptoms among pediatric in-patients with DF and compare it with that among healthy school-based controls.
    a. explore the predictors of these symptoms; and;
    b. identify other self/parent-reported psychiatric manifestations that occur during the infection.
3. Describe the design and development process of the Mozzify and assess it in terms of engagement and information-sharing abilities, functionality, aesthetics, subjective quality, and perceived impact.
    a. among public health experts, environment and health-related researchers, and nonclinical or general public participants (end users) in Japan.
    b. among health experts and members of the general public in the Philippines.

1.2. Hypotheses

1. Knowledge, attitude and practices (KAP) regarding DF among pediatric and adult in-patients and controls:

a. pediatric and adult patients with DF would have lower levels of KAP domains than the pediatric and adult controls, respectively;

b. different clinical variables would be significant predictors of KAP among the pediatric and adult patients with DF;

c. patients' knowledge and attitude on DF would not have a significant positive relationship with their practices against DF, compared with that of pediatric and adult controls, which would imply that low practice levels exposed the patients to the infection.

2. The case-control study on the depressive and anxiety symptoms among pediatric in-patients with DF:

a. the prevalence of depressive or anxiety symptoms among pediatric patients with DF would be higher than that among controls;

b. predictors would include pain-related DF symptoms including headache, myalgia, arthralgia, retro-/peri-orbital pain, and abdominal pain suggesting a causal link between depressive, anxiety, and other psychiatric symptoms and DF infection;

3. The development and assessment of Mozzify, an integrated mHealth App for dengue reporting and mapping, health communication, and behavior modification:

a. the participation and acceptance rates (user's intention to use the app) among the participants will be high due to the app's relevance to the dengue fever control and health communication program;

b. the majority of participants will perceive that users would have increase awareness, improve knowledge, change attitude about dengue fever, which will increase health

care-seeking behavior and behavior change (on preventive practices against dengue fever) through the use of the app;

4. The testing and assessment of Mozzify, the first integrated mhealth app for dengue fever in the Philippines:

a. participation and acceptance rates (user's intention to use the app), and app mean score ratings among the participants will be high due to the app's relevance to the current dengue fever outbreak;

b. the total app mean score ratings will be the same across ages, gender, income categories, and self and family DF history which indicate that the app is acceptable among users of any age group, gender, socioeconomic status, and DF history.

c. individual interviews and focus group discussions would yield similar results as our pilot study;

d. individual interviews and focus group discussions will produce more comprehensive and meaningful results that will reveal the app's strengths and weaknesses in an actual environment and real condition.

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Chapter 2

Review of Related Literature

This chapter presents the literature review of the topics in focus: dengue fever, its symptoms and phases; knowledge, attitude, and practices (KAP); depressive and anxiety symptoms among patients with DF; and development and assessment of Mozzify, an integrated mHealth app for DF.

2.1. Dengue Fever: symptoms and phases

A primary characteristic of the target population in our first two studies was a confirmed (laboratory) and clinical diagnosis of Dengue infection. Based on the Dengue Guidelines for Diagnosis, Treatment, Prevention and Control by the World Health Organization (WHO), probable dengue patients are those who live in or travel to dengue endemic area, has fever and two (2) of the following criteria: nausea, vomiting, rash, aches and pains, Tourniquet test positive, and Leukopenia [1]. Warning signs include abdominal pain or tenderness, persistent vomiting, clinical fluid accumulation, mucosal bleed, lethargy, restlessness, and liver enlargement >2 cm. On the other hand, laboratory-confirmed dengue infection Laboratory tests may include: molecular tests for dengue virus (PCR), antibody tests, IgM and IgG; and, Basic metabolic panel (BMP) [1].

Figure 2.1 shows that platelet count starts to decrease during the febrile phase and in its lowest during the critical phase. Even though fever subsides during the critical phase, patients should continue to monitor platelet count till the drop-in count stops. Platelet count below 20,000 (median: 30,000/mm3) has higher chances of developing bleeding

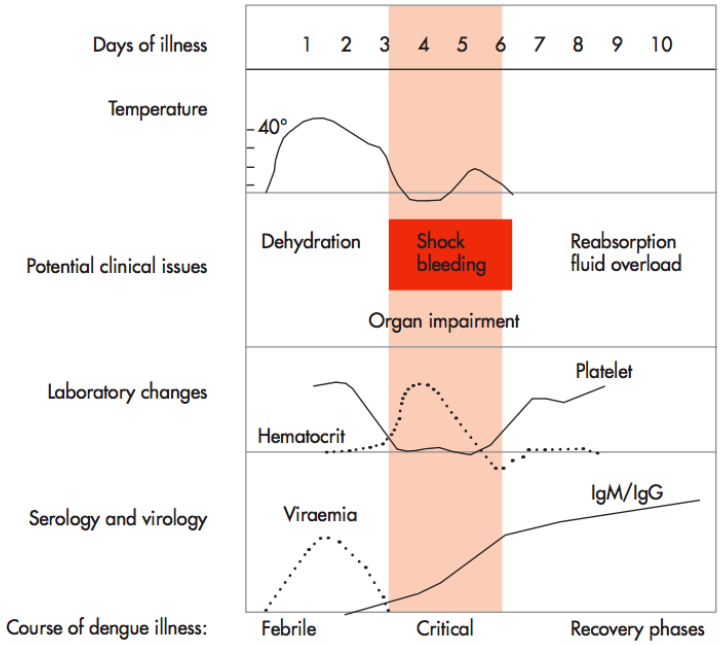

Figure 2.1. The course of Dengue Illness. From the Dengue Guidelines for Diagnosis, Treatment, Prevention and Control by the WHO & the Special Programme for Research and Training in Tropical Diseases (TDR) [1].

complication as seen in dengue hemorrhagic fever. Platelet count reaches the normal during recovery phase [1].

Acute Phase (Febrile to Critical Phase): During the acute febrile phase, patients typically develop high-grade fever suddenly that usually lasts 2–7 days and is often accompanied by facial flushing, skin erythema, generalized body ache, myalgia, arthralgia and headache and neurological disturbances and febrile seizures in young children. Some patients may have sore throat, injected pharynx and conjunctival injection. Anorexia, nausea

and vomiting are common. However, distinguishing dengue from non-dengue is difficult due to these presentations in the early febrile phase unless a positive tourniquet test is determined [1].

Moreover, the difference between severe and non-severe dengue cases are also difficult therefore warning signs and clinical parameters should be monitored to recognize progression to the critical phase. Mild hemorrhagic manifestations like petechiae and mucosal membrane bleeding (e.g. nose and gums) may be seen and liver is often enlarged and tender after a few days of fever. In this phase, there is a progressive decrease in total white cell count, which increases probability of dengue. Around the time of defervescence, when the temperature drops to 37.5–38o C or less and remains below this level, usually on days 3–7 of illness, an increase in capillary permeability in parallel with increasing hematocrit levels may occur. This marks the beginning of the critical phase wherein clinically significant plasma leakage, severe hemorrhage and organ impairment usually lasts 24–48 hours [1].

Recovery Phase: If the patient survives the 24–48-hour critical phase, a gradual reabsorption of extravascular compartment fluid takes place in the following 48–72 hours. General well-being improves, appetite returns, gastrointestinal symptoms abate, hemodynamic status stabilizes and diuresis ensues. Some patients may have a rash of "isles of white in the sea of red", generalized pruritus. Bradycardia and electrocardiographic changes are common during this stage. The hematocrit stabilizes or may be lower due to the delusional effect of reabsorbed fluid. White blood cell count usually starts to rise soon after defervescence but the recovery of platelet count is typically later than that of white blood cell

count. During the critical and/or recovery phases, excessive fluid therapy is associated with pulmonary edema or congestive heart failure [1].

2.2. Knowledge, attitude and practices (KAP)

In spite of many health programs enacted by the government to control vector mosquitoes and manage DF infection, there is still an increase in the incidence of DF. Because DF epidemiology and ecology are strongly associated with human habits and activities [9], assessing knowledge, attitude, and practices (KAP) is deemed necessary, yet, at present, to the best of our knowledge, no study has been done to assess the KAP regarding DF in Metro Manila.

Community-based KAP studies have been done to assess the KAP of different communities in other countries. However, most of them have included only community-based samples and investigation on samples with clinical or serologically-confirmed DF diagnosis remains inadequate. To our knowledge, only two community-based case-control studies have been done. Chen et al. [2] interviewed patients with DF who were randomly chosen from a web-based reporting system through telephone interviews, whereas Kenneson et al. [3] performed clinical ascertainment and community screening to interview households with and without DF infections by identifying acute or recent DF infections. However, these studies had limitations in their data collection methods. The first study limited collection to individuals and households with telephones, which had only a 50% response and completion rate among respondents [2]. The second study collected data among households with acute or recent DF infections, suggesting a self-report bias, as members of these households may

have already acquired knowledge and changed their behavior or attitude towards DF during their surveillance [3]. Thus, I tried to address these limitations by performing hospital-based face-to-face interview surveillance among patients with DF through the use of a questionnaire. Although this method has been reported to have good response and acceptance rate (99%) and a low refusal rate (1%) among in- and out-patients [4,5], this also allowed us to capture patients' knowledge and attitude and their family's/household's practices against DF during the onset (acute phase (febrile-critical) of the infection [1]). I assumed that during the onset of DF, they had no acquired knowledge on DF nor had they changed their attitude or behavior toward DF. Moreover, studying this group will provide important benchmark information on identifying and confirming which of the three KAP domains plays a vital role in the presence and spread of disease which, in turn, would help structure more targeted and proactive community-wide disease prevention and control programs.

Previous KAP studies have also reported that sociodemographic data such as income, employment, education, marital status, religion, sex, age, location, socio-economic status, type of residence, and DF history were associated with KAP [6–16]. However, to our knowledge, no study has investigated the association between clinical parameters (e.g., diagnosis, platelet count), clinical symptoms (e.g., fever, rash, abdominal pain), and KAP. Thus, the inclusion of clinical parameters collected during patient hospitalization could give us significant clues as to whether particular attributes are associated with the disease [17].

Several community-based KAP studies have also investigated the correlation among the KAP domains. Harapan et al. [6] reported that good knowledge is positively associated with good practice. This is parallels with the report by Alyousefi et al. [18] that poor knowledge

on DF has significant positive association with poor preventive practices. However, other similar studies had different results. Kumaran et al. [19] and Shuaib et al. [7] reported that knowledge on causes, signs, symptoms, mode of transmission, and preventive practices against DF are not correlated with the practice of preventive measures against DF. Aside from these, two case-control studies reported which preventive practices are protective factors against DF. Regression models revealed that removing trash and stagnant water from around the residence, using mosquito repellent oils, use of mosquito bed nets, fumigation inside the house, and piped water inside the house can reduce the risk and vulnerability to DF infection [2,3].

2.3. Depressive and Anxiety symptoms

Recently, the number of studies reporting this virus to be neurovirulent has increased [20], associating it with neurological complications in patients with DF [21]. The most prevalent neurological disorder occurring during DF is encephalopathy [22]. Case study reports found that adult patients with DF exhibit delusions with auditory and visual hallucinations, agitation and psychotic symptoms and fears, agitation, irritable affect, psychosis, mania, and catatonia [23–30]. The link between these symptoms and DF infection have been thought to be the result of metabolic disturbances, direct tissue lesion, intercranial hemorrhage, cerebral edema and anoxia and hyponatremia [23,27,28]. Among the identified encephalopathies, depressive and anxiety symptoms were the most studied among adult patients with DF [31–34]. The prevalence of borderline and clinical depression and anxiety among adult patients with DF ranges from 60% to 81% [32,33]. During the acute phase, the

majority (90%) of patients exhibit thanatophobia or fear of death (90%), and during the recovery phase (1 week after onset of DF), more than half (55%) of patients develop fear of mosquitoes (55%) [31,34]. Most importantly, the severity of DF symptoms such as fever, headache, myalgia, arthralgia, retro-/peri-orbital pain, and thrombocytopenia positively correlate with depression and anxiety [32] and increased levels of proinflammatory cytokines such as Interleukin 4/6 and tumor necrosis factor (TNF)-alpha, and platelet brain-derived neurotrophic factors (BDNF) account for the presence of depressive and anxiety symptoms among adult patients with DF [32].

Depression and anxiety have been investigated in children with fatigue syndrome, fibromyalgia, migraine/tension headache [35], chronic abdominal pain [36], juvenile idiopathic arthritis [37], cancer [38], and human immunodeficiency virus (HIV) [39], yet information among pediatric patients with DF remains inadequate. One prospective study provides information on neurologic manifestations of DF in children. Pancharoen and Thisyakorn [40] reported that 80 of 1493 (5.4%) Thai in-patient children (3 months to 14 years old), who had serologically confirmed DF diagnosis, exhibited seizures and encephalopathy-like depressed sensorium and mental confusion during the febrile (acute) stage of DF based on recorded medical charts. However, studies that prospectively use a self-report screening tool to detect depressive and anxiety symptoms [41], which has a high acceptance and response rate (99%) and a low refusal rate (1%) among in- and out-patients [42], are lacking. To date, the study done by Mushtaq and Zahir [43] is the only known study, to our knowledge, that has used a self-report screening tool to measure depression, anxiety, and stress among pediatric patients with DF and investigated its relationship with self-

efficacy. The study used the Depression Anxiety and Stress Scale (DASS) to measure depression, anxiety, and stress and the General Self-Efficacy Scale (GSES) to measure self-efficacy among the participants [43]. They found out that self-efficacy has a negative correlation with depression, anxiety, and stress; thus, developing self-efficacy among the patients is deemed necessary [43]. Although this study adds to the emerging topics on the presence of depressive and anxiety symptoms among pediatric patients with DF, there is still a pressing need to conduct more studies to measure the impact of DF infection on the mental health of pediatric patients.

2.4. Mozzify: Integrated mHealth App

For the last 10 years, mobile phones have provided the global health community with innovative and cost-effective strategies to address the challenges in the prevention and management of dengue fever [44]. Dengue fever, which is considered an international public health concern especially in tropical and subtropical countries, puts an estimated 2 to 3.97 billion people at risk of hospitalization and even death [1,45].

Mobile health (mHealth) is a concept that uses mobile communication devices, such as mobile phones, to deliver services through mobile apps [44]. Apps are specialized software programs that are often equipped with the capability to link to internet sources and services including health care providers [44]. App-enabled mHealth is emerging as the driver for next-generation telemedicine and telehealth [44]. However, there is a lack of apps that address the limitations in the prevention and control of dengue fever with relevant studies.

Development and Initial Assessment

To our knowledge, only one app has been developed with relevant studies, Mo-Buzz. It is a mobile pandemic surveillance system for dengue fever with three main components: predictive surveillance, civic engagement, and health communication [46,47]. These components address the three main limitations in the control and management of dengue fever: (1) use of traditional epidemiological methods (eg, failure to identify the "turning point" of the outbreak leads to vector control measure such as carpet-combing ["search-and-destroy" mosquito breeding sites] near or at the peak of transmission be less impactful [48]), which leads to reactive or poor disease monitoring and surveillance; (2) lack of participation from the public; and (3) lack of effective and interactive health education for the public, which prevents successful translation of awareness or knowledge into actions [46].

Although Mo-Buzz was found to play a significant role in the management and control of dengue fever, I have developed a different mobile app, Mozzify, which offers an integrated mHealth system to address the challenges in dengue fever prevention and management. It has three components: real-time surveillance, health communication, and behavior modification. The main component which is the real-time surveillance features reporting and mapping of dengue fever cases, both laboratory-confirmed hospital and probable dengue fever cases, and mosquito bites. Compared with Mo-Buzz, Mozzify reports and maps dengue fever cases and mosquito bites in real time rather than predictive surveillance, through an online Web map system. There is a lack of spatiotemporal data for dengue fever cases; the data from the real-time surveillance will serve as springboard data for combined predictive and real-time reporting and mapping features of the app in the future.

These will be helpful in identifying dengue fever hotspots (locations with high incidences of dengue fever cases) for health officials to deliver prompt and early warning communication, as well as awareness to the public who are at risk of contracting the disease. Another difference is that Mozzify not only allows reports of probable cases of dengue fever and mosquito bites but also allows reporting of laboratory-confirmed dengue fever cases. Kao et al [49] recommended the introduction of a holistic surveillance system (eg, clinical, serological, and virological) to prevent large-scale epidemics and severe dengue fever cases. The study also recommended the use of a geographical information system for spatial analysis and epidemic prediction models [49].

Another difference of Mozzify from Mo-Buzz is the inclusion of some features in the health communication component. I have developed a system that reports real-time worldwide news about dengue fever and other mosquito-borne diseases; within-app educational videos on the diagnosis, treatment, and management of dengue fever and control of vector mosquitoes; links to local and international health agencies websites; and a real-time timeline chat forum for sharing information among users. These features aim to increase the public's awareness of the signs and symptoms, treatment, and management of dengue fever as well as the prevention and control of vector mosquitoes.

In addition to these features that center on real-time data, two other unique features of Mozzify that differentiate it from Mo-Buzz are the signs and symptoms checker and the interactive hospital directions. I designed a system that lets users check their signs and symptoms of dengue fever and identify the hospitals that have dengue fever express lanes and cater to Dengvaxia-vaccinated individuals. The aim is to not only inform users about the

signs and symptoms of dengue fever but also motivate their health care-seeking behavior, which is based on the health belief model (Figure 2.2).

The health belief model is a widely used social cognition model to predict health behaviors. This model suggests that a change in behavior or action can be expected if a person perceives themselves to be at risk or susceptible to the disease (perceived susceptibility), that the disease will have serious consequences (perceived severity), a course of action will minimize consequences (perceived benefits), and the benefits of action will outweigh the cost of barriers (perceived barriers) and self-efficacy [51]. However, barriers to sustained self-prevention against dengue fever are caused by lack of self-efficacy, lack of perceived benefit, and low perceived or unsure susceptibility [52]. People who perceive themselves at risk of

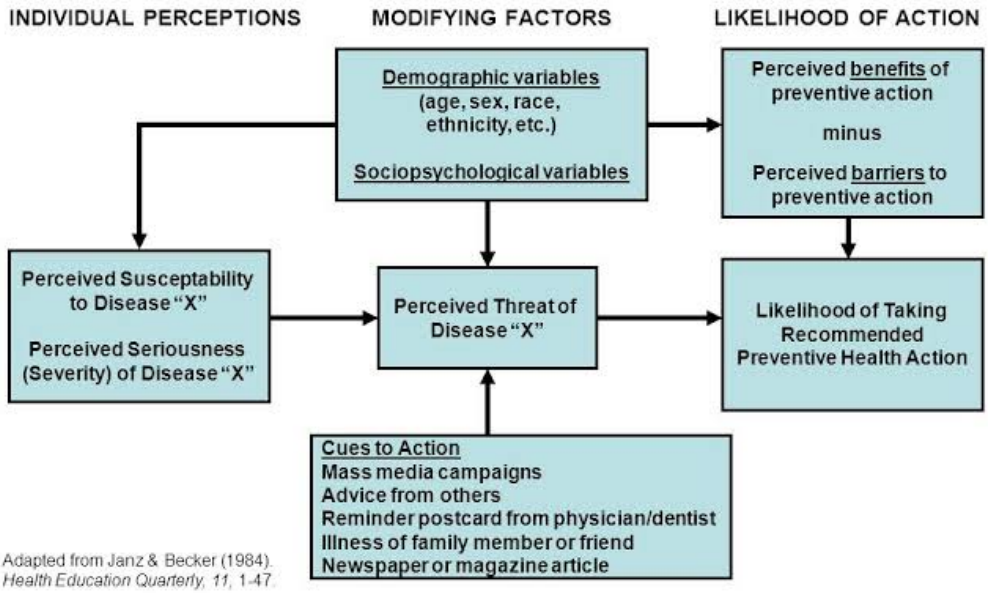

Figure 2.2. The health belief model by Becker (1974; 1988), Janz & Becker (1984) [50].

dengue fever visit a health care provider promptly compared with those who perceive the opposite [53]. Health care-seeking behavior is also greatly influenced by the inadequacy of primary health care facilities in giving adequate services to dengue fever patients [53].

More importantly, what makes Mozzify different from Mo-Buzz is the inclusion of behavior modification as an important component to address the poor translation of awareness or knowledge of the different preventive practices against dengue fever into actions. To address this, I added a feature that allows users to choose and add items on the list of preventive practices against dengue fever and directly transmit it to the built-in iPhone iOS Reminders app to set-up dates and locations of alerts. It has been reported that epidemiology is strongly associated with human habits and activities [54]. Kumaran et al [19] and Shuaib et al [7] reported that knowledge of the causes, signs, symptoms, mode of transmission, and preventive practices against dengue fever is not correlated with the practice of preventive measures against dengue fever. Thus, health programs should be designed to focus on translating knowledge into better and effective practices against dengue fever through behavior change. Many programs continue to focus only on changing people's knowledge or raising awareness rather than physical activity programs, which are more successful at producing behavior change [55]. I have used the concept behind Communication for Behavioral Impact (COMBI), a comprehensive strategy that uses communication for knowledge to have significant effect to behavioral change (making people become aware, informed, convinced, and decide to act, then repeating and maintaining that action) to increase the practice of preventive measures against dengue fever [19,56].

Testing and Assessment

Early detection and effective control of epidemics depend on appropriate surveillance methods [57]. However, Philippines relies its DF surveillance system on passive surveillance method which mainly depends on notifications from barangay/village health centers, municipal or city health offices, hospitals and clinics, and quarantine sections [58,59,60]. This limits the reports to cases that are clinically diagnosed without laboratory confirmation [58] which is only a portion (14.3%) of the dengue cases [58,61]. This leaves those patients with undifferentiated febrile illness or viral syndrome underreported, thus, limits our capability to predict or control epidemics [62].

The main aim of public health surveillance is to monitor dengue transmission accurately which will trigger the necessary effective preventive measures and programs to prevent occurrence and spread of diseases [62]. Recently, the use of mhealth (mobile health) technology, mobile apps specifically, has been gaining prominence as a potential surveillance system that meet the need for real-time disease surveillance and timely identification of epidemics [57, 63]. Mohanty et al [57] found 26 apps relevant to epidemic surveillance which are mostly free of charge and provide real-time tracking and interactive maps. However, they also found some limitations: majority are in Android platform only and focus on a single disease (mostly influenza), some were country and language-specific and had narrow applicability and, only a few are tailored for health professionals [57]. Thus, there is a pressing need to develop an app that not addresses these limitations.

I have developed Mozzify, a free app that features real-time reporting and mapping of dengue cases, comprehensive health communication and evidence-based behavior

modification system, tailored for the general public and healthcare professionals. It is an integrated mhealth because it combines appropriate surveillance methods in early detection of disease outbreaks: indicator-based surveillance (IBS) and event-based surveillance (EBS) [57]. It includes healthcare professionals from clinics, hospital and other healthcare facilities in reporting laboratory confirmed DF, which is the provision of IBS [57, 64]. Moreover, it also uses ArcGIS' spatial analysis feature to identify DF hotspots, which is also an IBS method (sentinel surveillance) [57, 65]. It also includes reporting and mapping of patients with probable or suspected (with clinical symptoms) dengue fever through the use of its interactive symptoms checker, which is the provision of the syndromic surveillance, also an IBS method [57, 64, 66]. Finally, it includes media reports and news, social media (timeline/chat forum) and links to websites of international and local health agencies to detect and monitor outbreaks which is the provision of event-based surveillance method [57,67].

2.5. Conceptual Framework

Figure 2.3. shows how improving KAP may reduce the risk for DF. DF which has been known to present physical symptoms among patients, has also been reported recently to be neurovirulent which means that they also experience psychological (high levels of depressive and anxiety) symptoms during the infection. Thus, to improve the KAP that will reduce the risk for acquiring DF, and will reduce the risk for its psychological complications, I developed, Mozzify, an integrated mHealth app for DF case surveillance and KAP-based health communication and behavior modification systems.

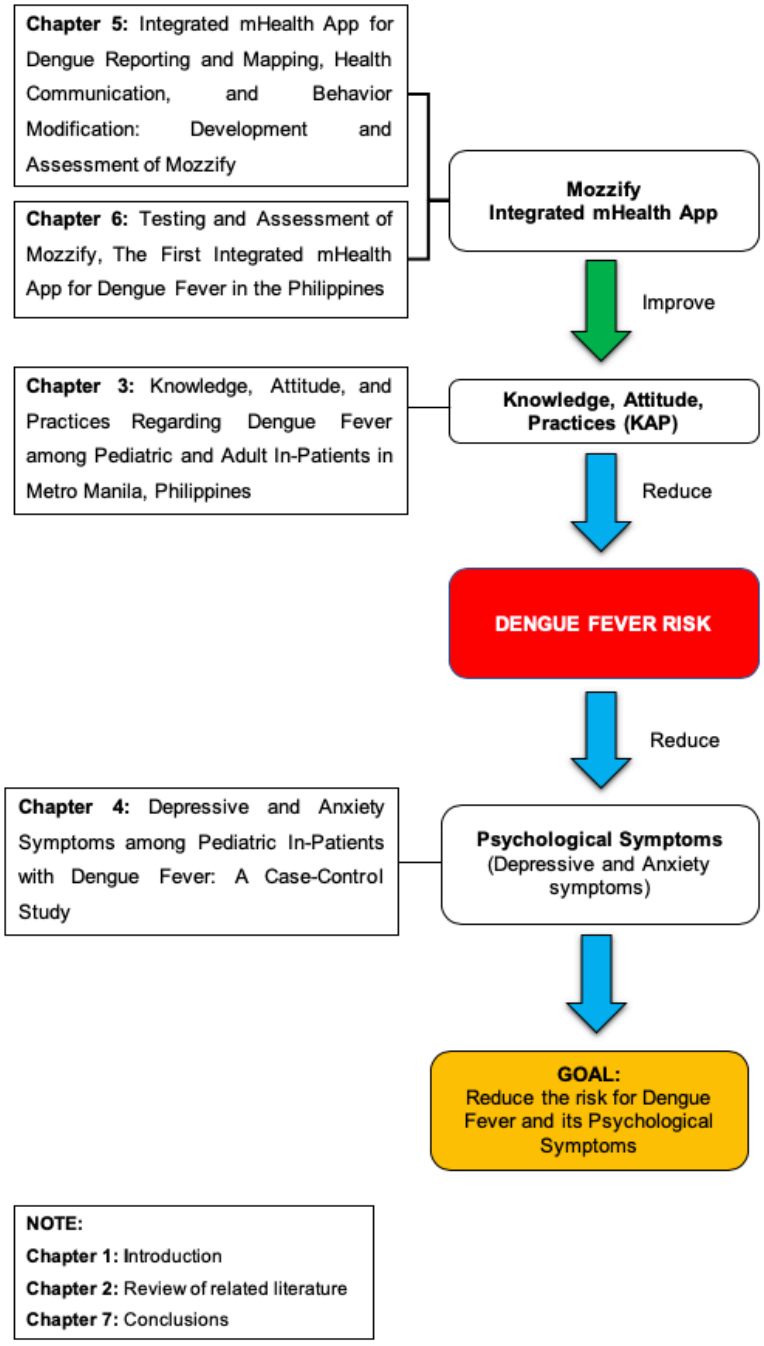

Figure 2.3. Conceptual framework on the impact of improving KAP, through the use of the Mozzify mHealth app, may help reduce the risk for dengue fever thus also reducing the risk for its psychological symptoms.

2.6. Significance of the Study

The results of the study on depressive and anxiety symptoms among pediatric patients with DF will help healthcare providers to identify the importance of emotional and psychological health in providing holistic care for patients with DF. The KAP study will be of great help to community health service providers especially on DF information dissemination to reduce the risk of high number of DF incidences in their community through health communication and behavior modification. The KAP results also served as springboard in the development of Mozzify which will help healthcare practitioners and experts to identify the different DF hotspots in the Metro Manila, improving awareness and knowledge, changing attitude, and improving help-seeking behavior and behavior change among its target users.

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Chapter 3

Knowledge, Attitude, and Practices Regarding Dengue Fever among Pediatric and Adult In-Patients in Metro Manila, Philippines

Abstract

Background: Knowledge, attitude, and practice (KAP) of in-patients with dengue fever (DF) through hospital-based surveillance has not been done. This study aimed to assess and compare the KAP, identify its predictors, correlation, and protective factors among pediatric and adult patients with DF and community-based controls to structure proactive community-wide DF prevention and control programs. Methods: This case-control study involved clinically or serologically confirmed patients (pediatrics n = 233; adults n = 17) with DF admitted in three public hospitals and community-based controls in Metro Manila, Philippines. A pretested structured KAP questionnaire was administered to participants to assess their KAP. Results: Pediatric and adult patients had significantly lower mean scores in the practice ($p < 0.001$) domain compared with the pediatric and adult controls. Being in senior high school, having had days in hospital, and rash were predictors of KAP among pediatric patients. Knowledge and attitude of patients with DF did not correlate with their practices against DF. Use of mosquito-eating fish, screen windows, and dengue vaccine were protective factors against DF. Conclusion: The study highlights the importance of behavioral change for knowledge and attitude to have significant effect to practices against DF. Thus, I recommend two comprehensive health programs, Communication for Behavioral Impact (COMBI) and Health Belief Model (HBM).

1. Introduction

To date, there is no known cure for dengue fever (DF), the world's fastest spreading mosquito-borne viral disease transmitted mainly by female Aedes aegypti mosquitoes. It causes approximately 390 million cases per year and puts an estimated 3.9 billion people at risk in 128 countries [1–3]. DF was first recognized during a dengue epidemic in the Philippines in 1950, and ever since, it has been a substantial and major public health burden causing hospitalization and deaths among children and adults in all regions of the country [2]. The Department of Health (DOH) reported that from 2010 to 2014, there has been an average 170,503 symptomatic cases (178 per 10,000 population) and 750 deaths (0.44% fatality rate) in the Philippines [4].

Metropolitan (Metro) Manila, also known as the National Capital Region (NCR), located in the southwestern part of Luzon, is the capital region of the Philippines [5]. In 2015, according to the DF disease surveillance report of the DOH, Metro Manila was one of the three regions in the country that had the highest number of DF cases (25,208) [6]. Then, in 2017 it ranked second with the highest increase (19.1%) in DF cases (4706) from 1 January to 3 June (morbidity week 1–22) compared with the same period in 2016 [7]. In spite of many health programs enacted by the government to control vector mosquitoes and manage DF infection, there is still an increase in the incidence of DF. Because DF epidemiology and ecology are strongly associated with human habits and activities [8], assessing knowledge, attitude, and practices (KAP) is deemed necessary, yet, at present, to the best of our knowledge, no study has been done to assess the KAP regarding DF in Metro Manila.

Community-based KAP studies have been done to assess the KAP of different communities in other countries. However, most of them have included only community-based samples and investigation on samples with clinical or serologically-confirmed DF diagnosis remains inadequate. To our knowledge, only two community-based case-control studies have been done. Chen et al. [9] interviewed patients with DF who were randomly chosen from a web-based reporting system through telephone interviews, whereas Kenneson et al. [10] performed clinical ascertainment and community screening to interview households with and without DF infections by identifying acute or recent DF infections. However, these studies had limitations in their data collection methods. The first study limited collection to individuals and households with telephones, which had only a 50% response and completion rate among respondents [9]. The second study collected data among households with acute or recent DF infections, suggesting a self-report bias, as members of these households may have already acquired knowledge and changed their behavior or attitude towards DF during their surveillance [10]. Thus, I tried to address these limitations by performing hospital-based face-to-face interview surveillance among patients with DF through the use of a questionnaire. Although this method has been reported to have good response and acceptance rate (99%) and a low refusal rate (1%) among in- and out-patients [11,12], this also allowed us to capture patients' knowledge and attitude and their family's/household's practices against DF during the onset (acute phase (febrile-critical) of the infection [1]). I assumed that during the onset of DF, they had no acquired knowledge on DF nor had they changed their attitude or behavior toward DF. Moreover, studying this group will provide important benchmark information on identifying and confirming which of the

three KAP domains plays a vital role in the presence and spread of disease which, in turn, would help structure more targeted and proactive community-wide disease prevention and control programs.

Previous KAP studies have also reported that sociodemographic data such as income, employment, education, marital status, religion, sex, age, location, socio-economic status, type of residence, and DF history were associated with KAP [13–23]. However, to our knowledge, no study has investigated the association between clinical parameters (e.g., diagnosis, platelet count), clinical symptoms (e.g. fever, rash, abdominal pain), and KAP. Thus, the inclusion of clinical parameters collected during patient hospitalization could give us significant clues as to whether particular attributes are associated with the disease [24].

Several community-based KAP studies have also investigated the correlation among the KAP domains. Harapan et al. [13] reported that good knowledge is positively associated with good practice. This is parallel with the report by Alyousefi et al. [25] that poor knowledge on DF has significant positive association with poor preventive practices. However, other similar studies had different results. Kumaran et al. [26] and Shuaib et al. [14] reported that knowledge on causes, signs, symptoms, mode of transmission, and preventive practices against DF are not correlated with the practice of preventive measures against DF. Aside from these, two case-control studies reported which preventive practices are protective factors against DF. Regression models revealed that removing trash and stagnant water from around the residence, using mosquito repellent oils, use of mosquito bed nets, fumigation inside the house, and piped water inside the house can reduce the risk and vulnerability to DF infection [9,10].

On the basis of the literature presented, I hypothesized that pediatric and adult patients with DF would have lower levels of KAP domains than the pediatric and adult controls, respectively. In line with this, different clinical variables would be significant predictors of KAP among the pediatric and adult patients with DF. Moreover, patients' knowledge and attitude on DF would not have a significant positive relationship with their practices against DF, compared with that of pediatric and adult controls, which would imply that low practice levels exposed the patients to the infection. Therefore, this study aimed to assess and compare the KAP of pediatric patients with DF and pediatric controls, and adult patients with DF and adult controls. I also sought to identify the predictors of KAP domains by socio-demographic profiles, clinical parameters, and symptoms; analyze the relationship among the KAP domains; and identify protective factors against DF. The results will be used as a springboard in identifying and recommending a structure for more targeted and proactive community-wide DF prevention and control programs.

2. Materials and Methods

2.1.Study and Sampling Design

This case-control study involved clinically or serologically confirmed patients (pediatrics n = 233; adults n = 17) and community-based controls (pediatrics n = 233; adults n = 17). Patients with DF were admitted in three public tertiary (>100 beds) hospitals in Metro Manila, Philippines, at San Lazaro Hospital, a referral facility for infectious/communicable diseases; Quezon City General Hospital; and Pasay City General Hospital, whereas the controls were community (adults)- and school (pediatrics)-based

samples. I used the 1:1 ratio (one case patient/one control) with an assumed odds-ratio of ≥2, power (1-β) of 0.80, 0.05 significance level, Zα = 1.96 [27]. Community-based adult controls were compared with adult patients with DF, whereas pediatric patients with DF were compared with school-based grade 3 to grade 12 students (8 to 18 years old). However, I failed to control potential confounders by matching them in terms of age, gender, and grade level because availability and participation rates among the controls were low. Thus, I chose those who were eligible on the basis of the inclusion criteria, and those who were available and willing to participate. The collection was done during the rainy season where high DF transmission occurs from 26 July to 26 November 2017.

2.2. Participant Inclusion and Exclusion Criteria

A semi-structured bedside interview was done among pediatric (18 years old and below) and adult in-patients (19 years old and above) with serology-confirmed or clinically diagnosed DF, who were conscious and able to read and write. Excluded were those who were not able to comply with consent procedures, or with life-threatening comorbidities. Controls were sampled individuals who had no signs and clinical symptoms of DF and who had no family member hospitalized for or diagnosed with DF at the time of interview. For more information about the transcript used in the semi-structured interview, see Supplementary File S1.

2.3. Ethical Considerations and Data Collection Procedures

The study was conducted on the basis of international and local ethical guidelines: Declaration of Helsinki, International Council for Harmonization-Good Clinical Practice (ICH-GCP) Guidelines, and National Ethical Guidelines for Health Research [28–30], and reported on the basis of the Strengthening The Reporting of OBservational Studies in Epidemiology (STROBE) statement checklist (Supplementary File S2). It was reviewed and approved by the Institutional Ethics and Review Boards (IERBs) of each participating hospital: Research Ethics and Review Unit of San Lazaro Hospital, Research Ethics and Technical Committee of Pasay City General Hospital and Planning, Development, and Education and Research office of Quezon City General Hospital (ethics approval numbers: RERU-SLH 2017-016 E and PGH-RETC-01-0-091417001DENGUE).

Informed consent was obtained from all the controls and patients and/or their parent or legally authorized representative (LAR), or caregiver, especially in the case of those who were under 18 years old. They were asked to read and sign an informed consent form (verbal assent for children aged 7–12 years and assent form for children aged 12–15 years) in Filipino before their participation in the study. They were also informed that their participation in the study was voluntary and they may stop their participation any time. Recruitment and interviews of patients were completed by one trained investigator and were supervised by physicians, nurses, and co-investigators assigned at each hospital. The controls were recruited and interviewed by guidance and counseling personnel and a psychologist on the basis of the inclusion and exclusion criteria. To avoid bias, interviews were done with a consistent pre-determined instructions and questions using structured forms and a pre-tested

self-report questionnaire. This was done with the expectation of fairly consistent data from one participant to another. Forms and questionnaires of each participant were coded for their protection and privacy.

2.4. Forms and Instruments

2.4.1. Explanatory Variables

Socio-demographic profile, clinical parameters, and symptoms: Both patients and controls were asked about their personal information such as age, civil status, gender, educational attainment or employment status, family monthly income, and the DF history of their family and themselves. Patients' clinical parameters such as admitting diagnosis, serologic test results (non-structural protein 1 antigen (NS1Ag) and BLOT: immunoglobin G antibody (IgG) and immunoglobin M antibody (IgM)) and laboratory data (i.e., complete blood count (CBC) with platelet count) were obtained from medical charts that were used to identify their current DF phase (acute: febrile to critical and recovery phase). Clinical symptoms or chief complaints were also asked.

2.4.2. Response Variables

KAP regarding DF was developed by Shuaib et al. [14] in Jamaica, which was pretested and then completed three Delphi method review rounds for question and response construction and purpose of the questionnaire. The questionnaire has three domains: 29-item knowledge (dengue symptoms, modes of transmission, preventive practices, and disease management), 3-item attitudes (seriousness, risk, and prevention), and 12-item practices

(mosquito–human contact and eliminating breeding sites) [14]. Knowledge and attitude domains pertain to each participant's self-report of knowledge and perception towards DF, whereas the practice domain involves each participant's household-report of the preventive practices against DF. I added two items in the list of sources of information (e.g., social media and "barangay" or villages and community) and one item in practice (dengue vaccine). A three-point scale, "yes", "no", and "I don't know" was used in the knowledge domain. Correct responses were scored 1, otherwise, scored 0 [20]. A five-point scale, "strongly agree" to "strongly disagree" was used to identify participants' attitudes where "strongly agree" scored 2 and "agree" scored 1. Likewise, one item in practices (frequency of cleaning ditches and containers with water) used a four-point scale of "always" to "never" where "always", "often", and "sometimes" were scored 3, 2, and 1, respectively. Approval was obtained from one of its authors for the use of the test with modifications, forward translation (English to Filipino), expert validation (content, construct, face), back translation (Filipino to English), and pilot testing procedures. The translated questionnaire in Filipino was tested for internal consistency (Cronbach's alpha), and results evidenced KAP domains' acceptable internal consistency Cronbach's alpha of $\alpha = 0.75$, $\alpha = 0.76$, and $\alpha = 0.76$ for the three domains, respectively.

2.5. Statistical and Data Analysis

Statistical analysis was done using Statistical Package for Social Sciences (SPSS) version 25 (IBM Corp., Armonk, NY). I compared the groups—pediatric patients and pediatric controls, and adult patients and adult controls—by their mean scores in each KAP

domain using independent samples t-test. Then, I conducted multiple linear regression analysis where socio-demographic and clinical variables (dummy variables (i.e., 0 or 1) for categorical variables) were inputted in the model using a stepwise method in backward selection to identify significant ($p < 0.05$) predictors of KAP among patients with DF. To calculate the correlation values between the KAP domain scores, Spearman's rank correlation (rs) (two-tailed) and the fisher's R-to-Z transformation to obtain confidence interval (CI) were used, as Shapiro–Wilk and Kolmogorov–Smirnov normality tests revealed that the scores were not normally distributed [20]. All preventive practices were used in a logistic regression analysis to identify protective factors against DF infection in pediatric and adult samples. All significant factors ($p < 0.05$) were put in the multiple regression analysis using stepwise backward selection method.

3. Results

3.1. Socio-Demographic Profile, Clinical Parameters, and Symptoms

Initially, 350 patients with DF participated in the study. However, I excluded those who had incomplete responses (n = 15, 4.3%) and those whose responses came from a family member instead of the patient themselves (n = 85, 24.3%). Thus, data from 500 participants comprising 250 patients with DF (pediatrics n = 233 (93.2%); adults n = 17 (6.8%)) and 250 controls (youth n = 233; adults n = 17) were included in the final analysis. The profile of the participants is shown in Table 3.1. Pediatric patients with DF had a mean (M) age of 13, and an SD (±) of 3.16 years. A total of 56.7% were males, 46.9% were in junior high school, and 84% belonged to a family with a monthly income of ≤10,000 pesos. The age of adult patients

Table 3.1. Socio-demographic profile, clinical parameters, and clinical symptoms among pediatric and adult patients with DF and pediatric and adult controls.

			Patients with DF			Controls		
			Total	**PP**	**AP**	**Total**	**PC**	**AC**
			n = 250	*n* = 233	*n* = 17	*n* = 250	*n* = 233	*n* = 17
Socio-demographic profile	Gender	Male	138 (55.2)	132 (56.7)	6 (35.3)	125 (50.0)	119 (51.1)	6 (35.3)
		Female	112 (44.8)	101 (43.3)	11 (64.7)	125 (50.0)	114 (48.9)	11 (64.7)
	Age	8–10	54 (21.6)	54 (23.2)		4 (1.60)	4 (1.70)	
		11–13	53 (21.2)	53 (22.7)		93 (37.2)	93 (39.9)	
		14–16	75 (30.0)	75 (32.2)		111 (44.4)	111 (47.6)	
		17–18	51 (20.4)	51 (20.4)		25 (10.0)	25 (10.7)	
		19–21	5 (2.00)		5 (29.4)	3 (1.20)		3 (17.6)
		22–24	2 (0.80)		2 (11.8)	4 (1.60)		4 (23.5)
		25–27	2 (0.80)		2 (11.8)	3 (1.20)		3 (17.6)
		≥28	8 (3.20)		8 (47.1)	7 (2.80)		7 (41.2)
	Education/employment	Grade school	72 (30.1)	72 (31.9)		11 (4.40)	11 (4.70)	
		JHS	106 (44.4)	106 (46.9)		204 (81.6)	204 (87.6)	
		SHS	39 (16.3)	36 (15.9)	3 (23.1)	12 (4.80)	12 (5.20)	
		College	8 (3.30)	7 (3.10)	1 (7.70)	9 (3.60)	6 (2.60)	3 (17.6)
		Employed	13 (5.40)	5 (2.20)	8 (61.5)	10 (4.00)		10 (58.8)
		Unemployed	1 (0.40)	0	1 (7.70)	4 (1.60)		4 (23.5)
	Income (₱)	≤10,000 PHP	192 (83.1)	180 (84.1)	12 (70.6)	18 (7.20)	17 (7.30)	1 (6.30)
		≥10,000 PHP	39 (16.9)	34 (15.9)	5 (29.4)	231 (92.8)	216 (92.7)	15 (93.8)
	Civil status	Single	243 (98.4)	232 (100)	11 (73.3)	249 (99.6)	233 (100)	16 (94.1)
		Married/live-in	4 (1.60)	0 (0.00)	4 (26.7)	1 (0.40)		1 (0.30)
	Household member	≤5 members	128 (55.4)	116 (54.2)	12 (70.6)	174 (69.6)	164 (70.4)	10 (58.8)
		≥6 members	103 (44.6)	98 (45.8)	5 (29.4)	76 (30.4)	69 (29.6)	7 (41.2)
Clinical parameters	Medical diagnosis	DHF w/ws	198 (79.2)	181 (77.7)	17 (100)			
		Severe dengue	6 (2.40)	6 (2.57)				
		Probable	46 (18.4)	46 (19.7)				
	Days in the hospital	≤2 days	170 (76.2)	159 (77.2)	11 (64.7)			
		≥3 days	53 (23.8)	47 (22.8)	6 (35.3)			
	DF history	Had DF	16 (7.30)	15 (7.3)	1 (6.70)	32 (12.8)	31 (13.3)	1 (5.90)
		First-time	204 (92.7)	190 (92.7)	14 (93.3)	218 (87.2)	202 (86.7)	16 (94.1)

	Family DF history	None	155 (70.5)	140 (69.0)	15 (88.2)	195 (78.0)	185 (79.4)	10 (58.8)
		≥1 had DF	65 (29.5)	63 (31.0)	2 (11.8)	55 (22.0)	48 (20.6)	7 (41.2)
	Dengue phase	Acute	200 (80.0)	188 (80.7)	12 (70.6)			
		Recovery	50 (20.0)	45 (19.3)	5 (29.4)			
	Dengue tests	(−) NS1Ag	52 (44.1)	42 (38.9)	10 (100)			
		(+) NS1Ag	66 (55.9)	66 (61.1)				
		(−) IgG	46 (68.7)	41 (67.2)	5 (83.3)			
		(+) IgG	21 (31.3)	20 (32.8)	1 (16.7)			
		(−) IgM	14 (20.9)	13 (21.3)	1 (16.7)			
		(+) IgM	53 (79.1)	48 (78.7)	5 (83.3)			
Clinical Symptoms	Headache	Asymptomatic	206 (82.4)	193 (82.8)	13 (76.5)			
		Symptomatic	44 (17.6)	40 (17.3)	4 (23.5)			
	Fever	Asymptomatic	210 (84.0)	194 (83.3)	16 (94.1)			
		Symptomatic	40 (16.0)	39 (16.9)	1 (5.9)			
	Nausea and vomiting	Asymptomatic	188 (75.2)	177 (76.0)	11 (64.7)			
		Symptomatic	62 (24.8)	56 (24.3)	6 (35.3)			
	Myalgias and arthralgias	Asymptomatic	193 (77.2)	180 (77.3)	13 (76.5)			
		Symptomatic	57 (22.8)	53 (22.9)	4 (23.5)			
	Petechiae (rash)	Asymptomatic	145 (58.0)	134 (57.5)	11 (64.7)			
		Symptomatic	105 (42.5)	99 (43.0)	6 (35.3)			
	Retro-/peri-orbital pain	Asymptomatic	223 (89.2)	208 (89.3)	15 (88.2)			
		Symptomatic	27 (10.8)	25 (7.86)	2 (11.8)			
	Abdominal pain	Asymptomatic	157 (62.8)	145 (62.2)	12 (70.6)			
		Symptomatic	93 (37.2)	88 (37.9)	5 (29.4)			
	Thrombocytopenia	≤9900/mm^3	72 (28.8)	70 (22.01)	2 (11.8)			
		≥10,000/mm^3	165 (66.0)	150 (68.2)	15 (88.2)			

DF—dengue fever; PP—pediatric patients; AP—adult patients; PC—pediatric controls; AC—adult controls; JHS—junior high school; SHS—senior high school; ₱—Philippine peso (52.16 USD = 1 ₱); Acute—febrile to critical phase; ws—warning signs; DHF—dengue hemorrhagic fever; (+)—positive; (−)—negative; NS1Ag—non-structural protein 1 antigen; IgG—immunoglobin G antibody; IgM—immunoglobin M antibody

ranged from 19 to 49 years old (M, 29.9 ± 10), 64.7% were females; 73.3% were single, 61.5% were employed, 70.6% belonged to a family with a monthly income of ≤10,000 pesos, and 70.6% belonged to a family with ≤5 members. All (100%) adult patients and the majority (77.7%) of pediatric patients with DF had dengue with warning signs. A large proportion of pediatric patients and adult patients had no DF history (92.7% and 93.3%, respectively), had no family DF history (69% and 88.2%, respectively), and were in the acute (febrile-critical) phase of the infection (80.7% and 70.6%, respectively). More than half (68.2%) of pediatric patients and the majority (88.2) of adult patients had thrombocytopenia (9900/mm3). Nearly half (43%) of pediatric patients and 35.3% of adult patients had petechiae or rashes.

Furthermore, pediatric controls had a mean age of 14.11 (±1.88) years with almost half (47.6%) belonging to the 14–16 age group, whereas adult controls had a mean age of 26.6 (±6.07) years that ranged from 20 to 46 years old. Half (51.1%) of pediatric controls were males, whereas 64.7% of adult controls were females. All (100%) of youth controls and the majority (94.1%) of adult controls were single. Most of the pediatric (92.7%) and adult controls (93.8%) belonged to a family with a monthly income of ≥10,000 pesos. There was a preponderance of pediatric (86.7%) and adult (94.1%) controls who had no DF history. More than half of pediatric (79.4%) and adult controls (58.8%) had no family DF history.

3.2. Mean Score Difference of Knowledge, Attitude, and Practice between Patients and Controls

An independent samples t-test revealed that pediatric patients with DF had significantly higher mean scores in knowledge ($p < 0.001$) and attitude ($p < 0.001$) domains

than pediatric controls (Table 3.2). However, pediatric patients with DF obtained significantly lower mean score in practice domain ($p < 0.05$) than pediatric controls. In adult samples, adult patients with DF had significantly lower mean scores in knowledge ($p < 0.001$) and practice ($p < 0.001$) domains than adult controls.

Table 3.2. Results of independent t-test for the difference of knowledge, attitude, and practice (KAP) mean scores between patients and controls.

	Pediatrics			**Adults**		
	PP (*n* = 233)	**PC (*n* = 233)**		**AP (*n* = 17)**	**AC (*n* = 17)**	
Domains	**Mean (SD)**	**Mean (SD)**	***p*-Value**	**Mean (SD)**	**Mean (SD)**	***p*-Value**
Knowledge	19.6 (3.49)	14.5 (6.26)	<0.001	17.7 (3.58)	22.5 (2.69)	<0.001
Attitude	3.46 (1.91)	2.46 (2.12)	<0.001	3.88 (2.23)	4.12 (1.49)	0.72
Practices	9.29 (2.32)	9.83 (2.93)	0.03	7.94 (2.04)	11.1 (1.78)	<0.001

PP—pediatric patients; PC—pediatric controls; AP—adult patients; AC—adult controls; SD—standard deviation.

3.3. Predictors of Knowledge, Attitude, and Practice

Multiple linear regression analysis found significant regression equations in all KAP domains among pediatric patients with DF, as shown in Table 3.3. It shows that knowledge increased significantly more in pediatric patients who were in senior high school, whereas it decreased significantly more in pediatric patients who were in college and those who had DF for the first time. Being in senior high school also tended to increase pediatric patients'

attitude. Additionally, the longer they stayed in the hospital, the higher their attitude score became. However, the older their age, their attitude scores lowered. Further, practice scores

Table 3.3. Multiple linear regression results showing the predictors of KAP among pediatric patients with DF.

Outcome Variables	Predictors	R^2	β	*p*-Value
Knowledge	Education (senior high school)	0.09	0.18	0.01
	Education (college)		−0.16	0.02
	No DF history (first-time)		−0.15	0.04
Attitude	Age	0.11	−0.30	0.004
	Education (senior high school)		0.39	<0.001
	Days in the hospital		0.16	0.04
Practice	Severe dengue	0.07	−0.15	0.04
	Rash or petechiae		0.18	0.01

β = standardized beta coefficients; DF = dengue fever.

tended to decrease among those with severe dengue, yet, tended to increase in those pediatric patients who had petechiae or rash. No significant predictors were found among adult patients with DF.

3.4. Correlation among Knowledge, Attitude, and Practices

Spearman rank correlation revealed that, although not statistically strong (r_s = 0.2), there was a significant positive correlation between knowledge and attitude domains of pediatric patients with DF, as shown in Table 3.4. As hypothesized, there was no correlation

found in knowledge–practice and attitude–practice domains of both pediatric and adult patients with DF. Among controls, only youth controls had obtained significant positive correlations among the KAP domains, wherein a relatively strong correlation was found between knowledge–practice domains with a correlation coefficient of 0.42 (95% CI: 0.34–0.57).

3.5. Protective Factors against DF

All preventive practices were used in a logistic regression analysis to identify protective factors against DF. Then, after a multiple regression analysis, use of mosquito-eating fish, dengue vaccine, use of screen windows, and performing at least one preventive practice against DF were found to be protective factors against DF among youth samples (pediatric patients with DF and pediatric controls), as shown in Table 3.5. Among adults (adult patients with DF and adult controls), only the use of screen windows was identified as a significant protective factor against DF, with an adjusted odds-ratio (aOR) of 23.9 (95% CI: 2.08–275.2, $p = 0.01$). For both youth and adult samples, mosquito-eating fish, screen windows, and dengue vaccine were identified as protective factors against DF infection. The strongest factor in the model was use of mosquito-eating fish, with an adjusted ratio (aOR) of 8.69 (95% CI: 3.67–20.57, $p \leq 0.001$).

4. Discussion

Pediatric patients with DF had significantly higher mean scores in knowledge and attitude than pediatric controls, who, in turn, as expected, had a significantly higher mean score in the practice domain compared with pediatric patients with DF. As expected, adult

patients with DF had significantly lower mean scores in knowledge and practice domains than adult controls. Being in senior high school, having had days in the hospital, and having a rash were predictors of KAP among pediatric patients with DF, whereas no significant predictors were found among adult patients with DF. There was a significant positive correlation between knowledge and attitude ($p < 0.01$) of pediatric patients with DF, however, similar with adult patients with DF, these domains did not correlate with their practices against DF. Moreover, mosquito-eating fish, screen windows, and dengue vaccine were protective factors against DF, although further community-based studies should confirm these results.

Table 3.4. Correlation among the KAP domains among patients with DF and controls.

	Patients with DF		**Controls**	
Variables	**r_s (95% CI)**	***p*-Value**	**r_s (95% CI)**	***p*-Value**
Knowledge-attitude				
Pediatrics	0.20 (0.08, 0.13)	0.002	0.34 (0.24–0.48)	<0.001
Adults	0.02 (−0.51, 0.59)	0.95	−0.05 (−0.50, 0.60)	0.84
Knowledge-practice				
Pediatrics	0.06 (−0.06, 0.20)	0.36	0.42 (0.34–0.57)	<0.001
Adults	−0.39 (−0.81, 0.24)	0.12	0.03 (−0.58, 0.52)	0.91
Attitude-practice				
Pediatrics	−0.04 (−0.15, 0.10)	0.57	0.23 (0.13–0.38)	<0.001
Adults	−0.13 (−0.62, 0.48)	0.62	0.19 (−0.41, 0.68)	0.46

r_s: Spearman rank correlation coefficients; 95% confidence intervals (CI) were transformed using Fisher's R-to-Z.

Our study extends the investigations done by Chen et al. [9] and Kenneson et al. [10] that focus on clinical and laboratory-confirmed DF infections as the primary outcome of

interest rather than preventive practices. As this was a hospital-based study, this allowed us to easily identify individuals with positive cases according to clinical diagnostic criteria and laboratory-confirmation of DF diagnosis. Our study provides the first report on the use of clinical ascertainment through hospital-based surveillance among pediatric and adult patients with DF and the first description on the difference of KAP regarding DF between patients with DF and community-based controls. It also provided the first investigation on the association of clinical data to KAP domains, correlation among the KAP domains and protective factors against DF among patients with DF and community-based controls.

The significantly high mean scores in knowledge and attitude, as well as the low mean scores in practice among pediatric patients with DF compared with their counterparts, may be explained by factors associated with being hospitalized. It may be possible that hospitalization caused pediatric patients to gain more knowledge about DF compared with pediatric controls. Being diagnosed with DF increased their awareness regarding DF, and multiple encounters with different healthcare providers or other patients might have increased their knowledge about DF. Having DF history was also found to be a significant determinant of high knowledge mean scores among pediatric patients with DF. Although only 7.3% had DF before, this may appear obvious; however, past experiences such as infection, which is prevalent among children [29], also increased pediatric patients' knowledge about DF. Moreover, the significantly high score obtained by pediatric controls in the practice domain implies that they had good practice against DF compared with pediatric patients with DF. This seemed to be also true among adult controls who had higher

mean scores in the practice domain than adult patients with DF, which may explain why controls, in general, did not have DF.

Table 3.5. Multiple logistic regression model of predictors of absence of DF infection.

Likelihood Ratio Estimates						
Practices	**DF**	**β**	**SE**	**Wald X^2**	**aOR (95% CI)**	***p*-Value**
Pediatrics						
screen windows	1	1.45	0.31	21.15	4.25 (2.29–7.88)	<0.001
eliminate standing water	1	−1.40	0.41	11.96	0.24 (0.11–0.54)	0.001
mosquito-eating fish	1	2.03	0.45	20.70	7.62 (3.18–18.3)	<0.001
does nothing to reduce mosquitoes	1	0.98	0.37	6.87	2.67 (1.28–5.57)	0.009
dengue vaccine	1	1.60	0.28	32.58	4.95 (2.86–8.56)	<0.001
covering water containers	1	−2.32	0.53	19.15	0.10 (0.03–0.28)	<0.001
Adults						
professional pest control	1	1.82	0.93	3.88	6.20 (1.01–38.1)	0.05
screen windows	1	3.17	1.25	6.49	23.9 (2.08–275)	0.01
Both						
screen windows	1	1.53	0.30	25.92	4.60 (2.56–8.28)	<0.001
eliminate standing water	1	−1.41	0.39	13.20	0.24 (0.11–0.52)	<0.001
mosquito-eating fish	1	2.16	0.44	24.23	8.69 (3.67–20.6)	<0.001
does nothing to reduce mosquitoes	1	0.70	0.36	3.83	2.01 (1.00–4.04)	0.05
dengue vaccine	1	1.49	0.27	30.32	4.42 (2.61–7.55)	<0.001
covered water containers	1	−2.01	0.49	17.09	0.13 (0.05–0.35)	<0.001

DF = degree of freedom; β = standardized beta coefficients; SE = standard error; Wald X2 = Wald chi-square; aOR (95% CI) = adjusted odds-ratio 95% confidence interval.

Previous studies have reported that there is a significant positive correlation between education and level of knowledge and attitude toward DF [19,23]. However, in our study,

pediatric patients who were in senior high school tended to have increased knowledge and attitude on DF compared to those in college or university. One possible reason could be that senior high schools may have included contents about DF in their curriculum that may have increased the knowledge and attitude levels of pediatric patients in senior high school. As the age of pediatric patients with DF increased, their attitude towards DF decreased. Hospitalized younger children were reported to be very conscious about their health and expressed very positive health attitudes compared with older children [31,32]. This may be brought about by the fact that younger children who are hospitalized are more vulnerable to emotional upset and they experience greater anxiety, arising from separation from parents [33,34].

Another significant predictor of attitude towards DF was the number of days in hospital. The longer individuals stayed in hospital, the more they perceived DF as serious and threatening, which may have been due to their experience of anxiety towards medical settings and receiving of medical care [35]. Specifically, they had fear of medical procedures such as injection needles [36] (daily drawing of blood to check their platelet counts) and they perceived medical professionals such as doctors and nurses as inflictors of trauma [37]. Aside from these, hospitalization also increased the chance of children being dissatisfied with their hospital stay situation, due to factors such as food conditions, also experiencing anxiety because of limited physical activities such as being absent in school and having a limited chance of spending time and playing with peers and friends or siblings [38,39].

The appearance of petechiae or rash among pediatric patients may explain, in part, why it was found to be a significant predictor of the practice domain. The presence of petechial rash (which is also described as “isles of white in the sea of red”) and pruritus

(severe itching of the skin) occur towards the end of acute (febrile) phase and the beginning of the recovery phase [1]. This could mean that those pediatric patients who were already having rashes during the interview may have already changed their family/household members' behavior and started performing the preventive practices against DF, thus having higher practice mean scores. Severe dengue was a significant predictor of decreased practice among pediatric patients with DF. Pediatric patients with severe dengue, compared to those who had other DF diagnoses, had the significantly lowest mean score in the practice domain. A total of 50% of pediatric patients with severe dengue had to be confined in the intensive care unit (ICU). They were interviewed only after ICU confinement which was, on average, the fifth day of hospitalization. The time spent in the ICU might have decreased the opportunity of their family/household members to immediately perform the practices against DF, thus having a lower practice mean score. In general, although the regression models obtained low R-squared values, it is still important to investigate how the changes in the values of social and clinical variables are associated with the changes in the values of depressive and anxiety symptoms scores which is represented by the significant coefficients.

There was a positive correlation found between knowledge and attitude domains of pediatric patients with DF. Although it was considered a weak association, and relatively lower correlation coefficient compared with a previous study (r_s = 0.37) [20], it is still valuable to note that there was a good translation of knowledge to attitude on DF among pediatric patients with DF. Their knowledge on dengue symptoms, modes of transmission, preventive practices against DF, and disease management tended to change their beliefs that DF is a serious and threatening disease. Although pediatric patients' knowledge correlated

with their attitude towards it, as expected, both knowledge and attitude did not correlate with their practices against DF. This clearly signifies that the translation of knowledge and attitude to practice among pediatric patients was poor. This was also found to be true among adult patients with DF. This means that although pediatric and adult patients with DF were knowledgeable about the symptoms of DF, vector breeding site control, and transmission modes of DF, and had the perception of DF as a serious and threatening disease, it did not lead to a change in their behavior of performing the preventive practices against it. This implies that the poor practice against DF might have exposed them to a higher risk of contracting the disease.

Multiple logistic regression analysis on the practices revealed that use of mosquito-eating fish, screen windows, and dengue vaccine were protective factors against DF. Studies have found that larvivorous fish (*Gambusia affinis*), the common guppy (*Poecilia reticulata*), or Cyprinidae or Tilapia spp. can be effectively used to control the mosquito population at their larval stages [40–42]. Moreover, in our study, I assumed that the use of screen windows equates to the use of glass windows in air-conditioned rooms among controls, especially the youth. Screen and glass windows could be potential forms of reducing DF transmission by the reduced exposures to vectors that enter homes through open windows [9]. These may not have been available to the patients with DF because the majority (85.2%) of them belong to households with low monthly family income, thus, increasing their vulnerability to DF infection.

Surprisingly, dengue vaccine was found to be a protective factor against DF among youth samples. Another limitation of this study was that I could not rely on the participants'

responses about their dengue vaccine acquisition history. I had no means of confirming whether they were vaccinated or not. Thus, this result may require more intensive community-based studies to identify whether it could truly be a protective factor against DF infection.

I also identified different factors that limited the generalizability of our findings: a small sample size of adult patients with DF, failure to match patients with controls, confounding effect of economic status and hospitalization, and false positive responses. First, limitation was the relatively small sample size of adult patients with DF, which is a possible reason why no significant predictors of KAP were found among this population. The underrepresentation of adult patients may have been caused by the reason that DF is more prevalent in children and a younger age group and only those adult patients who reported severe symptoms and those who needed special attention were admitted to hospital while others were asked to stay at home and consult outpatient clinics. A second limitation was the failure to match the pediatric patients and pediatric controls at least in terms of age, which also limits the generalizability of the findings. As I mentioned previously, matching was difficult because not all the control sample that I approached were available and willing to participate. The third limitation was that participating hospitals were public tertiary hospitals, where most patients belong to low-income families; thus, association of income with the domains was hard to estimate. Fourth, only in-patients were included in this study, limiting the analysis to those admitted to hospitals. Therefore, I recommend that future studies also include out-patients to see whether hospitalization confounds the association between the domains and the DF infection. The inclusion of patients who had DF was also found to be a

confounding variable in the level of knowledge and attitude; thus, future studies should consider focusing on patients who had no history of DF. Lastly, our data collected from both patients with DF and controls, through the use of questionnaire, were subjective, which might have produced false positive responses. I had no means of confirming whether the participants, especially the patients, really had mosquito-eating fish at home, if they had been using screen windows, or if they had been vaccinated with dengue vaccine; thus, future studies should include direct household observation to validate these results.

5. Conclusions

Pediatric and adult patients with DF admitted in three hospitals in Metro Manila, compared with their counterparts, had lower mean scores in the practice domain, and knowledge and attitude were not correlated with practice, highlighting the importance of behavioral change for knowledge and attitude to have a significant effect on practices against DF. Health programs should focus on translating knowledge and attitudes into more effective practices against DF through behavior change. Many programs continue to focus only on changing people's knowledge and on raising awareness, rather than physical activity programs, which are more successful at producing behavior change [43]. Thus, I recommend two comprehensive health programs that aid the successful translation of knowledge and attitude to better practice. The Communication for Behavioral Impact (COMBI) is a comprehensive strategy that uses communication of knowledge to have a significant effect upon behavioral change (making people becoming aware, informed, convinced, and deciding to act, then repeating and maintaining that action) or increased practices against DF [26,44].

Moreover, another model that facilitates behavioral change that could increase the translation of attitude to practice among children and adolescents is the Health Belief Model (HBM). This model suggests that a change in behavior can be expected if a person perceives themselves to be at risk or susceptible to the disease (perceived susceptibility), that the disease will have serious consequences (perceived severity), a course of action will minimize consequences (perceived benefits), and the benefits of action will outweigh the cost of barriers (perceived barriers) and self-efficacy [45]. Both models should be used in changing behavior, not only at individual and household levels, but also at the community level, as community participation, including schools and especially among children, is necessary to effectively control the vector mosquitoes [46].

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Chapter 4

Depressive and Anxiety Symptoms Among Pediatric In-Patients with Dengue Fever: A Case-Control Study

Abstract:

Background: Psychiatric symptoms have been reported in adult patients with dengue fever (DF); however, information on pediatric patients remains inadequate. I sought to identify the prevalence and predictors of depressive and anxiety symptoms and identify other psychiatric symptoms among pediatric patients with DF. This case-control study involved pediatric in-patients (n = 225) who had clinical or serologic-confirmed DF and healthy school-based controls (n = 260). Participants completed the Revised Child Anxiety and Depression Scale (RCADS). Results: The prevalence of depressive (13.3%) and anxiety (34.2%) symptoms among pediatric patients with DF was significantly ($p < 0.001$) higher than that among controls (3.5% and 16.2%, respectively). Multiple linear regression analysis found that age, family history of DF, ≤2 days of hospitalization, myalgia, and arthralgia were predictors of increased depressive and anxiety symptoms among the patients. Further, 26.7% of pediatric patients reported irritability, agitation, visual hallucinations, and aggressiveness. Conclusion: Pediatric patients present depressive and anxiety symptoms whose levels were associated with social and clinical factors. However, whether these symptoms are present only during the infection or may still persist after recovery or are brought by children's adverse reactions to hospitalization are unknown, and thus, further studies are needed.

1. Introduction

As the world's most rapidly spreading mosquito-borne disease, dengue fever (DF) causes approximately 50 million cases a year, putting an estimated 2.5 billion people at risk, especially children [1]. Its incidence has increased by 30 times in the last five decades [2] and is now prevalent in 128 countries [3]. It presents flu-like symptoms that include high-grade fever accompanied by headache, myalgia and arthralgia, nausea and vomiting, intense abdominal pain, rash, retro-/peri-orbital pain, bleeding, and low platelet count (thrombocytopenia), which can lead to acute organ failure, cardiomyopathy, encephalitis, profound shock, and death [1]. Recently, the number of studies reporting this virus to be neurovirulent has increased [4], associating it with neurological complications in patients with DF [5].

The most prevalent neurological disorder occurring during DF is encephalopathy [6]. Case study reports found that adult patients with DF exhibit delusions with auditory and visual hallucinations, agitation and psychotic symptoms and fears, agitation, irritable affect, psychosis, mania, and catatonia [7–14]. The link between these symptoms and DF infection have been thought to be the result of metabolic disturbances, direct tissue lesion, intercranial hemorrhage, cerebral edema and anoxia and hyponatremia [7,11,12]. Among the identified encephalopathies, depressive and anxiety symptoms were the most studied among adult patients with DF [15–18]. The prevalence of borderline and clinical depression and anxiety among adult patients with DF ranges from 60% to 81% [16,17]. During the acute phase, the majority (90%) of patients exhibit thanatophobia or fear of death (90%), and during the recovery phase (1 week after onset of DF), more than half (55%) of patients develop fear of

mosquitoes (55%) [15,18]. Most importantly, the severity of DF symptoms such as fever, headache, myalgia, arthralgia, retro-/peri-orbital pain, and thrombocytopenia positively correlate with depression and anxiety [16] and increased levels of proinflammatory cytokines such as Interleukin 4/6 and TNF-alpha, and platelet brain-derived neurotrophic factors (BDNF) account for the presence of depressive and anxiety symptoms among adult patients with DF [16].

Depression and anxiety have been investigated in children with fatigue syndrome, fibromyalgia, migraine/tension headache [19], chronic abdominal pain [20], juvenile idiopathic arthritis [21], cancer [22], and human immunodeficiency virus (HIV) [23], yet information among pediatric patients with DF remains inadequate. One prospective study provides information on neurologic manifestations of DF in children. Pancharoen and Thisyakorn [24] reported that 80 of 1493 (5.4%) Thai in-patient children (3 months to 14 years old), who had serologically confirmed DF diagnosis, exhibited seizures and encephalopathy-like depressed sensorium and mental confusion during the febrile (acute) stage of DF based on recorded medical charts. However, studies that prospectively use a self-report screening tool to detect depressive and anxiety symptoms [25], which has a high acceptance and response rate (99%) and a low refusal rate (1%) among in- and out-patients [26], are lacking. To date, the study done by Mushtaq and Zahir [27] is the only known study, to our knowledge, that has used a self-report screening tool to measure depression, anxiety, and stress among pediatric patients with DF and investigated its relationship with self-efficacy. The study used the Depression Anxiety and Stress Scale (DASS) to measure depression, anxiety, and stress and the General Self-Efficacy Scale (GSES) to measure self-

efficacy among the participants [27]. They found out that self-efficacy has a negative correlation with depression, anxiety, and stress; thus, developing self-efficacy among the patients is deemed necessary [27]. Although this study adds to the emerging topics on the presence of depressive and anxiety symptoms among pediatric patients with DF, there is still a pressing need to conduct more studies to measure the impact of DF infection on the mental health of pediatric patients.

Therefore, this study aimed to estimate the prevalence of depressive and anxiety symptoms among pediatric in-patients with DF and compare it with that among healthy school-based controls. I also sought to explore the predictors of these symptoms and to identify other self/parent-reported psychiatric manifestations that occur during the infection. I hypothesized that the prevalence of depressive or anxiety symptoms among pediatric patients with DF would be higher than that among controls, and predictors would include pain-related DF symptoms including headache, myalgia, arthralgia, retro-/peri-orbital pain, and abdominal pain suggesting a causal link between depressive, anxiety, and other psychiatric symptoms and DF infection.

2. Materials and Methods

2.1. Study and Sampling Design

This case-control study involved pediatric patients (cases) admitted at three public tertiary (>100 beds) hospitals in Metro Manila, Philippines, from July to November 2017, during the high transmission of DF cases. Metro Manila was chosen due to an increase in the

number of DF cases (15.5% increase compared with previous year [28]) from 1 January to 6 May (morbidity week, 1–18), which was one of the highest rates in the country in 2017 [29]. Simultaneously, healthy grade 3 to 12 students, whose ages were similar with the cases, 8 to 17 years old, were also recruited to serve as controls. Since some of the patients with DF could not answer the test because of sickness, I asked their parents to answer the parent version of the screening tool. Thus, I also recruited parents of children whose age and grade level matched those of the patients with DF, as controls. I used the 1:1 ratio (one case patient/one control) with an assumed odds ratio of ≥2, power (1-β) of 0.80, 0.05 significance level, Zscore = 1.96 [30], however, I was able to recruit a large number of controls. I failed to match them with the cases to control the confounding effects of age, gender, and grade level because availability of controls with matching criteria with the cases was limited during collection. While I also acknowledge the importance of obtaining controls in the same hospitals as the cases, I opted to sample controls in schools, who, like the cases, were students. I assumed that recruiting students as controls would increase our chance to sample healthy (no DF (like the cases) or any psychiatric and/or medical conditions) controls to investigate the true association between depressive and anxiety symptoms and DF infection.

2.2. Participant Inclusion and Exclusion Criteria

Participants were selected based on the pre-determined inclusion and exclusion criteria, availability, willingness to communicate their experiences and participate in the study [31–33]. A semi-structured interview was conducted among pediatric in-patients with serologically (laboratory) confirmed or clinically diagnosed DF and healthy school-based

controls with no current or existing signs and clinical symptoms or diagnosis of DF. Recruitment of the patients and controls was also based on age (age 8–17 years) and grade level (grades 3 to 12) criteria of the Revised Child Anxiety and Depression Scale (RCADS-25), a screening tool for depressive and anxiety symptoms. Eligible participants had no history and/or existing diagnosis of psychiatric and/or medical conditions for which they received medical advice or treatment prior to the interview. Patients with life-threatening comorbidities and controls who were not able to comply with consent procedures were excluded.

2.3. Ethical Considerations and Data Collection Procedures

Our study was approved by the Research Ethics and Review Unit of San Lazaro Hospital, Research Ethics and Technical Committee of Pasay City General Hospital and Planning, Development, Education, and Research office of Quezon City General Hospital (ethics approval numbers: RERU-SLH 2017-016 E and PGH-RETC-01-0-091417001DENGUE). It complied with the ethics guidelines of the Declaration of Helsinki [34], International Council for Harmonization-Good Clinical Practice (ICH-GCP) guidelines [35], and National Ethical Guidelines for Health Research [36]. I also followed the reporting guidelines of case-control studies required by the STrengthening the Reporting of OBservational Studies in Epidemiology (STROBE) statement checklist in writing this manuscript (File S1).

All the participants (especially the patients, and their parents, legally authorized representatives (LARs) or caregivers) gave their consent before participating in this study. They were asked to read and sign an informed consent form (and assent form for children

below 18 years old) in Filipino and were informed that participation in the study was voluntary and they may stop their participation at any time. Interviews were rescheduled for patients who could not participate due to sickness and severity of symptoms (e.g., intensive care unit confinement for severe dengue patients). In some cases, a parent, LAR or caregiver was asked to complete the forms and the RCADS-25-parent version for their children. Recruitment and interviews of patients were done by a primary investigator who underwent ICH-GCP guidelines training and with supervision from co-investigators (e.g., physicians, nurses) at each hospital. A psychologist and a guidance counselor recruited and interviewed the controls. A semi-structured interview (consistent pre-determined instructions, questions, and standardized screening tool) was done among all the participants to keep the data free from inconsistencies, incomplete responses, and biases. All forms and tests with confidential information of the participants were coded. Participants were informed about their scores on the tests, and a consent for further psychiatric assessment was solicited from those whose scores suggested a need for clinical intervention during follow-up and those who reported other psychiatric manifestations during the onset of the infection.

2.4. Forms and Measures

2.4.1. Explanatory Variables

Socio-demographic profile, clinical parameters and symptoms: Socio-demographic profile included age, civil status, gender, educational attainment, occupation, family's monthly income. and living arrangements. For age, I adjusted the age–disease association data (simple clustering method: k-means) which closely matched the accepted Medical

Subject Heading (MeSH) ranges, into three age groups: 8–11, 12–14, and 15–17 based on the age criteria of RCADS-25 [37]. Income of the participants was identified by the help of their parents, guardian or LAR using the clusters from the indicative range of monthly family incomes (for a family of 5) in 2015 and 2017 [38]. However, I decided to have two clusters (above and below 10,000 pesos) as most of the patients had income below 10,000 pesos.

I also collected clinical information from the patients that included admitting diagnosis information, self and family history of DF, serologic test results (non-structural protein 1 antigen (NS1Ag) and BLOT: immunoglobin G antibody (IgG) and immunoglobin M antibody (IgM)) and laboratory data (i.e., complete blood count (CBC) with platelet count). The inclusion of family DF history was to investigate whether a previous diagnosis or history of DF in a family is associated with increased depressive and anxiety symptoms scores among the patients with DF. Clinical DF diagnosis was made under the following circumstances in three categories: probable (lived or traveled to endemic areas, has fever, and two DF symptoms); dengue hemorrhagic fever (DHF) with or without warning signs (abdominal pain, vomiting, mucosal bleeding, lethargy, liver enlargement (>2 cm), decreased platelet count or thrombocytopenia); and severe dengue (severe plasma leakage, hemorrhage, and organ impairment) [1]. These were used to identify the patient's current dengue infection phase (acute, febrile–critical, and recovery phase). Acute phase is the onset of high-grade fever and other warning signs (e.g., headache, myalgia, arthralgia, nausea and vomiting, mucosal bleeding, and thrombocytopenia) usually lasting for a week. Some patients may develop rashes, signaling the beginning of the recovery phase [1]. During this phase, well-

being improves, some warning signs tend to abate, and platelet count typically starts to rise [1]. Clinical symptoms or warning signs were also queried.

2.4.2. Response Variables

The Revised Child Anxiety and Depression Scale (RCADS) is an assessment tool for screening depressive and anxiety symptoms in children and adolescents [39]. I used the RCADS-25 (25 items), the shorter version of RCADS-47 developed by Chorpita et al. [39], with child and parent versions [40]. The child version was administered to pediatric patients and controls, whereas the parent version was administered to parents of pediatric patients who could not complete the child version due to sickness and other comorbidities. RCADS-25 has two scales: depression (10 items) and anxiety (15 items); items were rated on a 4-point Likert-scale from 0 ("never") to 3 ("always") and were scored and interpreted using a "*t*-score" [40]. T-scores are transformed raw scores used to obtain a normal distribution with a maximum score of 80. A *t*-score of 65 means borderline and a *t*-score of 70 means clinical threshold [40]. The *t*-scores were adjusted for gender (girl and boy) and grade level (grade 3 to 12); the child version has different *t*-scores from the parent version [40]. Both depression and anxiety scales have good internal consistency (Cronbach's alpha) of $\alpha = 0.78$ and $\alpha = 0.88$ in clinical and general or school-based populations [37–41]. This tool has been reported to be a cross-culturally reliable measure of depressive and anxiety symptoms for children and adolescents [42].

Both RCADS-25 child and parent forms were translated to Filipino (Tagalog) by independent bilingual translators and was then face, content, and construct validated by

experts [43]. Then it was pilot tested among selected clinical and school-based samples. When a consensus was reached, it was translated back to English by bilingual translators. I calculated the internal consistency (Cronbach's alpha) of the RCADS-25 child and parent forms in Filipino, and results evidenced an acceptable internal consistency which ranged from $\alpha = 0.70$ to $\alpha = 0.80$ in clinical samples and $\alpha = 0.73$ to $\alpha = 0.83$ in school-based samples, but were not included in the final analysis.

RCADS-25 was used to screen the presence of depressive or anxiety disorder symptoms and not to diagnose disorders associated with the mentioned symptoms. Thus, I recommended further psychiatric assessment among patients whose scores suggested the presence of borderline or clinical levels of depressive and anxiety symptoms.

Self/parent-reported psychiatric manifestations: Patients and their parents/guardians were also asked to report other psychiatric manifestations that they observed during the onset of the disease and hospitalization through a structured interview based on the diagnostic criteria of depressive and anxiety disorders of the Diagnostic and Statistical Manual of Mental Disorders 5th Edition (DSM-V) [44]. Similar to the results of the RCADS-25, patients who reported the presence of psychiatric symptoms were also recommended for further psychiatric assessment.

2.5. Statistical and Data Analysis

Statistical analyses were conducted using the Statistical Package for Social Sciences version 25 (IBM Corp., Armonk, NY, USA). The Chi-squared test was used to test the significant differences between the groups in terms of their socio-demographic profile and in

the prevalence (%) of pediatric patients and controls with borderline or clinical depressive and anxiety symptoms. Odds ratio effect sizes were also computed to measure the differences in the proportion of those with depressive and anxiety symptoms among pediatric and controls. An independent *t*-test (2-tailed) was also conducted to test the significant differences in the mean depression and anxiety scores (*t*-scores) between the two groups. I also reported the effect sizes of the mean differences between the two groups in depressive and anxiety symptoms by calculating Cohen's *d*, Glass' *delta*, and Hedges' *g* effect size estimations. Multiple linear regression was done by inputting all variables (dummy variables (i.e., 0 or 1) for categorical variables) in the model using a stepwise method in forward selection to identify significant ($p < 0.05$) predictors of depressive and anxiety symptoms. Patients' reported psychiatric manifestations were translated into English by an independent bilingual translator and were analyzed using content analysis, a method that can identify patterns across qualitative data (words or phrases) that can be counted (frequency) for quantitative analyses [45–47].

3. Results

3.1. Socio-Demographic Profile, Clinical Parameters, and Symptoms

Initially, 625 participants (pediatric patients $n = 321$; controls $n = 304$) were recruited in the study, but only 485 (pediatric patients $n = 225$; controls $n = 260$) were found eligible, complied to the informed consent procedures, and participated in this study. Among the 225 data collected from the patients with DF, 155 (68.9%) were from pediatric patients with DF and 70 (31.1%) were from parents of other patients with DF who could not answer the

Table 4.1. Socio-demographics, clinical parameters, and clinical symptoms of pediatric patients with dengue fever (DF) and controls.

Socio-Demographic Profile		Patients	Controls	X^2
		***n* = 225**	***n* = 260**	***p*-Value**
Gender	Male	120 (53.3)	133 (51.2)	0.65
	Female	105 (46.7)	127 (48.8)	
Age	8–11	71 (31.6)	132 (50.8)	<0.001
	12–14	67 (29.8)	61 (23.5)	
	15–17	87 (38.7)	67 (25.8)	
Education	Grade School	78 (35.6)	132 (50.8)	0.004
	Junior HS	106 (48.4)	94 (36.2)	
	Senior HS	35 (16.0)	34 (13.1)	
Income (₱)	≤10,000 PHP	171 (83.4)	21 (9.0)	<0.001
	≥11,000 PHP	34 (16.6)	213 (91.0)	
Household size	≤5 members	110 (53.12)	209 (88.6)	<0.001
	≥6 members	97 (46.9)	27 (11.4)	
Clinical Parameters				
Medical diagnosis	Clinical	24 (10.7)		
	Probable	23 (10.2)		
	DHF w/ws	172 (76.4)		
	Severe dengue	6 (2.67)		
Days in the hospital	≤2 days	150 (66.7)		
	≥3 days	46 (20.4)		
DF history	Had DF	11 (4.89)		
	First-time	185 (82.2)		
Family DF history	None	135 (60.0)		
	≥1 member/s had DF	59 (26.2)		
Dengue phase	Acute	179 (79.6)		
	Recovery	46 (20.4)		
Dengue tests	(−) NS1Ag	59 (26.2)		
	(+) NS1Ag	39 (17.3)		
	(−) IgG	21 (9.33)		
	(+) IgG	39 (17.3)		
	(−) IgM	48 (21.3)		
	(+) IgM	12 (5.33)		
Clinical Symptoms				
Headache	Symptomatic	35 (15.6)		
Fever	Symptomatic	38 (16.9)		
Nausea and vomiting	Symptomatic	55 (24.4)		
Retro-/peri-orbital pain	Symptomatic	16 (7.11)		
Myalgias & arthralgias	Symptomatic	48 (21.3)		
Abdominal pain	Symptomatic	87 (38.7)		
Petechiae (rash)	Symptomatic	96 (42.7)		
Thrombocytopenia	≤9900/mm^3	143 (63.5)		

DF—dengue fever; HS—high school; ₱—Philippine peso (52.16 USD = 1 ₱); Acute—febrile to critical phase; ws—warning signs; DHF—dengue hemorrhagic

fever; (+)—positive; (−)—negative; NS1Ag—non-structural protein 1 antigen; IgG—immunoglobin G antibody; IgM—immunoglobin M antibody.

screening tool. Similarly, the 260 data collected among controls were from 220 (84.6%) students and 40 (15.4%) parents of children who had the same age and grade level as the patients with DF. The profile of the participants is shown in Table 4.1.

The two groups had significantly different proportions and distributions in terms of their age, education, income, and households. In terms of gender, the two groups were significantly the same, where both had nearly the same distribution (50%) of each gender. Pediatric patients had a mean age (M) of 10.96 and a standard deviation (±) of 2.95 years, 53% were males, the majority had DHF with warning signs (76.4%) and were in the acute (febrile–critical) phase of DF (79.6%) of the infection. Thrombocytopenia (low platelet counts) and petechiae (rashes) were the most commonly reported symptoms among the patients. The controls, male (n = 133) and female (n = 127), had a mean age of 12 (±2.8) years.

3.2. Prevalence and Mean Score Differences of Depressive and Anxiety Symptoms

More pediatric patients with DF (13.3%) had borderline or clinical depressive symptoms than controls (3.5%). Similarly, a significant proportion (34.2%) of pediatric patients with DF compared with controls (n = 42; 16.2%) had borderline or clinical anxiety symptoms. Chi-squared analyses also revealed that pediatric patients with DF had a significantly ($p \leq 0.001$) higher prevalence of depressive and anxiety symptoms than the controls, as shown in Table 2. This represents the fact that based on the odds ratio, pediatric patients were 4.3 times

more likely to have depressive symptoms and 2.7 times more likely to have anxiety symptoms than controls. Moreover, when I compared the mean scores of the participants, pediatric patients had significantly ($p \leq 0.001$) higher mean depressive and anxiety mean scores than controls (also shown in Table 4.2). The significant effects in the differences between the mean scores also represented a fairly substantial medium effect sized estimations in depression (r = 0.30–0.32) and anxiety (r = 0.30–0.34) between the two groups based on Cohen's *d*, Gates' *delta*, and Hedges' *g* effect size estimations.

Table 4.2. Prevalence and mean score differences of depressive and anxiety symptoms between pediatric patients with DF and controls.

Symptoms	**Prevalence**			**Mean Score Difference**		
	Patients (*n* = 225)	**Controls (*n* = 260)**	X^2	**Patients (*n* = 225)**	**Controls (*n* = 260)**	***t*-Test (2-Tailed)**
	***n* (%)**	***n* (%)**	***p*-Value**	**Mean (SD)**	**Mean (SD)**	***p*-Value**
Depressive symptoms	30 (13.3)	9 (3.5)	<0.001	52.3 (9.87)	49.3 (8.64)	<0.001
Anxiety symptoms	77 (34.2)	42 (16.2)	<0.001	59.3 (11.5	55.8 (9.34)	<0.001

3.3. Predictors of Depressive and Anxiety Symptoms

The multiple linear regression analysis (Table 4.3) showed significant ($p < 0.001$) regression models in depressive and anxiety symptoms. Although the coefficients (R^2) were low (<1), significant predictors like the presence of myalgias and arthralgias and a family history of DF were found to increase the depressive symptoms score, whereas ≤2 days of hospitalization and age (older) both increased anxiety symptom scores among pediatric patients with DF.

Table 4.3. Predictors of depressive and anxiety symptoms among pediatric patients with DF.

Outcome Variables	Predictors	R^2	β	Predictor *p*-Value	Model *p*-Value
Depressive symptoms	Myalgias and arthralgias	0.07	4.87	0.002	<0.001
	Family history of DF		3.19	0.028	
Anxiety symptoms	Age	0.15	1.26	<0.001	<0.001
	Days in the hospital (≤2 days)		1.26	0.005	

β—beta coefficients; DF—dengue fever.

3.4. Self/Parent-Reported Psychiatric Manifestations

Table 4.4 shows the results of content analysis on the reported psychiatric manifestations during the onset of infection. Our quantitative analysis shows that 60 (26.7%) pediatric patients with DF had irritable mood or irritability, agitation, visual hallucinations, and aggressiveness during the onset of dengue infection. However, the reports of these manifestations were not sufficiently intense and not clinically assessed by a psychiatrist (patients' unwillingness to be referred) to qualify for an anxiety disorder or depressive disorder due to the span (less than six months) of time these symptoms were present among the patients.

4. Discussion

Results show that the prevalence of depressive (13.3%) and anxiety (34.2%) symptoms among pediatric patients with DF was significantly ($p \leq 0.001$) higher than that among

Table 4.4. Self/parent-reported psychiatric manifestations among pediatric patients with DF using content analysis and quantitative analysis.

Manifestations (In Filipino) *	**English Translation/Meaning**	**Patterns (DSM-V) [a]**	**Pediatric Patients (*n* = 60)**
Mainit ang ulo Mainitin ang ulo	Irritable mood Irritable	Irritable mood	24 (40.0)
Irritable Naiirita Bugnutin	Irritable Irritable Quick-tempered	Irritability	12 (20.0)
Worry	Worry	Worry	2 (3.3)
Kinakabahan o natatakot	Nervous/fear that something awful might happen		
Nag-Hallucinate noong nilalagnat Isip-bata Hindi kami kilala; iba ang nakikita niyang mukha noong nilalagnat	Hallucination Childish Visual hallucination	Hallucination	4 (6.7)
Madalis magalit	Easily-angered/agitated	Agitation	9 (15.0)
Pikon	Easily angered by jokes or jests, touchy		
Masungit	Ill-tempered, short-tempered/agitated		
Aggressive Sumisigaw	Aggressive Shouting	Aggression	4 (6.7)
Hindi Nagsasalita Tahimik	Does not talk Quiet	Quiet	2 (3.3)
Tinatamad	Laziness	Fatigue	2 (3.3)
Matamlay	Listless: seeming too tired to care about anything, not interested in things, not caring to be active		
Nanghihina	Feeling weak		
Mahirap kausap	Hard to talk with	Hard to talk with	1 (1.67)

* Responses in Filipino (Tagalog) language were analyzed and translated to English by an independent bilingual translator; [a] based on the Diagnostic and Statistical Manual of Mental Disorders 5th Edition (DSM-V) diagnostic criteria for depressive and anxiety disorders.

controls (3.5% and 16.2%, respectively). Similarly, analysis of mean scores also showed that pediatric patients had significantly ($p \leq 0.001$) higher depressive and anxiety mean scores than controls. The regression model identified that the presence of myalgias and arthralgias,

family history of DF, ≤2 days of hospitalization, and age (older) were significant ($p \leq 0.001$) predictors of increased depressive and anxiety symptoms among pediatric patients with DF. Additionally, 26.7% of pediatric patients with DF also reported psychiatric manifestations like irritability, agitation, visual hallucinations, and aggressiveness during the onset of the infection.

To our knowledge, this study is one of the very first reports to measure the prevalence of depressive and anxiety symptoms among patients with DF; more so, among pediatric patients with DF compared it to controls with the use of a standardized self-report screening tool. The study also provided an initial investigation on the predictors of anxiety and depressive symptoms among pediatric patients with DF by including clinical data (e.g., DF history, serologic test results, DF symptoms). This study also extends previous quantitative and qualitative (case studies) studies by using a standardized screening tool and structured interview in collecting information on the presence of psychiatric manifestations during the onset of infection. Thus, the combination of these quantitative and qualitative techniques was also considered as one of the strengths of this study.

The difference between the prevalence of depressive and anxiety symptoms between pediatric patients and controls may have been brought about by the presence of pain related to myalgia and arthralgia which was one of the predictors of increased depressive symptom scores. The presence of these symptoms has been reported to be the result of inflammatory cytokines, such as Interleukin-1 beta (IL-1 β), Interleukin-2 (IL-2), and Interleukin-6 (IL-6) [48]. These cytokines were found to be of significantly higher levels among children and adolescents with major depressive disorder (MDD) compared with healthy controls [49–52].

Thus, I propose that the presence of these cytokines, which were absent among controls, may explain the possible presence and increased levels of depressive symptoms among pediatric patients during DF infection.

Predictors like ≤2 days of hospitalization and family history of DF, may also explain the increased depressive mood and anxiety symptoms among pediatric patients compared to that of controls. High depressive and anxiety symptoms during the ≤2 days of hospitalization would have been aggravated by the pediatric patients' fear of medical settings and receiving medical care as common symptoms of anxiety [53]. Children usually report medical procedures, such as drawing of blood, as traumatic and seeing medical professionals as traumatic as well [54]. Further, family history of DF also tended to increase depressive symptoms among pediatric patients with DF. An indicator of anxiety disorders in children is worrying about multiple issues like future events [55], for instance, contracting DF. This can be linked to a painful past experience, such as a family member diagnosed with, and hospitalized due to, DF. Observing the severity and seriousness of symptoms, the level of associated pain may have affected patients' perception of the disease and thus their response may have presented as depressive symptoms. Unlike controls, pediatric patients with DF were anxious of hospital conditions like limited food options, limited physical activities, limited time playing with friends, and being absent in school [56,57].

Opposite to the results of our previous study which found that as the age of pediatric patients with DF increased, their attitude towards DF decreased [58], this present study found that as their age increased, their anxiety also increased. Thus, their knowledge about their disease, rather than their attitude towards it, may explain this finding. It has been reported

that children and adolescents with chronic illnesses have limited knowledge of their conditions and perceive their diseases differently from a much older population [59,60]. Thus, older children who have more of an ability to correctly understand the meaning of their disease and its severity, had higher anxiety symptoms than the younger ones.

Our study also extends previous studies which reported adult patients with DF had auditory and visual hallucinations, agitation and delusional fears, irritable affect or behavior, persecutory delusions, and psychotic episodes during DF infection [7,12]. Our results confirm that pediatric patients with DF also exhibit psychiatric manifestations during DF infection. Although these manifestations were not qualified to be considered as depressive and anxiety disorder symptoms due to the duration of their presence, it still confirms that these symptoms also impact children with DF. I found out that 26.7% of pediatric patients with DF reported irritable mood/irritability, visual hallucination, agitation, and aggressiveness. Children are more likely to be irritable, agitated and report possible delusions or hallucinations which are symptoms of MDD [53,61], than older patients. Irritability which is an overlapping symptom among children and adolescents [55], is also a diagnostic criterion for anxiety disorder, for MDD and for disruptive mood dysregulation disorder of the new DSM-V and oppositional defiant disorder (ODD) of the International Classification of Disorders (ICD-11) among children [62]. Further, hallucinations are key features of psychotic conditions and acute neurological states, such as encephalitis, and are often presented with delirium and delusions which are more prevalent in children than adults [63]. Since these results were not confirmed by a psychiatric assessment, studies that include

clinical assessment by a psychiatrist and evaluation through imaging techniques may help shed light on whether these symptoms are associated with DF infection virus or not.

The low consent rate (<1%) for referral to further psychiatric assessment to assess the false positive and negative responses of the patients in the screening tool and reported psychiatric symptoms, has highlighted how patients view mental health disorders. This may be affected by cultural orientation and perception of depressive and anxiety symptoms and treatment-seeking response among patients with DF in this study. In the Philippines for example, as a collectivist-oriented culture [64], with greater social support and where family and wider society are more highly considered than one's own self, a lower tendency to develop depressive disorder symptoms can be expected [65]. Moreover, many cultures view mood disorders as a social and moral problem associated with stigma and loss of reputation, not as mental health problems [66]. These conditions are perceived as a moral or character development that requires self-mastery and endurance and help or treatment with medication is seen as unnecessary [67].

I also identified a number of limitations in our methods: failure to match cases with controls, income and hospital setting, time of collection and lack of further psychiatric assessment by a psychiatrist. First, I failed to match pediatric patients with DF and controls at least by age which decreased the ability of our study to draw generalizable conclusions from the findings. As I mentioned, matching cases and controls was difficult due to the limited number of eligible controls. Second, the inclusion of public tertiary hospitals limited the study findings to low-income families, thus, future studies may include patients admitted to private hospitals to see whether income and hospital setting are confounding the

relationship between depressive and anxiety symptoms and DF infection. Third, this study is limited only to DF cases during the peak transmission or rainy seasons from July to November. Thus, the results that patients with DF had high depressive and anxiety symptoms during this time may not apply to other periods where there is low transmission of DF. Future studies may rely in comparing patients interviewed during the high transmission season and patients interviewed during low transmission season in order to investigate whether results collected may be generalizable in any period of time and not due to the panic and alarm brought by a large number of DF cases. The fourth and the most important, was the lack of further psychiatric assessment by a psychiatrist to confirm the scores (false positive responses) in RCADS-25 and the reported psychiatric manifestations. Other than the scores in RCADS-25, I had no other means to encourage them to seek further psychiatric assessment.

5. Conclusions

Our study highlights that there was a high prevalence of depressive and anxiety symptoms among pediatric patients with DF compared with controls, due to social and clinical factors which might be associated with DF infection. I also learned that pediatric patients with DF also exhibit psychiatric manifestations such as irritable mood/irritability, visual hallucination, agitation, and aggressiveness like adult patients with DF which has been reported in previous studies. Thus, it is important to screen patients with DF for these psychiatric symptoms, and if necessary, healthcare professionals must refer and encourage them to seek help to avoid long-term post-DF chronic psychiatric complications in the future.

However, information on whether these symptoms are present only during the infection and may disappear on their own or may still persist after the infection, is unknown. Thus, longitudinal post-DF recovery studies would provide information on the possibilities that these symptoms may or may not develop to subsequent chronic psychiatric conditions in the future. Most importantly, this study provides benchmark information on the possible causal or direct link between depressive and anxiety symptoms and DF infection among pediatric patients with DF, yet, there is insufficient evidence to draw conclusions. Thus, the potential trauma of hospitalization and not directly DF infection, may have caused the increased depressive and anxiety symptoms among the pediatric patients with DF. Therefore, future studies must distinguish between children's adverse reactions to hospitalization and psychiatric symptoms due to DF. While RCADS-25 is widely used and psychometrically salient, the lack of further psychiatric assessment among patients with borderline or clinical depressive and anxiety symptoms and who reported the presence of other psychiatric symptoms, hindered us to conclude whether these symptoms were directly due to DF infection or not. More so, determining whether the findings may only be specific to pediatric patients with DF infection or may be extended to children with other serious infectious diseases in general, also remains unknown and needs further studies.

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Chapter 5

Integrated mHealth App for Dengue Reporting and Mapping, Health Communication, and Behavior Modification: Development and Assessment of Mozzify

Abstract

Background: For the last 10 years, mobile phones have provided the global health community with innovative and cost-effective strategies to address the challenges in the prevention and management of dengue fever. Objectives: The aim is to introduce and describe the design and development process of Mozzify, an integrated mobile health (mHealth) app that features real-time dengue fever case reporting and mapping system, health communication (real-time worldwide news and chat forum/timeline, within-app educational videos, links to local and international health agency websites, interactive signs and symptoms checker, and a hospital directions system), and behavior modification (reminders alert program on the preventive practices against dengue fever). I also assessed Mozzify in terms of engagement and information-sharing abilities, functionality, aesthetics, subjective quality, and perceived impact. Methods: The main goals of the Mozzify app were to increase awareness, improve knowledge, and change attitude about dengue fever; health care-seeking behavior; and intention-to-change behavior on preventive practices for dengue fever among users. It was assessed using the Mobile Application Rating Scale (MARS) among 50 purposively sampled individuals: public health experts (n=5), environment and health-related researchers (n=23), and nonclinical (end users) participants (n=22). Results: High acceptability and excellent

satisfaction ratings (mean scores ≥4.0 out of 5) based on the MARS subscales indicate that the app has excellent user design, functionality, usability, engagement, and information among public health experts, environment and health-related researchers, and end users. The app's subjective quality (recommending the app to other people and the app's overall star rating), and specific quality (increase awareness, improve knowledge, and change attitude about dengue fever; health care-seeking behavior; and intention-to-change behavior on preventive practices for dengue fever) also obtained excellent satisfaction ratings from the participants. Some issues and suggestions were raised during the focus group and individual discussions regarding the availability of the app for Android devices, language options limitations, provision of predictive surveillance, and inclusion of other mosquito-borne diseases. Conclusions: Mozzify may be a promising integrated strategic health intervention system for dengue fever case reporting and mapping; increase awareness, improve knowledge, and change attitude about dengue fever; and disseminating and sharing information on dengue fever among the general population and health experts. It also can be an effective aid in the successful translation of knowledge on preventive measures against dengue fever to practice.

1. Introduction

For the last 10 years, mobile phones have provided the global health community with innovative and cost-effective strategies to address the challenges in the prevention and management of dengue fever [1]. Dengue fever, which is considered an international public

health concern, especially in tropical and subtropical countries, puts an estimated 2 to 3.97 billion people at risk of hospitalization and even death [2,3].

Mobile health (mHealth) is a concept that uses mobile communication devices, such as mobile phones, to deliver services through mobile apps [1]. Apps are specialized software programs that are often equipped with the capability to link to internet sources and services, including health care providers [1]. App-enabled mHealth is emerging as the driver for next-generation telemedicine and telehealth [1]. However, there is a lack of apps that address the prevention and control of dengue fever with relevant studies.

To our knowledge, only one app has been developed with relevant studies, Mo-Buzz. It is a mobile pandemic surveillance system for dengue fever with three main components: predictive surveillance, civic engagement, and health communication [4,5]. These components address the three main limitations in the control and management of dengue fever: (1) use of traditional epidemiological methods (eg, failure to identify the "turning point" of the outbreak leads to vector control measures such as carpet-combing ["search-and-destroy" mosquito breeding sites] near or at the peak of transmission be less impactful [6]), which leads to reactive or poor disease monitoring and surveillance; (2) lack of participation from the public; and (3) lack of effective and interactive health education for the public, which prevents successful translation of awareness or knowledge into actions [4].

Although Mo-Buzz was found to play a significant role in the management and control of dengue fever, I have developed a different mobile app, Mozzify, which offers an integrated mHealth system to address the challenges in dengue fever prevention and management. It has three components: real-time surveillance, health communication, and

behavior modification. The main component is the real-time surveillance feature for reporting and mapping dengue fever cases (both laboratory-confirmed hospital and probable dengue fever cases) and mosquito bites. Compared with Mo-Buzz, Mozzify reports and maps dengue fever cases and mosquito bites in real time (versus predictive surveillance) through an online Web map system. There is a lack of spatiotemporal data for dengue fever cases; the data from the real-time surveillance will serve as springboard data for combined predictive and real-time reporting and mapping features of the app in the future. These will be helpful to identify dengue fever hotspots (locations with high incidences of dengue fever cases), so health officials can deliver prompt and early warning communication as well as awareness to the public who are at risk of contracting the disease. Another difference is that Mozzify not only allows reports of probable cases of dengue fever and mosquito bites but also allows reporting of laboratory-confirmed dengue fever cases. Kao et al [7] recommended the introduction of a holistic surveillance system (eg, clinical, serological, and virological) to prevent large-scale epidemics and severe dengue fever cases. The study also recommended the use of a geographical information system for spatial analysis and epidemic prediction models [7].

Another difference of Mozzify from Mo-Buzz is the inclusion of some features in the health communication component. I have developed a system that reports real-time worldwide news about dengue fever and other mosquito-borne diseases; within-app educational videos on the diagnosis, treatment, and management of dengue fever and control of vector mosquitoes; links to websites of local and international health agencies; and a real-time timeline chat forum for sharing information among users. These features aim to increase

the public's awareness of the signs and symptoms, treatment, and management of dengue fever as well as the prevention and control of vector mosquitoes.

In addition to these features that center on real-time data, two other unique features of Mozzify that differentiate it from Mo-Buzz are the signs and symptoms checker and the interactive hospital directions. I designed a system that lets users check their signs and symptoms of dengue fever and identify the hospitals that have dengue fever express lanes and cater to Dengvaxia-vaccinated individuals. The aim is to not only inform users about the signs and symptoms of dengue fever but also motivate their health care-seeking behavior, which is based on the health belief model.

The health belief model is a widely used social cognition model to predict health behaviors. This model suggests that a change in behavior or action can be expected if a person perceives themselves to be at risk or susceptible to the disease (perceived susceptibility), that the disease will have serious consequences (perceived severity), a course of action will minimize consequences (perceived benefits), and the benefits of action will outweigh the cost of barriers (perceived barriers) and self-efficacy [8]. However, barriers to sustained self-prevention against dengue fever are caused by a lack of self-efficacy, lack of perceived benefit, and low perceived or unsure susceptibility [9]. People who perceive themselves at risk of dengue fever visit a health care provider promptly compared with those who perceive the opposite [10]. Health care-seeking behavior is also greatly influenced by the inadequacy of primary health care facilities in giving adequate services to dengue fever patients [11]. More importantly, what makes Mozzify different from Mo-Buzz is the inclusion of behavior modification as an important component to address the poor translation of awareness or

knowledge of the different preventive practices against dengue fever into actions. To address this, I added a feature that allows users to choose and add items on the list of preventive practices against dengue fever and directly transmit it to the built-in iPhone iOS Reminders app to set-up dates and locations of alerts. It has been reported that epidemiology is strongly associated with human habits and activities [12]. Kumaran et al [13] and Shuaib et al [14] reported that knowledge of the causes, signs, symptoms, mode of transmission, and preventive practices against dengue fever is not correlated with the practice of preventive measures against dengue fever. Thus, health programs should be designed to focus on translating knowledge into better and effective practices against dengue fever through behavior change. Many programs continue to focus only on changing people's knowledge or raising awareness rather than physical activity programs, which are more successful at producing behavior change [15]. I have used the concept behind Communication for Behavioral Impact (COMBI), a comprehensive strategy that uses communication for knowledge to have a significant effect on behavioral change (making people aware, informed, convinced, and decide to act, then repeating and maintaining that action) to increase the practice of preventive measures against dengue fever [13,16].

This paper aims to describe the design and development process of the Mozzify app. I will also assess it in terms of engagement and information-sharing abilities, functionality, aesthetics, subjective quality, and perceived impact among public health experts, environment and health-related researchers, and nonclinical or general public participants (end users). I hypothesize that the participation and acceptance rates (user's intention to use the app) among the participants will be high due to the app's relevance to the dengue fever

control and health communication program. I also hypothesize that the majority of participants will perceive that users will have increased awareness, improved knowledge, and changed attitudes about dengue fever, which will increase health care-seeking behavior and behavior change (on preventive practices against dengue fever) through the use of the app.

2. Methods

2.1. Mozzify App Design and Development

Mozzify is an integrated mHealth app for dengue fever cases reporting and mapping, health communication, and behavior modification. It was developed for the iOS mobile phone platform using Xcode (versions 10.1 to 11.0) software in Swift (versions 4.2 to 5) programming language. The name, Mozzify, is based on the word *mosquito* because its primary purpose is to collect and disseminate information about dengue fever, which is a viral infection transmitted by mosquitoes.

Mozzify has three components: (1) real-time dengue fever cases reporting and mapping, (2) health communication, and (3) behavior modification. These components were matched to three main goals: (1) increase awareness, improve knowledge, and change attitude about dengue fever; (2) increase health care-seeking behavior; and (3) increase intention-to-change behavior on preventive practices against dengue fever. Figure 5.1 shows the app's three components and goals with its corresponding features. Screenshots of some of the features are shown in Figure 5.2.

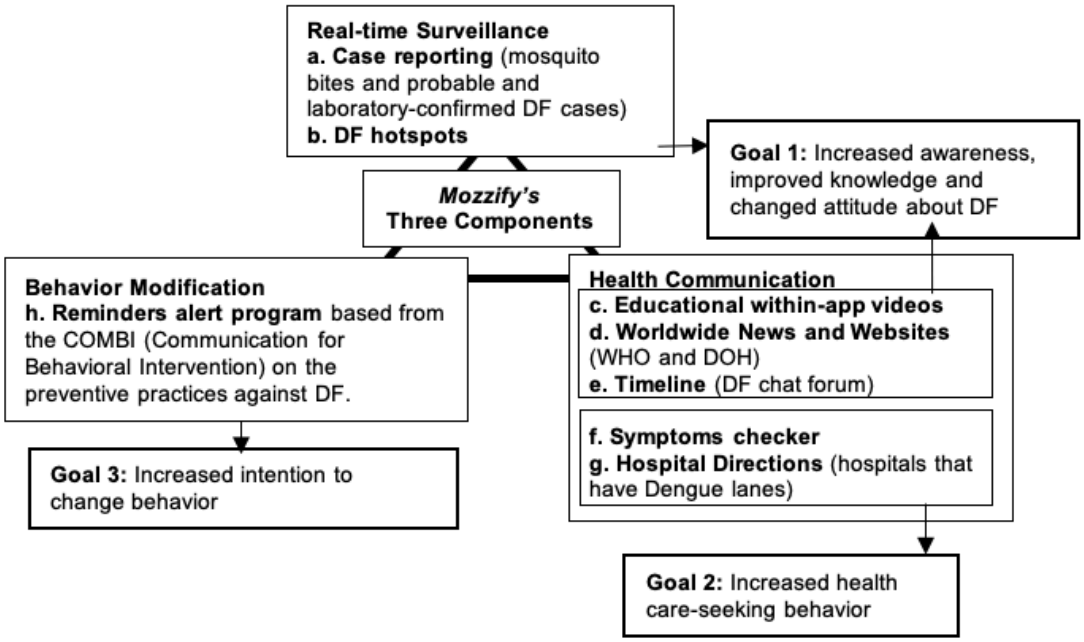

Figure 5.1. Mozzify's three components with their corresponding features and goals. DF: dengue fever; DOH: Department of Health; WHO: World Health Organization.

Sign-Up

Sign-up required users to provide information (eg, username and photo [optional], email, and password) to access the app's features. The app collects, stores, and uses personally identifiable information through Firebase, a third-party service provider that serves as our database. The app will collect, store, and use some identifiable information from users to provide its services; therefore, I generated our own privacy policy and terms and conditions (see the Mozzify app user guide Multimedia Appendix 1). Agreement to these was necessary to proceed with sign-up.

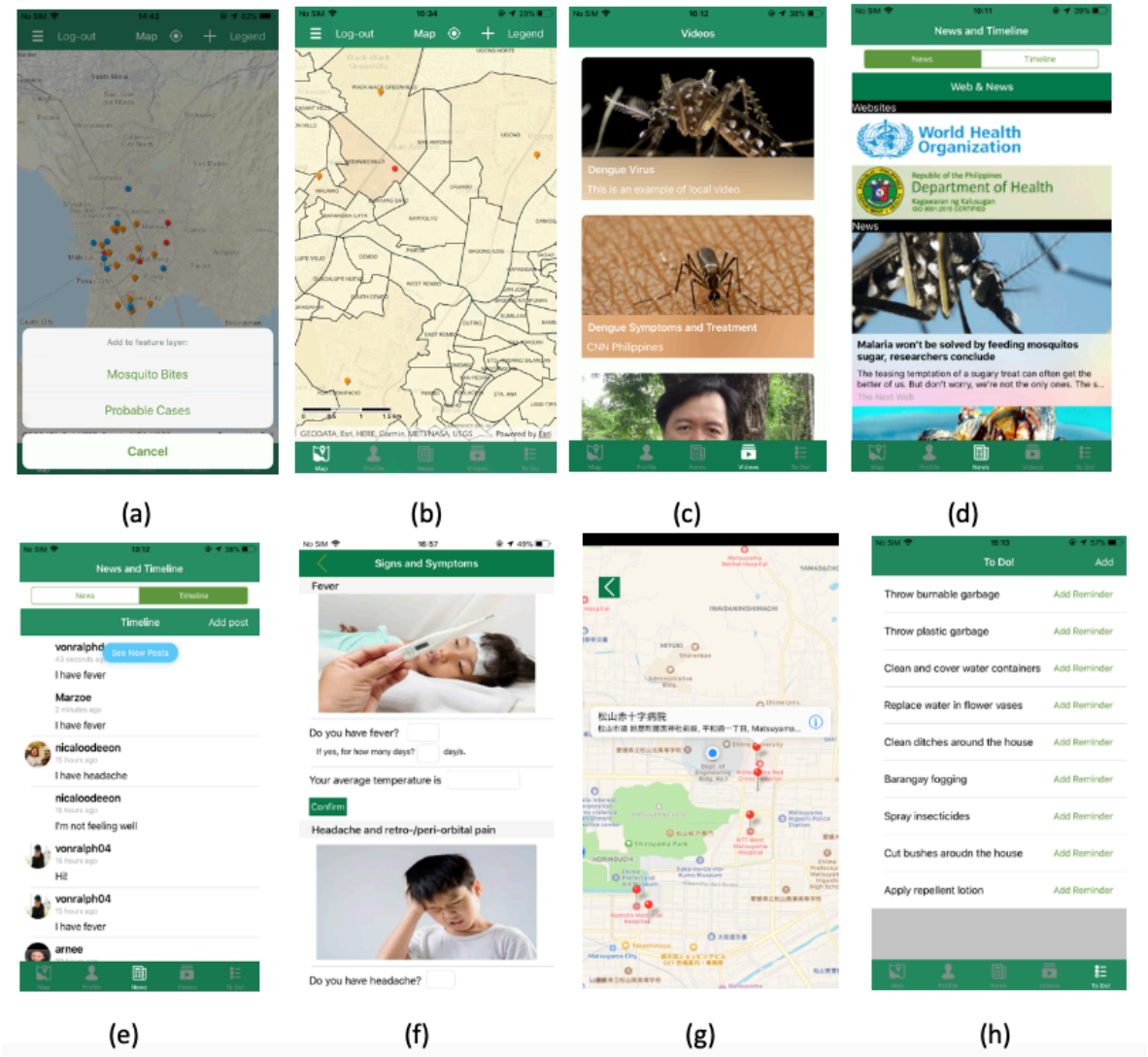

Figure 5.2. Screenshots of the Mozzify app. (a) Real-time dengue fever cases and mosquito bite reporting and mapping, (b) dengue fever hotspots, (c) within-app educational videos, (d) worldwide news and health agencies websites, (e) chat forum (timeline), (f) symptoms checker, (g) hospital directions, and (h) reminders alert program.

Component 1: Real-Time Dengue Fever Cases Reporting and Mapping System

The main feature of this app is the real-time reporting and mapping of dengue fever cases and mosquito bites through ArcGIS Online. ArcGIS Online is an online, cloud-based, collaborative and configurable Web geographical and information system that allows developers to use, create, analyze, and share maps in mobile apps [17]. To use the ArcGIS Online features in our app, I configured the source code provided by Data Collection.NET, which required the installation of ArcGIS Runtime SDK (version 100.5) [18]. Configuration involved registration of our own ArcGIS Portal app, modifying the project in reference to our app, and licensing it for deployment [19]. The map shows real-time probable and laboratory-confirmed dengue fever cases and mosquito bite reports in pins. Probable cases are in blue pins, confirmed dengue fever cases are in red pins, and mosquito bite reports are in orange pins. Users will be able to report a probable case or a mosquito bite incidence, which they can pin at their current location (or any other location). In reporting, users can disclose their personal information (eg, name, home address, and age) and attach images. The map also shows the location (*barangay* or village) with high dengue fever incidences by color using the ArcGIS analysis feature. This feature assigns a darker color to a location with high dengue fever incidences by counting the number of pins (confirmed and probable dengue fever cases) within its boundary. This analysis is done on a daily basis.

Component 2: Health Communication

The unique parts of the health communication component are the dengue fever warning signs and symptoms checker and the hospital directions feature. Users can answer

26 simple questions (three questions per symptom) in each symptom (eg, Do you have fever? If yes, for how many days? What is your average temperature?), and the app alerts the user if the symptoms need prompt clinical attention by a physician. I formulated the questions and set an algorithm based on the clinical diagnosis, treatment, and management guidelines of dengue fever to allow the app to analyze whether the user needs to go to the nearest hospital to receive prompt clinical assessment by a health professional based on their answers (eg, a fever above 41°C for four days requires immediate clinical assessment by a physician) [2]. If the user's symptoms require prompt medical assessment by a physician, the app sends an alert that the user needs to go to the hospital. Then the app will present a map that shows the user's current location and the nearest hospitals. I collected the coordinates (latitude and longitude) of each hospital and pinned them as an annotation in the map using Google Maps. Once the user clicks a pin of a hospital, the app then shows the directions from their current location to the chosen hospital. In this trial, I selected random nearby hospitals to show the app's feature. The app is intended to be trialed in the Philippines; therefore, I used the list of the hospitals from the Department of Health that has dengue express lanes (including for Dengvaxia-vaccinated individuals who might need immediate medical assistance and free hospital services) [21]. This feature aims to increase health care-seeking behavior among users by encouraging them to go to the hospital to seek medical help from health care professionals and not to self-diagnose or, more importantly, cause a panic.

The app contains different online-sourced, evidence-based, local and international guidelines on the control, prevention, diagnosis, and treatment of dengue fever in PDF (portable document format) files [2,22-25]. Users can also watch predownloaded videos in

English and Filipino (Tagalog) on the dengue fever virus, symptoms, diagnosis, and treatment available. I also used news Application Programming Interface (API), a free, open-source, and noncommercial API that collects news from our set request parameters (eg, keywords: mosquito, dengue fever) and shows users the latest international and local news from almost 30,000 news sources and blogs on dengue fever and other mosquito-borne diseases, such as malaria, zika, chikungunya, and Japanese encephalitis. The app also shows the websites of international and local health agencies, such as the World Health Organization and Department of Health, which give the users information on key facts, prevalence, treatment, immunization, prevention, and control guidelines and programs on dengue fever [26,27]. The app's health communication feature was also designed to let users exchange and share posts on events, concerns, and questions on dengue fever through a chat forum (timeline) by using the Firebase online database. Altogether, these aim to increase awareness, improve knowledge, and change attitudes about dengue fever.

Component 3: Behavior Modification (Preventive Practices Against Dengue Fever)

Another component of the app is the behavior modification feature, which includes the Reminder alerts program based on COMBI. This is expected to develop or improve users' behavior on practicing preventive measures against dengue fever. COMBI is a comprehensive strategy that uses communication for knowledge to have a significant effect on behavioral change (making people aware, informed, convinced, and then deciding to act, and repeating and maintaining that action) or increase practices against dengue fever [13,16]. The app has a list of practices against dengue fever based on international and local guidelines

on prevention, management, and vector control programs [2,22-25]. The user has the option to select and add practices according to their needs or preference. After selection, the app adds all the items to the built-in iOS Reminders app on their mobile phones. In that app, users can set the priority and edit when (eg, time, day, and frequency [daily, weekly, or monthly]) and where (radial location settings) they want alerts.

2.2. Testing and Assessment

This study was written and conducted in accordance with international guidelines: the Declaration of Helsinki [29] and the International Council for Harmonization Good Clinical Practice guidelines [30]. The protocol was approved by the Ethics and Review Committee of Ehime University, Japan (ethics review approval number: K19-001). The app was tested in July 2019 after the completion of its development.

This study involved 50 purposively sampled participants grouped into three subgroups who tested the app: (1) public health experts (n=5), (2) environment and health-related researchers (n=23), and (3) nonclinical users (n=22). The participants were selected, recruited, and grouped according to the set inclusion criteria. Public health experts were academic and clinical research experts working directly on prevention, control (including an ArcGIS mapping expert), and clinical management of dengue fever. Environment and health-related researchers were university-based researchers working on vector-borne diseases and water ecology. Both the public health experts and environment and health-related researchers were from countries where dengue fever is prevalent (eg, the Philippines and Indonesia). The third subgroup, nonclinical, were considered as end users and had no comprehensive

knowledge of or experience with dengue fever. A few information technology and computer science researchers were also included in the environment and health-related researchers and nonclinical groups.

All participants were aged 18 years and older, with sound psychological conditions, who were able to read and understand the informed consent contents, and used an iPhone mobile phone of any model with iOS of 11.0 and above. Initially, when found eligible, participants were asked to sign an informed consent sheet. Of the 50 participants, 36 (72%) were invited for either a focus group or an individual discussion session to provide more comprehensive qualitative feedback, whereas others, who were mostly in the nonclinical group, were invited by email (n=14). All participants were asked to install the app on their mobile phones after a Web-based invitation by downloading Test Flight, the beta testing feature of the Apple Inc developer program. After installation, all participants were asked to use the app by following the instructions in the user's guide (see Multimedia Appendix 1), which was available in print and on a website.

Participants were asked to complete the Mobile Application Rating Scale (MARS). Their responses were automatically stored in the password-protected database, and each participant was given a unique code to protect their identity. MARS is a 23-item test that uses a 5-point scale (1=inadequate, 2=poor, 3=acceptable, 4=good, 5=excellent), which assesses the app quality on three subscales: objective quality, subjective quality, and app-specific quality [31]. The objective quality subscale has 19 items that are clustered into four parts: engagement (fun, interesting, customizability, interactivity, and well-targeted to audience), functionality (functioning, easy-to-learn, navigation, flow logic, and gestural design),

aesthetics (graphic design, overall visual appeal, color scheme, and stylistic consistency), and information quality (containing high-quality information from a credible source) [31]. The subjective quality subscale has four items that measure the user's desire to recommend the app to others, use the app for short or long term, and overall star rating of the app [31]. The app-specific subscale was modified based on the perceived impact of the app on the user's awareness and knowledge (dengue fever symptoms, hospitals that cater to dengue fever patients, dengue fever hotspots, dengue fever prevention and treatment), attitudes (perceived risk or susceptibility, perceived severity, benefits and barriers, and self-efficacy), help-seeking behavior (health care-seeking behavior), intentions, and actual change of behavior in practicing preventive measures against dengue fever. Scoring was done by calculating the mean score of each subscale, adding them together, and dividing by four (four subscales) to get the app quality mean score, four (four items) to get the app subjective quality mean score, or six (six items) to get the app-specific mean score [31]. Irrelevant items were one item in the information subscale (if the app underwent evidence-based trial/test) and one item in the subjective quality subscale (Would you pay for this app?) and these were not included in the analysis (app has not been trialed/tested and will not be sold). MARS has an excellent total score internal consistency level Cronbach alpha (α=.90) and excellent level of interrater reliability (two-way mixed interclass correlation coefficient [ICC]=0.79, 95% confidence interval [CI] 0.75-0.83). Its subscales also had very high internal consistencies that ranged from alphas of .80 to .89, and fair to excellent interrater reliabilities (ICC 0.50-0.80, median 0.65) [31]. The MARS form is available in Multimedia Appendix 2.

2.3. Data Analysis

Statistical analysis was conducted using SPSS version 25 (IBM Corp, Armonk, NY, USA). I calculated the mean scores of each subscale in the app objective quality scale and each item in the app subjective scale. The app subjective quality scale was reported as individual items and by mean score. Comments and suggestions in the focus group and individual discussions were analyzed, and similar or overlapping topics were grouped into different themes.

3. Results

A total of 50 individuals, aged from 19 to 45 years and mostly males (60%, 30/50), participated in the app testing. All participants I approached and recruited agreed to test the app and answer the scale; the majority (78%, 39/50) attended the focus group and individual discussions. This indicates excellent acceptability and nonwithdrawal rates among experts, health researchers, and the general public or end users. In all, 68% (34/50) were able to install the app on their mobile phones, whereas the rest used our available prototypes.

3.1. App Objective Quality

Mozzify was assessed using the MARS app objective quality, which has four subscales: engagement, functionality, aesthetics, and information. Figure 5.3 shows the mean score ratings of the public health experts, environment and health-related researchers, and nonclinical or general public participants. Mozzify received high (≥4 out of 5; 74%, 37/50) satisfaction mean ratings in all four subscales among the participants, with the highest mean

score ratings (mean 4.3, SD 0.2) for items relating to the app's functioning, easiness to learn, navigation, flow, logic, and gestural design, graphic design, overall visual appeal, color scheme, and stylistic consistency, and for containing high-quality information from a credible source. A mean rating of 4.2 (SD 0.2) was obtained for items relating to the app being fun, interesting, customizable, interactive, and well-targeted to the audience.

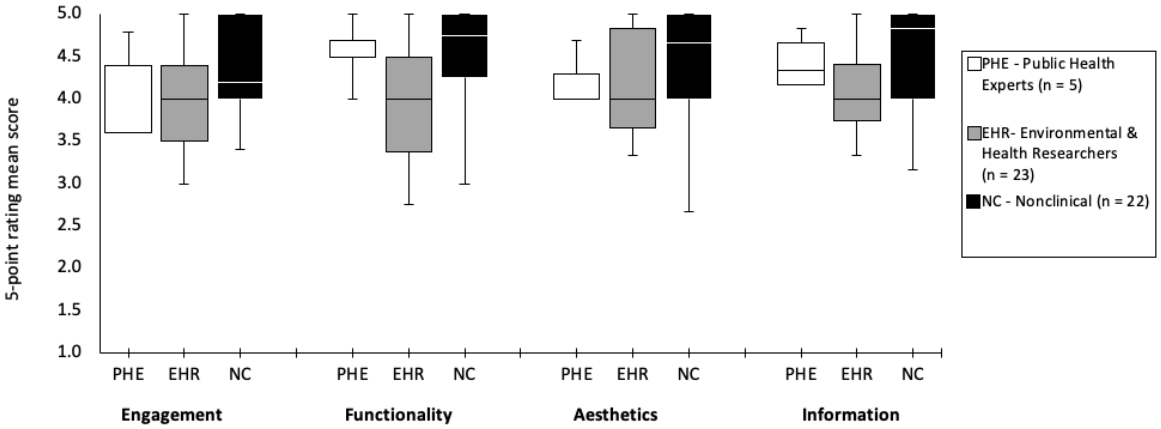

Figure 5.3. Mean scores of app objective subscales based on the Mobile Application Rating Scale (MARS) from public health experts, environment and health-related researchers, and nonclinical participants.

3.2. App Subjective Quality

Public health experts, environment and health-related researchers, and nonclinical participants had similar satisfaction mean ratings (mean 4.0, SD 0.4) in the app subjective quality subscale, as shown in Figure 4. Specifically, items about recommending the app to other people and the app's overall star rating had relatively high satisfaction mean ratings of

4.2 (SD 0.2), whereas the item on using the app in the next 12 months obtained the lowest satisfaction mean rating of 3.4 (SD 0.3) among the participants. All participants reported that they would recommend the app to people who might benefit from it. All public health experts and a majority of the environment and health-related researchers (86.9%, 20/23) and nonclinical participants (77.3%, 17/22) perceived that the app was relevant to them and they would use it 3 to more than 50 times in the next 12 months. Public health experts gave the app the highest overall star rating of 4.4 (SD 0.5), whereas both environment and health-related researchers and nonclinical participants gave it 4.1 (SD 0.7 and 0.8, respectively).

3.3. App-Specific Quality

The MARS app-specific quality subscale items were modified based on the components and goals of the app, which were to increase awareness, improve knowledge, change attitudes about dengue fever, and increase intention to change and help-seeking behavior among users. The item on increasing users' knowledge or understanding of dengue fever symptoms, hospitals that cater to dengue fever patients, dengue fever hotspots, and dengue fever prevention and treatment obtained an excellent satisfaction average mean rating of 4.7 (SD 0.3) (Figure 5.4). Items on increasing user awareness of the importance of addressing dengue fever symptoms, hospitals that cater to dengue fever patients, dengue fever hotspots, dengue fever prevention and treatment, and encouraging users to seek clinical assessment when they have dengue fever symptoms (if required) obtained an average satisfaction mean rating of 4.5 (SD 0.3 and 0.1, respectively) from all participants. Moreover, items on changing users' attitudes toward improving practices against dengue fever and

increasing users' intentions or motivation to address behavior change (practicing preventive measures against dengue fever) obtained overall mean ratings of 4.4 (SD 0.3) and 4.3 (SD 0.3), respectively, among the participants. In general, the app obtained a high satisfactory mean rating of 4.5 (SD 0.1) in the app-specific quality subscale among the participants.

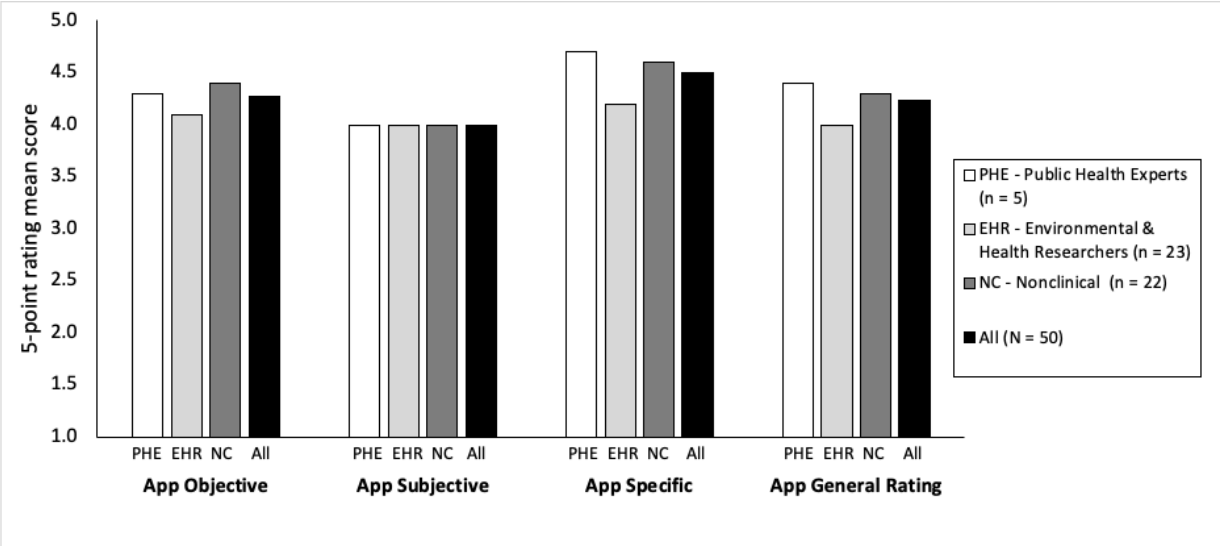

Figure 5.4. Mean scores of app objective, subjective, specific, and general rating based on the Mobile Application Rating Scale (MARS) from public health experts, environment and health-related researchers, and nonclinical participants.

3.4. Focus Group and Individual Discussions

Approximately 78% (39/50) of participants were able to attend the focus group and individual discussions. Five public health experts were able to participate in the focus group discussion. All found the app useful and were positive about its concept, components, and goals. However, three issues were raised during the session. The first issue was the

availability of the app for iOS (iPhone) mobile phones only. Participants mentioned that it would be better if the app was also available for Android so that everyone with a mobile phone could use it. The second issue was the app was only available in English, and it should also be available in other languages. This would allow the app to be distributed in many countries where dengue fever is highly prevalent. Lastly, one expert mentioned about the ability of the app to do predictive surveillance and identify dengue fever hotspots based on past annual dengue fever incidence reports and not only based on the number of pins in a location (barangay or village).

Environment and health-related researchers also had positive feedback about the app. They found the app concise and relevant, interesting, and convenient. Some perceived that the app was effective in reducing the number of dengue fever patients, and it would help increase user's awareness of dengue fever, especially those who live in tropical and subtropical countries with high numbers of dengue fever cases. Although the majority of the environment and health-related researchers mentioned that the app was easy to use, some suggested that it should include a within-app user's guide (eg, pop-ups or labels). Two other suggestions were raised about increasing the engagement ability of the app: (1) the app should include games so people will use it daily and (2) it should include other mosquito-borne diseases (eg, zika, chikungunya, Japanese encephalitis, and malaria) in the real-time reporting and mapping feature of the app. Similar to the public health experts, they also suggested that the inclusion of many languages other than English is highly desirable.

The nonclinical group, who were considered the end users, found the app excellent, useful, exciting, interesting, and helpful for countries that suffer from dengue fever outbreaks.

They perceived the app was able to improve their knowledge, attitudes, and awareness by seeing the pictures of symptoms, videos, dengue fever hotspots, and nearby hospitals that cater to dengue fever patients. Specific suggestions were mentioned about the technical and functional details of the app that needed polishing and revisions (eg, buttons and gestures).

4. Discussion

I have introduced and described the design and development process and the testing of the functions and features of Mozzify. Results show that it obtained excellent acceptability and satisfaction ratings based on the MARS app quality subscales among the participants. This indicates that it has good user design, functionality, usability, engagement, and contains a relevant information system. The app subjective ratings also indicate that the experts and users are more likely to recommend the app to others and more likely to use it frequently in the future. Moreover, based on the specific quality subscale ratings of the participants, the app achieved what it intended to achieve. It could be a highly effective tool in increasing user's knowledge and awareness of dengue fever symptoms, hospitals that cater to dengue fever patients, dengue fever hotspots, and dengue fever prevention and treatment; changing user's attitudes about dengue fever and its symptoms; and encouraging users to seek clinical assessment when they have dengue fever symptoms (if required). It also indicates the app can improve users' practice of measures against dengue fever, and increase users' intentions or motivation to address behavior change by practicing preventive measures against dengue fever.

Based on the focus group and individual discussions, participants found the app concise, relevant, interesting, convenient, excellent, useful, and exciting. Some perceived that the app is effective in reducing the number of dengue fever patients, and it will help increase user's awareness of dengue fever, especially those who live in countries with high incidences of dengue fever cases. They also perceived that the app was able to improve their knowledge, attitudes, and awareness of dengue fever. Although participants were positive toward the app, some issues were also raised: the availability of the app on iOS (iPhone) mobile phones only, language option limitations, the need for a within-app user's guide (eg, pop-ups or labels), and polishing of the app's technical and functional details (eg, buttons and gestures). Some suggestions were also given by the participants: the use of predictive surveillance, inclusion of other mosquito-borne diseases in the real-time reporting and mapping feature, and use of games to increase usability and engagement among users.

I have only managed to do minimal revisions (simpler log-in and sign-up pages and pin legend in the map screen) in the design of the app for an immediate trial and assessment in the Philippines.

5. Conclusion

I have developed and designed a mobile app, Mozzify, which obtained excellent acceptability and ratings (mean scores ≥4.0 out of 5) based on the MARS subscales among health experts and researchers and the general public, which indicate that it is ready for another trial among a larger population in the Philippines. It may be a promising integrated strategic health intervention system for reporting and mapping dengue fever cases; increasing

awareness, improving knowledge, and changing attitudes about dengue fever; and disseminating and sharing information on dengue fever among the general population and health experts and for the knowledge on how to prevent dengue fever to be successfully translated to practice.

I have started to collect data on the longitudinal spatial analysis of dengue fever hotspots in the Philippines as a provision for a predictive surveillance feature, and the inclusion of other mosquito-borne diseases in the reporting and mapping system in the future. Thus, I also plan to design an alert system on the map that would warn users when they enter or when they are near a barangay/village or area with a high incidence of dengue fever cases and mosquito abundance. I also working on developing an Android version of the app, more language options, and the possible inclusion of games to increase usability and engagement among users in the future. Our aim is that Mozzify will address the lack of available apps for the control and prevention of dengue fever not only in the Philippines but also in other countries with dengue fever and other mosquito-borne diseases worldwide.

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Chapter 6

Testing and Assessment of Mozzify, the First Integrated mHealth App for Dengue Fever in the Philippines

Abstract

Background: Philippines recently declared a national dengue fever (DF) epidemic. Yet, to our knowledge, there is no available integrated mhealth app for dengue fever that includes all the appropriate surveillance methods in early detection of disease outbreaks in the country. Objectives: This study aimed to test and assess the Mozzify app among health experts and general public in terms of the Mobile App Rating Scale (MARS) subscales: objective quality (engagement, functionality, aesthetics, information), app-subjective and app-specific qualities and compare the total app mean score ratings by socio-demographic profile and self and family DF history to see what factor is associated with high app mean score rating. I also conducted individual interviews and focus group discussions among the participants, and analyze their comments and suggestions to help structure further improvement and future development of the app. Methods: I have tested and assessed Mozzif*y*, among health experts and members of the general public using the Mobile Application Rating Scale (MARS) professional and user versions (uMARS). I compared the total app mean score ratings by socio-demographic and DF history using mean difference analyses. Content analysis was used to analyse the topics raised in individual interviews and focus group discussions. Results: In total, I have recruited 979 participants (health experts n = 94; general public n = 885) which indicates high participation rate. Mozzify also had high acceptance rate among

the participants as indicated by the high mean score ratings (>4 out of 5) in the MARS' and uMARS' app quality, subjective and specific scales, with the highest mean score ratings in information and functionality subscales, recommending app to others, and improving knowledge and awareness regarding DF and help-seeking items. Mean difference analyses revealed that total app mean score ratings were the same across ages and gender among health experts and general public. Similar results were found across income categories, and self and family DF history but not gender, among the general public. Content analyses of the topics discussed in the individual interviews and focus group discussions revealed eight major themes: positive comments regarding the app's concept, design, information and features; suggestions on adding features like multi-language options and including other diseases; Android version availability; improvements on the app's content, design and engagement; inclusion of users from low-income and rural areas; Wi-Fi connection and app size concerns, and; data credibility, and user security and privacy issues.Conclusions: This study confirms that Mozzify is a promising integrated strategic health intervention and surveillance system for reporting and mapping DF cases, increasing awareness, improving knowledge, and facilitating behavior change (practicing preventive measures against DF). It can be used by users of any age (>18 years), socioeconomic status and DF history. However, in spite of its many strengths and unique features, improvements that are tailored to the needs of the intended users should still be done without compromising their security and privacy. Mozzify could be an appropriate surveillance method in early detection of disease outbreaks in the Philippines and other countries where DF is endemic.

1. Introduction

In 1953, the first dengue hemorrhagic fever outbreak was reported in the Philippines [1]. Since then, it has been a leading public health burden in all regions of the country, especially Metro Manila or the National Capital Region (NCR), the capital region of the Philippines [2, 3]. In 2015, Metro Manila, was one of the three regions which had the highest number of dengue fever cases (25,208) according to the Weekly Disease Surveillance Report of the Epidemiology Bureau of the Department of Health (DOH) [4]. Three years later, in 2018, where majority (13%) of the 216,190 cases were from NCR, which accounted for a 42% increase compared with 2017 (152,224 cases) [5]. Moreover, a total of 1,083 deaths were reported last year, of which, 17% were from NCR [5].

This year, approximately 106,630 dengue fever cases and 456 deaths were reported in the Philippines from January 1 to June 29 (morbidity week 1 to week 26) which indicates an 85% increase in DF cases during the same period in 2018 (57, 564 DF cases) [6]. It was found higher than the alert and epidemic thresholds [6]. Thus, the DOH declared a National Dengue Alert on 15th July 2019 [7] which was followed by the declaration of a National Dengue Epidemic on 6th August 2019 [8]. As of August 17, 2019, the cases and deaths continued to rise to 229,736 and 958 respectively, 107% higher than the same period in 2018 [9].

Early detection and effective control of epidemics depend on appropriate surveillance methods [10]. However, Philippines relies its DF surveillance system on passive surveillance method which mainly depends on notifications from barangay/village health centers, municipal or city health offices, hospitals and clinics, and quarantine sections [11,12,13].

This limits the reports to cases that are clinically diagnosed without laboratory confirmation [11] which is only a portion (14.3%) of the dengue cases [11,14]. This leaves those patients with undifferentiated febrile illness or viral syndrome underreported, thus, limits our capability to predict or control epidemics [15].

The main aim of public health surveillance is to monitor dengue transmission accurately which will trigger the necessary effective preventive measures and programs to prevent occurrence and spread of diseases [15]. Recently, the use of mhealth (mobile health) technology, mobile apps specifically, has been gaining prominence as a potential surveillance system that meet the need for real-time disease surveillance and timely identification of epidemics [10, 16]. Mohanty et al [10] found 26 apps relevant to epidemic surveillance which are mostly free of charge and provide real-time tracking and interactive maps. However, they also found some limitations: majority are in Android platform only and focus on a single disease (mostly influenza), some were country and language-specific and had narrow applicability and, only a few are tailored for health professionals [10]. Thus, there is a pressing need to develop an app that not addresses these limitations.

I have developed Mozzify, a free app that features real-time reporting and mapping of dengue cases, comprehensive health communication and evidence-based behavior modification system, tailored for the general public and healthcare professionals. It is an integrated mhealth because it combines appropriate surveillance methods in early detection of disease outbreaks: indicator-based surveillance (IBS) and event-based surveillance (EBS) [10]. It includes healthcare professionals from clinics, hospital and other healthcare facilities in reporting laboratory confirmed DF, which is the provision of IBS [10, 17]. Moreover, it

also uses ArcGIS' spatial analysis feature to identify DF hotspots, which is also an IBS method (sentinel surveillance) [10, 18]. It also includes reporting and mapping of patients with probable or suspected (with clinical symptoms) dengue fever through the use of its interactive symptoms checker, which is the provision of the syndromic surveillance, also an IBS method [10, 17, 19]. Finally, it includes media reports and news, social media (timeline/chat forum) and links to websites of international and local health agencies to detect and monitor outbreaks which is the provision of event-based surveillance method [10,20]. Currently, an Android version of this app is being developed that will also include multi-language options and a wide-range of mosquito-borne diseases that can be used in mosquito-borne-diseases-endemic countries worldwide.

Mozzify has been pilot tested in Japan and results showed that it has high acceptability and excellent satisfaction ratings (mean scores ≥4.0 out of 5) based on the Mobile Application Ratings (MARS) subscales [21] among health experts and researchers and end-users. It has excellent user design, functionality, usability, engagement, and contain evidence-based information [21]. Its subjective quality (recommending the app to other people and the app's overall star rating), and specific quality (increase awareness, improve knowledge, and change attitude about dengue fever; health care-seeking behavior; and intention-to-change behavior on preventive practices for dengue fever) also obtained excellent satisfaction ratings from the participants [21]. Further, the pilot study concluded that Mozzify may be promising integrated strategic health intervention system for dengue fever case reporting and mapping; increasing awareness, improving knowledge, and changing attitude about dengue fever; disseminating and sharing information regarding DF

and an effective tool in the successful translation of knowledge on preventive measures against DF to practice [21]. Moreover, it was concluded that it was ready for another testing and assessment among health experts and the general public in a country where DF is endemic like the Philippines.

Therefore, the objectives of this study were threefold: a. test and assess the Mozzify app among health experts and general public in Metro Manila Philippines, in terms of the Mobile App Rating Scale (MARS) subscales: engagement, functionality, aesthetics, information, app-subjective and app-specific qualities; b. compare the total app mean score ratings by socio-demographic profile (e.g. age, gender, income) and self and family DF history to see what factor is associated with high app mean score rating, and; c. conduct individual interviews and focus group discussions among the participants, and analyze their comments and suggestions to help structure further improvement and future development of the app.

To the best of our knowledge, there is no other available integrated mhealth app for dengue fever that includes all the appropriate surveillance methods in early detection of disease outbreaks. Thus, this app will be the first to be tested and introduced in the Philippines, specifically Metro Manila, more so, during an outbreak. Hence, I hypothesized that the participation and acceptance rates (user's intention to use the app), and app mean score ratings among the participants will be high due to the app's relevance to the current dengue fever outbreak. I also hypothesized that the total app mean score ratings will be the same across ages, gender, income categories, and self and family DF history which indicate that the app is acceptable among users of any age group, gender, socioeconomic status, and DF

history. Lastly, the individual interviews and focus group discussions would yield similar results as our pilot study. However, I also hypothesized that it will produce more comprehensive and meaningful results that will reveal the app's strengths and weaknesses in an actual environment and real condition.

2. Methods

2.1. Ethical considerations and participant's eligibility criteria

This study was written and conducted in accordance with international guidelines: the Declaration of Helsinki [22] and International Council for Harmonization Good Clinical Practice guidelines [23]. The protocol was approved by the Ethics and Review Committee of Trinity University of Asia (TUA) (ethics review approval number: 2019-28-Herbuela-VPAA-Mozzify-v1). The app was tested in August to mid-September 2019 during the dengue fever outbreak in the Philippines, wherein Metro Manila was one of the most affected regions [9]. A sample size of 385 (5% margin of error, 95% confidence level (a = 0.05; critical value/Z-score of 1.96) was the minimum recommended size for this study based from the 13,698,889 estimated population of Metro Manila [24]. All participants were aged 18 years and older, with sound psychological condition, able to read and understand the contents of the informed consent and the questionnaire. Initially, when found eligible, participants were asked to sign an informed consent sheet. All forms that contain participant information were coded and stored in a password-protected database.

2.2. Socio-demographic and DF history profile

Socio-demographic information like age, gender, civil status, their family's monthly income. Age was clustered according to the minimum (18 years old) and maximum (53 years old) ages of the participants with an equal interval size of 5 (e.g. 18-22, 23-27, etc.) except for the 48 to 53 age group which has 6 interval size. Family monthly income was identified using the clusters from the indicative range of monthly family incomes (for a family of 5) in 2015 and 2017 [25]. However, I've decided to have six clusters in 10,000-peso interval size (e.g. ≤10,000, 11,000-20,000, etc.). I also asked the participants about their self and family history of DF. The inclusion of self and family DF history was to investigate whether a previous diagnosis or history of DF in a family would be associated with higher total mean score app ratings among the participants. Majority of health experts only disclosed information about their age and gender, thus, I decided not to include income, and self and family DF history in the mean score difference analyses.

2.2. Testing procedures

Mozzify is tailored for health experts and the general public, thus, I involved them in this study. Health experts were those who work on health and health-related disciplines in the academic setting (e.g. professors, clinical instructors, etc.), hospital (e.g. physicians, nurses, medical technologists, etc.), research-based setting (e.g. scientists in research centers or institutes) or social setting (e.g. non-government organizations (NGO)-based healthcare volunteers)). General public were mostly students recruited from a university and others were community-based samples.

The first phase of the testing was usability testing which was done to investigate the user-Mozzify interaction in terms of the Mobile Application Rating Scale (MARS) (functions, engagement, design, information, subjective and specific qualities) in the field or actual environment [26,27]. Since it was difficult to recruit participants, especially community-based ones, who were available and willing to join, I decided to include mostly students as end-users. Mozzify app was rated age12+ by Apple developer program which means that the app is suitable for children from 12 years old and above. 12 years was also the median age of the cases during the outbreak [7]. These indicate that including children from this age group was recommended, however, it was difficult because most of the secondary schools that I approached don't allow the students to bring or use mobile phones during class hours. Thus, university students were the best option. The inclusion of students as members of the general public allowed us to manage unpredictable conditions which will limit user's participation (e.g. interference in daily household or work activities) if the testing was done in a community. They were also more available, knowledgeable of apps and mobile technology, can easily understand the questions in the questionnaire, have more app user experience and voluminous which could be easily grouped together for focus group discussions.

All participants were asked to install the app in their mobile phones, otherwise, they were asked to use the available prototype. Individual user experience session was done among the health experts. Most of them either downloaded the app or used the prototype and only a few was recruited using web-based invitations. Among the general public, in most cases when there were only few of them who could install the app in their mobile phones and

there were no strong and stable WIFI connection available, I did a series of investigator-facilitated user experience sessions. The investigator used screen projection method in showing the actual mobile app and its functions to the participants and let them perform the tasks based from a predetermined checklist that were matched with the functions of the app.

2.3. Assessment and interviews

The second phase of testing was the use of a standardized self-administered questionnaire. I used the two versions of the Mobile Application Rating Scale, the professional version (MARS) and the user version (uMARS) [26, 28]. MARS is a 23-item test that was given to the health experts, while the uMARS, a shorter version (20 items) was given to the general public [28]. Three items that required professional expertise in MARS were removed in uMARS [28]. uMARS was also simplified using plain English with a required reading level of that among grade 8 [28]. Both versions use a 5-point scale (1=inadequate, 2=poor, 3=acceptable, 4=good, 5=excellent) to let the participants assess the app in terms of objective quality, subjective quality, and app-specific quality [26,28]. The objective quality subscale is divided into four subscales: engagement, functionality, aesthetics, and information quality [26]. The subjective quality subscale has four items that measure the user's desire to recommend the app to others, use the app for short or long term, and overall star rating of the app [26]. The app-specific subscale was modified based on the perceived impact of the app on the user's awareness and knowledge on and attitudes toward dengue fever, help-seeking behavior, intentions, and actual change of behavior in practicing preventive measures against dengue fever. One item in the subjective quality subscale

(Would you pay for this app?) was not included in the analysis because the app will be available to the public for free. Both MARS and uMARS had excellent internal consistency level Cronbach alpha (α=.90) [26,28].

The third phase was interview, wherein health experts were invited for an individual interview to provide more comprehensive qualitative feedback. The general public, who were mostly students were invited for focus group discussions. All the individual interviews and focus group discussions were done by one trained investigator who was guided with preselected questions (semi-structured) to ensure consistency in the data and simpler analysis.

2.4. Data Analysis

Statistical analysis was conducted using SPSS version 25 (IBM Corp, Armonk, NY, USA). I calculated the mean scores of each subscale in the app objective quality scale and each item in the app subjective scale. The app subjective quality scale was reported as individual items and by mean score.

I also computed for the total app mean score ratings which I used to investigate the differences in means within each category of socio-demographic and DF history variables. I used nonparametric Mann-Whitney U test for dichotomous (2 categories: gender, self and family DF history) variables and Kruskal-Wallis test for multi-categorical variables (age and income), as Shapiro–Wilk and Kolmogorov–Smirnov normality tests revealed that the scores were not normally distributed ($p < 0.001$). Comments and suggestions in the individual and focus group discussions were analysed, and similar or overlapping topics were quantified and

grouped into different themes. Inputs from those who had incomplete responses (who were excluded) in the MARS questionnaire were still included in the content analysis.

3. Results

3.1. Socio-demographic and DF history profile

I was able to recruit 1,000 (health experts, n = 100; general public, n = 900) participants which was more than the recommended minimum number of samples for this study (389). This indicates that Mozzify has high participation rate among the target participants that I approached. However, I have excluded those who had incomplete responses (health experts, n = 6; 6%; general public, n = 15; 1.67%). Thus, data from 979 (health experts, n = 94; general public, n = 885) participants was included in the final analysis. The general public, who were mostly females (70%; 560/799) had ages between 18 and 48 years old with a mean (M) age of 19.8 years and a standard deviation (SD) of 3.0 years as shown in Table 6.1. Out of 885 members of the general public, only 461 (52.1%, 461/885) disclosed information about their socio-demographic profile. Of which, 131 (28%) belong to a family with monthly income of ≥50,000 pesos, 43% (128/321) had DF before, and 76% (247/327) had family member/s who had DF before. The data collected from the health experts was limited to age (ages 19 to 53 years old (M = 1.8 years; SD = 11.1 years) and gender (51.2% males, 44/86) due to majority of them didn't disclose information about their family monthly income, and self and family DF history.

3.2. App objective, subjective and specific quality

All subscales of the MARS' app quality scale obtained high mean score ratings (>4 out of 5) which indicates that Mozzify had high acceptability among health experts and the general public as shown in Table 6.2. High mean rating scores (>4.50) was found in information subscale (M = 4.56, SD = 0.6) among general public followed by functionality (M = 4.2, SD = 0.52) among the health experts. Combined mean score ratings of the two groups revealed that information subscale (M = 4.52, SD = 0.66) had the highest mean score among the participants. In app-subjective scale, the item recommending app to others obtained the highest mean score ratings of 4.61 (SD = 0.6) and 4.59 (SD = 0.69) among health experts and the general public, respectively. Thus, this item also got the highest mean score rating among the items in app-subjective quality with a combined mean score rating of 4.59 (SD = 0.69) from the two groups.

On the other hand, the item, using the app for the next 12 months obtained the relatively lowest mean score ratings from the two groups (health experts, M = 3.43, SD = 0.77; general public, M = 3.67, SD = 0.92). All the items in app-specific scale obtained mean score ratings of above 4.40 among health experts and the general public, compared with the other subscales which items had mean score rating as low as 3.43. Moreover, improving awareness, knowledge and help-seeking behavior and behavior change items obtained relatively high (>4.50) mean score ratings among the health experts and general public.

Table 6.1. Socio-demographic and DF history profile of health experts and general public

Socio-demographic profile		Health experts (*n* = 94)	General public (*n* = 885)	Combined (*n* = 979)
Gender	Male	44 (46.8)	239 (27.0)	283 (28.9)
	Female	42 (43.7)	560 (63.3)	602 (61.5)
Age	18-22	6 (6.358)	711 (80.3)	717 (73.2)
	23-27	25 (26.2)	55 (6.21)	80 (8.17)
	28-32	17 (18.1)	13 (1.47)	30 (3.06)
	33-37	13 (13.8)	4 (0.45)	17 (1.74)
	38-42	6 (6.38)	0 (0.00)	6 (0.61)
	43-47	5 (5.32)	3 (0.34)	8 (0.82)
	48-53	5 (5.32)	1 (0.11)	6 (0.61)
Income (₱)	≤ 10, 000 PHP		46 (5.20)	
	11 to 20,000 PHP		81 (9.15)	
	21 to 30,000 PHP		91 (10.3)	
	31 to 40,000 PHP		60 (6.78)	
	41 to 50,000 PHP		52 (5.87)	
	≥51,000 PHP		132 (14.9)	
DF history				
Self DF history	Had DF		140 (15.8)	
	First-time		424 (47.9)	
Family DF history	None		310 (35.0)	
	≥ 1 had DF		248 (28.0)	

*₱—Philippine peso (52.16 USD = 1 ₱); DF: dengue fever

3.3. Socio-demographics and app mean score rating

Since majority of health experts only disclosed their age and gender, family monthly income, and self and family DF were not included in mean score difference analyses.

Education was also not included in the analysis because majority of the general public were college students. Among health experts, app mean score ratings were the same across age and gender as shown in Table 6.3. In the general public, the app mean score ratings were the same across ages, and income categories, and self and family DF history, except gender. I found that females had significantly ($p<0.001$) higher app mean score ratings of 4.48 (SD = 0.48) than the males (M = 4.34, SD = 0.49).

3.4. Individual interviews and focus group discussions

Out of 100 health experts, 60 (60%, 60/100) were able to attend the individual interviews and all members 900 (100%, 900/900) of the general public attended the focus group discussions. A total of 463 topics were collected, analyzed, quantified and grouped into major themes as shown in Table 4.4. A total of eight major themes emerged from the content analysis: positive comments regarding the app's concept, design, information and features (72.3%); suggestions on adding features like multi-language options and including other diseases (11.0%); Android version availability (8.21%); inclusion of users from low-income and rural areas (3.02%); improvements on the app's content, design and engagement (2.81%); Wi-Fi connection and app size concerns (1.30%); and, data credibility, and users' security and privacy issues (1.08%).

Table 6.2. Mean scores of app objective, subjective, and specific quality ratings based on the Mobile Application Rating Scale (MARS) from health experts and general public

MARS subscales	Health experts (*n* = 94)	General public (*n* = 885)	Combined (*n* = 979)
	Mean (SD)	**Mean (SD)**	**Mean (SD)**
App-objective quality	4.25 (0.64)	4.47 (0.69)	4.45 (0.69)
1. Engagement	4.27 (0.45)	4.39 (0.75)	4.38 (0.73)
2. Functionality	4.32 (0.52)	4.46 (0.68)	4.45 (0.68)
3. Aesthetics	4.23 (0.48)	4.47 (0.67)	4.44 (0.56)
4. Information	4.20 (0.71)	4.56 (0.63)	4.52 (0.66)
App-subjective quality	4.16 (0.84)	4.17 (0.88)	4.17 (0.87)
5. Recommending the app to others	4.61 (0.63)	4.59 (0.69)	4.59 (0.69)
6. Using the app for the next 12 months	3.43 (0.77)	3.67 (0.92)	3.65 (0.91)
7. Over-all (star) rating of the app	4.45 (0.65)	4.25 (0.74)	4.27 (0.73)
App-specific quality	4.49 (0.62)	4.55 (0.67)	4.55 (0.67)
8. Awareness (DF symptoms, hospital locations, hotspots, prevention, treatment)	4.61 (0.63)	4.61 (0.66)	4.61 (0.65)
9. Knowledge (DF symptoms, prevention, treatment)	4.55 (0.63)	4.59 (0.66)	4.58 (0.65)
10. Attitude (severity, susceptibility, preventive practices against DF)	4.41 (0.63)	4.42 (0.72)	4.42 (0.71)
11. Intention-to-change (preventive practices against DF)	4.43 (0.61)	4.49 (0.67)	4.48 (0.66)
12. Help-seeking (for clinical assessment for presence of DF symptoms)	4.56 (0.63)	4.63 (0.63)	4.63 (0.63)
13. Behavior change (preventive practices against DF)	4.38 (0.57)	4.57 (0.67)	4.55 (0.66)

SD: standard deviation; DF: dengue fever;

3.4.a. Positive comments

The major theme that obtained approximately 72.3% (338/463) of the topics discussed in individual and group discussions was the positive comments regarding the app. Health experts perceived that the app is concise and relevant, very interesting, well-executed and informative. They also perceived that the app will be of help to clinicians in improving healthcare awareness and services to the people, especially those patients with dengue fever.

> *This mobile application is what we need today to raise medical awareness about vector borne diseases. This is timely because the country is facing a big dilemma on Dengue. Thank you for this one and may this materialize on a larger scale.*

> *I will be more willing to really pay for the app. This is a good move to start an advocacy of helping the clinicians to spread health care awareness.*

> *I find this mobile application useful and helpful for our country. This could help doctors in locating possible dengue cases, so that proper medical attention will be given.*

Like the health experts, 75.2% (301/403) of the members of the general public had positive comments about the app: user-friendly, useful, educational, innovative, well-designed, interactive and unique. Some commented about the capability of the app in improving the public's awareness regarding dengue fever.

Table 6.3. Total mean scores comparison among health experts and general public by socio-demographic and DF history

		Health experts (*n* = 94)		General public (*n* = 885)	
Socio-demographic profile		**Mean (SD)**	***p-value***	**Mean (SD)**	***p-value***
Gender[a]	Male	4.35 (0.32)	0.14	4.34 (0.52)	<0.001
	Female	4.23 (0.39)		4.50 (0.42)	
Age[b]	18-22	4.42 (0.29)	0.87	4.45 (0.46)	0.69
	23-27	4.39 (0.31)		4.41 (0.46)	
	28-32	4.32 (0.40)		4.53 (0.43)	
	33-37	4.35 (0.36)		4.65 (0.47)	
	38-42	4.27 (0.58)		0.00 (0.00)	
	43-47	4.22 (0.08)		4.50 (0.34)	
	48-53	4.31 (0.39)		4.23 (0.00)	
Income (₱)[b,*]	≤ 10, 000 PHP			4.47 (0.58)	0.11
	11 to 20,000 PHP			4.46 (0.41)	
	21 to 30,000 PHP			4.43 (0.50)	
	31 to 40,000 PHP			4.39 (0.54)	
	41 to 50,000 PHP			4.32 (0.41)	
	≥51,000 PHP			4.48 (0.38)	
DF history					
Self DF history[a]	Had DF			4.43 (0.48)	0.59
	First-time			4.46 (0.44)	
Family DF history[a]	None			4.44 (0.46)	0.35
	≥ 1 had DF			4.47 (0.43)	

a: Mann-Whitney u test; b: Kruskal-Wallis test; SD: standard deviation; *₱: Philippine peso (52.16 USD = 1 ₱); DF: dengue fever

This app is a small step to fully catch the attention of people who are suffering from dengue and other mosquito related illnesses as the country progressively find ways to eradicate it for the good of the citizens.

Looking forward to use this app and hoping to be approved by the Department of health (DOH) because it really helps in our country to give awareness and knowledge about dengue and in future the high increase of dengue cases will be decreased.

I think it's finally time an app for tracking dengue cases becomes a thing. Dengue is becoming an epidemic and being able to keep track of it helps people with preventive measures.

3.4.b. Suggestions

There were 51 (11.0%) participants who suggested to include some additional features and information that they perceived should be in the app. Of which, 38 (9.43%, 38/403) were from the general public, and 13 (21.7%, 13/60) were from the health experts. Most of the suggestions were about including a feature that would allow users to easily access medical services professionals, the need for a multi-language options for the users, adding more information (through videos, graphics and PDF files) about vector mosquitoes, information about Dengvaxia vaccine, how to prevent or avoid DF, vector-human interaction, and including other diseases (e.g. HIV, TB, other mosquito-borne disease and diseases in the agricultural sector). Participants also suggested connecting the app to social media like

Facebook and Twitter, putting advertisements, adding games, and developing a desktop version for hospitals and clinics. These were some of the comments:

> *Apply doctors and other clinicians from the hospitals about their schedules and might apply for appointment to the available doctor to help out with the symptoms; Try to make the services mobile, like delivering of medicines through motorcycle authorized riders; Maybe link a feature that can immediately notify the nearby hospital for assistance; Add emergency hotlines of nearby hospitals /clinics; Put a tab or an option for the people where they can actually talk to a doctor for emergency and questions.*

Table 6.4. The major themes that emerged from individual interviews and focus group discussions among health experts and members of the general public

Themes	Health experts (*n* = 60)	General public (*n* = 403)	Combined (*n* = 463)
1. Positive comments (concept, design, information, features)	37 (61.7)	298 (73.9)	338 (72.3)
2. Suggestions (add features: multi-language, include other diseases, alerts, etc.)	13 (21.7)	38 (9.43)	51 (11.0)
3. Android version availability	7 (11.7)	31 (7.69)	38 (8.21)
4. Inclusivity (rural areas, low-income families)	2 (3.33)	12 (2.98)	14 (3.02)
5. Improvement (content and design, engagement)		14 (3.47)	13 (2.81)
6. Wi-Fi connection and app size		6 (1.49)	6 (1.30)
7. Data credibility, and users' security and privacy	1 (1.67)	4 (0.99)	5 (1.08)

Multi lingual setting would be better for wide range application; Have multilingual languages, so a particular country can use their own languages and to understand clear and better the use of the app; Have settings for different languages so that people who are non-English speaking can use it efficiently

More info about Dengvaxia because a lot of people are getting confused whether the vaccine is safe or not; Add a function which is integrate to the 4S program of DOH may be in the to do list.

Some information about the host and parasite interaction should be included in order for them to visualize more what would be the main reason how these vector-borne diseases were transferred and manifested.

This application should also include other diseases caused by mosquitoes; Maybe this app can also be applied not only for Dengue Cases or Human Health related but also for environmental issues and Disease outbreaks in agriculture sector.

Put advertisement can be good if it endorses medicine for dengue patients; Include videos or mini games that would make the app more interactive; A windows/mac version should be developed specifically for hospitals and other healthcare establishments.

3.4.c. Android version

One of the major themes that emerged from the individual and group discussion was the need for an Android version of the app. A total of 38 (8.21%, 38/463) health experts (n = 7, 11.7%, 7/60) and general public (n = 31, 7.69%, 31/403) raised concerns regarding the need for an Android version of the app. Some of the comments were:

> *The application should be available to all and not restricted to iOS only to fully utilized its intention to help raise awareness about these diseases cause by mosquitoes; The mobile application is commendable. However, this should be available for not IOS users so that many will benefit; I hope you first tested in an android phone because most of the people in the community has android phones and it will really be accessible for them. But overall, I totally liked the app.*

3.4.d. Inclusivity

Another major theme is the need for inclusivity which were raised by 14 participants (3.02%, 14/463). Of which, 12 (2.98%, 12/403) health experts and 2 (3.33%, 2/60) commented that the app should bridge the gap between low-income and those who are in rural areas and receiving appropriate medical services through the use of the app. Some of the comments were:

> *The app is very handy and interactive, but I think it's target audience isn't the one's who need health teaching about dengue. However, this app could be used by healthcare professionals and nursing students like me to document our patients in*

farther communities who doesn't have access in healthcare facilities and telecommunications.

This is a novel approach to mitigate the barriers between rural areas and healthcare; I hope that this application is not only for the people who are in urban areas. Please also include the availability for the people in the rural areas that doesn't have sufficient signal in the specific areas.

The problem is mostly the people who are in the low status of the community have dengue and how will they even access the app? Not everyone has a phone nor the knowledge how to do this or download it. This will only help middle class and the high class, when it should be helping the low class the most. Hope you can fix this issue. It's for the betterment of everyone. It's because when you start from the bottom, everything will go smoothly to the top.

This will help many families in seeking medical help for their children suffering from dengue specially for those unfortunate families; The intention to make this app is nice, however, the downside is the most of the low class that were affected by the dengue cannot use this app if they have the proper technology. The people living in the line of poverty might not be able to access the app immediately and since most people are experiencing poverty are the ones most vulnerable to dengue; Need to be access more by people ion different social class; An app like this should be for free since most

people affected by the disease are on the lower end of social ladder so it would be accessible to everyone mostly those in need.

This app needs to be free so all can access it. And have further awareness especially the areas living in poverty who do not have access to healthcare

3.4.e. Improvement

This theme emerged based on the comments of 14 (3.47%, 14/403) members of the general public regrading improving the app's design, color, mapping system, and making the app more interactive. The comments were:

Enhance the graphics to be more aesthetically pleasing so that many would attract to use it often; The app is nice. Though it should be more colorful to attract millennial students or even kids/teen; The UI (user-interface) seems pretty bare, so maybe make it a bit more appealing; Hope you can make this more colorful and interactive.

Improve the map and pins; The colors used in the mosquito bites probable cases and the other should be modified because red and orange kind of looks like the same; Please change the color of the pins make it more unique and distinct.

3.4.f. WIFI connection and app size

Another theme was concerns regarding the limited access to WIFI connection and the huge size of the app were raised by 6 (1.49%, 6/403) members of the general public:

It is a useful app but what about for people who don't have strong WIFI connection; The app is very useful and quiet fun but what about the people who don't have strong WIFI and people who lives in areas with a lot of mosquitoes; I don't think the app will be widely used in the Philippines. Seeing that only 50% of the population has access to the internet constantly.

I think there are flaws in a user inputted app in which it may differ on the number of users, their responsibility to respond to dengue using this app. I am not sure either if the PDFs and the Videos that supposedly can play without internet are required since I assume this will take a lot of space within the phone's storage; Possible can you make the app smaller in size?

3.5.g. Data credibility, and user security and privacy

The last, but probably one of the most important themes that emerged was concerns regarding data security and privacy issues which was raised by a member of health experts (1.67%, 1/60) and 4 (0.99%, 4/403) members of the general public:

How can we prevent the abuse of misinformation and credibility of the app? How can we ensure that no one person is simply placing "pins" just for the sake of it; How will you verify if a certain report from the app is accurate and not a troll?; I just think that the only problem for me is the credibility of where the source of the mosquito bites or cases came from.

Concern regarding validation and data privacy act. Accessibility with all which is not advisable due to discrimination; Maybe not include the person location some people may not want to give the app access to their location; Do not disclose / sell information on private companies/third parties.

Surprisingly, one member of the general public suggested a feature that would help clinicians to deal with patients psychologically.

Add a feature on how to deal with patients i.e. psychologically.

4. Discussion

In total, I have recruited 979 participants which indicate high participation rate among health experts and members of the general public. Mozzify also had high acceptance rate among the participants as indicated by the high mean score ratings (>4 out of 5) in the MARS' app quality, subjective and specific scales, with the highest mean score ratings in information and functionality subscales, recommending app to others, and improving awareness and help-seeking items. Mean difference analyses revealed that total app mean score ratings were the same across ages among health experts and general public. Similar results were found across income categories, and self and family DF history but not gender, among general public, where females had significantly ($p<0.001$) higher mean scores than males. Content analyses of the topics discussed in the individual interviews and focus group discussions revealed eight major themes: positive comments regarding the app's concept, design, information and features; suggestions on adding features like multi-language options and including other

diseases; Android version availability; improvements on the app's content, design and engagement; inclusion of users from low-income and rural areas; Wi-Fi connection and app size concerns, and; data credibility, and user security and privacy issues.

This study extends the pilot study that I conducted in Japan by including a significantly large sample size in an actual setting like the Philippines where DF is endemic []. To our knowledge, Mozzify is the first mobile app on dengue fever that has been tested and introduced in the Philippines, especially in Metro Manila. Our study also provides the first report on the perception of intended users (health experts and members of the general public) regarding the app's usability in terms of its functions, engagement, design, information, subjective and specific qualities during actual and real conditions, in our case, an outbreak.

The high mean score ratings (>4 out of 5) in the MARS' app quality scale, specifically in information and functionality subscales, indicate that the app contains high-quality information from a credible source and excellent functioning, easy-to-learn, navigation, flow, logic, and gestural design. In app-subjective scale, the item, recommending app to others obtained the highest mean score which indicate that the participants had high desire or intention to recommend the app to others. Most importantly, the results in the app-specific scale indicate that the app may be successful in achieving what it intends to achieve. First, improving user's awareness and knowledge on DF symptoms, DF hotspots, DF prevention and management through the use of its ArcGIS reporting and mapping system with spatial analysis, educational videos, worldwide news and links to websites of local and international agencies (World Health Organization (WHO) and Department of Health (DOH)), and DF

chat forum. Second, it encourages help-seeking (healthcare) behavior among the users through its unique and interactive symptoms checker and Google Map-based hospital navigation system (hospitals that have DF express lanes and hospitals that cater Dengvaxia-vaccinated individuals). Third, it improves intentions, and encourages users to develop or perform the preventive measures against dengue fever with its iOS-based Reminders alert program based on Communication for Behavioral Impact (COMBI). It is a comprehensive strategy that uses communication for knowledge to have a significant effect on behavioral change (making people becoming aware, informed, convinced, and then deciding to act, and repeating and maintaining that action) or increased practices against dengue fever.

The similar total app mean score ratings across ages among health experts and general public indicate that Mozzify is acceptable among users of any age (above 18 years). Moreover, the same total app mean score ratings across income categories, and self and family DF history among the members of the general public indicate that Mozzify is acceptable among users of any socio-economic status, and users who had DF or had family member who had DF before or not. Surprisingly, among the general public, females had significantly ($p<0.001$) higher total app mean score ratings than males. Aside from the fact that there were more females (6.3%, 560/885) than males (27%, 239/885) among the general public, the nearly equal distribution of males and females among health experts may also help explain this. Notice that the app mean score ratings between male and female health experts were the same. This suggests that the app mean score ratings between female and male members of the general public would also be the same if they would have had equal sample sizes.

The results of the content analyses of the topics from the individual interviews and focus group discussions revealed some similarities in the results of the individual and group discussions of our pilot study in Japan [21]. Participants found the app concise and relevant, very interesting, well-executed and informative, user-friendly, useful, educational, innovative, well-designed, interactive and unique. However, they also suggested the need for adding features like multi-language options, including other diseases, specifically mosquito-borne diseases; adding alert system; developing an Android version of the app; and, enhancing the app's engagement ability by adding games. I have mentioned in the first trial that I have been planning to design an alert system in the map that would warn the users when they enter or when they are near a barangay/village or area with high DF case incidence and mosquito abundance. I also mentioned that I have been developing an Android version of the app, more language options, and possible inclusions of games to increase usability and engagement among users in the future. I have been considering the idea of including other mosquito-borne diseases (e.g. Malaria, Zika, Chikungunya and Japanese Encephalitis) in the app, hence, the name Mozzify, which was termed after the word mosquito.

Individual interviews and focus group discussions among health experts and general public also introduced some important factors that are need to be considered in the further improvement of the app. First, stable Wi-Fi connection is indeed necessary in most of the features of the app to function. ArcGIS (Arc Geographic Information System) has an offline version of the online map, however, it does not allow users to input mosquito bite reports and DF cases. I also addressed this issue by directly installing the educational videos, and online-sourced evidence-based local and international guidelines on the control, prevention and

treatment and diagnosis of DF in portable document format (PDF). However, it increases the app's size, which I also need to address to distribute the app in Apple Store. Second, and probably the most important, are issues regarding credibility of user's data inputs and user's security and privacy. To ensure credibility of data inputs from the users, I have been designing the mechanism to include email or phone number verification among users when signing up for the app which would allow us to track suspicious accounts. Also, I have been planning to connect with and train healthcare workers to confirm inputted data or users within their barangays or neighborhood. However, I have contemplating if I need to limit the access of the online map that shows DF cases among healthcare providers and local government officials to help in proper planning and mitigation with the affected areas. Lastly, one member of the general public suggested to add a feature that would help clinicians to deal with patients, for example, psychologically. I thought of including this in the feature because recently, it has been reported that patients with DF, especially children, experience depressive and anxiety symptoms during the onset of DF [30]. Thus, a holistic app that not only focus on the physical aspect of DF will be available and of great help to the public, especially parents.

I have identified several imitations of our study. First, the samples were limited to members of general public who were above 18 years old, which indicate that adolescents, who were also part of the target users, were not represented in this sample. Second, majority of the participants, especially the general public were from a private university who belong to families with above average income. Although there were participants from low-income families, future testing of the app should also include participants from below-average-

income families. Third, this study only included school-based participants to represent the general public. Including community-based participants, both from urban and rural communities may also produce different findings and perspective regarding the app. Fourth, majority of the general public were not able to install and test the app using their own mobile phones. This may have limit them to see the strengths and weaknesses of the app and the entire system in general.

In conclusion, I have confirmed that Mozzify is a promising integrated strategic health intervention system for reporting and mapping dengue fever cases, increasing awareness, improving knowledge, changing attitude about dengue fever, and disseminating and sharing information on dengue fever among the general population and health experts. It may also be an effective strategy for knowledge on how to prevent dengue fever to be successfully translated to practice [31]. It could also be used by users of any age group, gender, and socio-economic status. I also learned that in spite of its many strengths and unique features, improvements that are tailored to the needs of the intended users should still be done. This includes adding multi-language options, including other mosquito-borne diseases, developing alert system, developing an Android version, and enhancing the app's engagement ability. Most importantly, these improvements should be done without compromising their security and privacy. In general, based from the findings and the experience of testing the app in an actual environment, once I have completed further improvements, Mozzify could be an appropriate surveillance method in early detection of disease outbreaks in the Philippines and other countries where DF is endemic.

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Chapter 7
Conclusions

I have presented how improving knowledge (symptoms, management, prevention), attitude (susceptibility, severity and risk) and practices (preventive measures against DF) or KAP may reduce the risk for DF. DF which has been known to present physical symptoms among patients, has also been reported recently to be neurovirulent which means that they also experience psychological (high levels of depressive and anxiety symptoms) manifestations during the infection. Thus, to improve the KAP that will reduce the risk for acquiring DF and its psychological symptoms, I developed, Mozzify, an integrated mHealth app for DF case surveillance and KAP-based health communication and behavior modification systems. This chapter presents our conclusions matched with general objectives in each study conducted.

Objective 1. Assess and compare the KAP of pediatric patients with DF and pediatric controls, and adult patients with DF and adult controls, identify the predictors of KAP domains by socio-demographic profiles, clinical parameters, and symptoms, analyze the relationship among the KAP domains, and identify protective factors against DF.

Pediatric and adult patients with DF admitted in three hospitals in Metro Manila, compared with their counterparts, had lower mean scores in the practice domain, and knowledge and attitude were not correlated with practice, highlighting

the importance of behavioral change for knowledge and attitude to have a significant effect on practices against DF. Health programs should focus on translating knowledge and attitudes into more effective practices against DF through behavior change. Many programs continue to focus only on changing people's knowledge and on raising awareness, rather than physical activity programs, which are more successful at producing behavior change. Thus, I recommend two comprehensive health programs that aid the successful translation of knowledge and attitude to better practice. The Communication for Behavioral Impact (COMBI) is a comprehensive strategy that uses communication of knowledge to have a significant effect upon behavioral change (making people becoming aware, informed, convinced, and deciding to act, then repeating and maintaining that action) or increased practices against DF. Moreover, another model that facilitates behavioral change that could increase the translation of attitude to practice among children and adolescents is the Health Belief Model (HBM). This model suggests that a change in behavior can be expected if a person perceives themselves to be at risk or susceptible to the disease (perceived susceptibility), that the disease will have serious consequences (perceived severity), a course of action will minimize consequences (perceived benefits), and the benefits of action will outweigh the cost of barriers (perceived barriers) and self-efficacy. Both models should be used in changing behavior, not only at individual and household levels, but also at the community level, as community participation, including schools and especially among children, is necessary to effectively control the vector mosquitoes.

Objective 2. Estimate the prevalence of depressive and anxiety symptoms among pediatric in-patients with DF and compare it with that among healthy school-based controls, explore the predictors of these symptoms; and identify other self/parent-reported psychiatric manifestations that occur during the infection.

Our study highlights that there was a high prevalence of depressive and anxiety symptoms among pediatric patients with DF compared with controls, due to social and clinical factors which might be associated with DF infection. I also learned that pediatric patients with DF also exhibit psychiatric manifestations such as irritable mood/irritability, visual hallucination, agitation, and aggressiveness like adult patients with DF which has been reported in previous studies. Thus, it is important to screen patients with DF for these psychiatric symptoms, and if necessary, healthcare professionals must refer and encourage them to seek help to avoid long-term post-DF chronic psychiatric complications in the future. However, information on whether these symptoms are present only during the infection and may disappear on their own or may still persist after the infection, is unknown. Thus, longitudinal post-DF recovery studies would provide information on the possibilities that these symptoms may or may not develop to subsequent chronic psychiatric conditions in the future. Most importantly, this study provides benchmark information on the possible causal or direct link between depressive and anxiety symptoms and DF infection among pediatric patients with DF, yet, there is insufficient evidence to draw conclusions. Thus, the potential trauma of hospitalization and not directly DF infection, may have caused the increased depressive and anxiety symptoms among the pediatric patients with DF. Therefore, future

studies must distinguish between children's adverse reactions to hospitalization and psychiatric symptoms due to DF. While RCADS-25 is widely used and psychometrically salient, the lack of further psychiatric assessment among patients with borderline or clinical depressive and anxiety symptoms and who reported the presence of other psychiatric symptoms, hindered us to conclude whether these symptoms were directly due to DF infection or not. More so, determining whether the findings may only be specific to pediatric patients with DF infection or may be extended to children with other serious infectious diseases in general, also remains unknown and needs further studies.

Objective 3. Describe the design and development process of the Mozzify and assess it in terms of engagement and information-sharing abilities, functionality, aesthetics, subjective quality, and perceived impact among public health experts, environment and health-related researchers, and nonclinical or general public participants (end users) in Japan and among health experts and members of the general public in the Philippines.

I have developed and designed a mobile application, Mozzify, which obtained excellent acceptability and ratings among health experts and researchers and the general public which indicate that it is ready for another trial among a larger population in the Philippines. It is a promising integrated strategic health intervention system in DF cases reporting and mapping system, raising knowledge, awareness and attitude and disseminating and sharing information on DF among general population and health experts and encouraging the need to have knowledge on preventive measures against DF successfully translated to practice.

I started to collect data on the longitudinal spatial analysis of DF hotspots in the Philippines as a provision for predictive surveillance feature and the inclusion of other mosquito-borne diseases in the reporting and mapping system in the future. Thus, I also plan to design an alert system in the map that would warn the users when they enter or when they are near a barangay/village or area with high DF case incidence and mosquito abundance. I'm also working on developing an Android version of the app, more language options, and possible inclusions of games to increase usability and engagement among users in the future. Most importantly, I aim that the development of Mozzify will address the lack of available apps that address the limitations in the control and prevention of DF not only in the Philippines but also in other DF and other mosquito-borne disease-endemic countries worldwide.

In the trial and assessment conducted in the Philippines, I have confirmed that Mozzify is a promising integrated strategic health intervention system for reporting and mapping dengue fever cases, increasing awareness, improving knowledge, changing attitude about dengue fever, and disseminating and sharing information on dengue fever among the general population and health experts. It may also be an effective strategy for knowledge on how to prevent dengue fever to be successfully translated to practice. It could also be used by users of any age group, gender, and socio-economic status. I also learned that in spite of its many strengths and unique features, improvements that are tailored to the needs of the intended users should still be done. This includes adding multi-language options, including other mosquito-borne diseases, developing alert system, developing an Android version, and enhancing the app's engagement ability. Most importantly, these improvements should be

done without compromising their security and privacy. In general, based from the findings and the experience of testing the app in an actual environment, once I have completed further improvements, Mozzify could be an appropriate surveillance method in early detection of disease outbreaks in the Philippines and other countries where DF is endemic.

Appendix A

Supplementary File 1. Semi-structured interview transcript

Please follow the instructions and the script.

I. Informed consent

Interviewer:

1. Hi! Good morning. I am/My name is_____. I'm a researcher studying the knowledge, attitudes and practices regarding dengue fever among patients with dengue.

2. I'd like to invite you/your child to join our study. Your/your child's participation in this study is entirely voluntary and you can leave or stop any time you want. This will only take 10 to 15 minutes of your time.

3. If you agree to join, I will just ask you some questions about you and your family, then I will give you a survey questionnaire about knowledge, attitude and practices regarding dengue for you to answer.

-Pause and let the patient and/or parent decide to join or not.

-If yes, ask about the patient's age.

Interviewer:

4. Before we start, can I ask your age, please?

NOTE: verbal assent: ages 7-12 years with informed consent of parent, LAR or caregiver assent form: ages 12-15 years informed consent: age 15 and above (for patients under 18 years old, parents, LAR or caregiver co-sign the informed consent)

-Prepare the informed consent and/or assent form (two copies each)

NOTE: Please follow the script in the Informed consent or Assent form (highlight the foreseeable **risk, incentives, benefits and confidentiality management, and contact numbers for grievance and complaints**).

-Once finished, ask the patient, parent, LAR or guardian if they have questions, then address them.

-Then, ask them to write their name, affix their signature and write the date in the informed consent or assent form in their appropriate sections.

-If the patient cannot read or write, ask for a witness to sign.

-After they've signed, write your name and affix your signature and date today.

II. Profile sheet: Don't force the patient to answer all the questions.

-Write the hospital, room and bed number, attending physician, and date of interview in the Profile sheet.

5. When is your birthday?

6. Are you single or married? (only for adult patients)

- encircle his/her gender.

7. Are you studying? (If yes, proceed to #9; if no, proceed to number #11)

8. What is your grade level? (proceed to # 10)

9. What is the name of your school/company? Where is it located?

10. Are you working? (If yes, go back to #10)

11. Are you living with your family? (If no, ask probing questions if necessary)

12. How many are you in your family?

13. How much is your family's monthly income? (for children, ask their parents, LAR or guardian) (Probe by letting him/her choose among the options: below 10,000 pesos, etc.)

14. May I ask about your diagnosis? (What was your doctor's diagnosis?)

15. When were you admitted here?

16. How long have you been admitted here in the hospital?

17. Is this your first time to have dengue? (If no, probe by asking date, diagnosis and frequency)

18. Is there someone in your family who has dengue now? (If yes, probe by asking hospital information [whether hospitalized or not], admission diagnosis, relationship with him/her, etc.)

19. Is there someone in your family who had dengue before? (If yes, probe by asking hospital information [whether hospitalized or not], admission diagnosis, relationship with him/her, etc.)

20. How do you feel right now? Do you feel feverish? or cold? (if yes, ask for temperature)

21. Do you feel any pain anywhere in your body? (probe by asking each symptom and ask the severity of pain)

NOTE: (Mild (or Grade 1): Transient or mild symptoms; no limitation in activity; no intervention required; **Moderate (or Grade 2)**: Symptom results in mild to moderate limitation in activity; no or minimal intervention required; **Severe (or Grade 3)**: Symptom results in significant limitation in activity; medical intervention may be required.)

22. What is your recent platelet count? (check the medical charts for confirmation)

23. What medicines do you take? (probe by asking treatment interventions like antibiotics, blood transfusion, etc.It may also give clue to other diagnosis)

III. KAP Questionnaire: Please follow this script.

Interviewer:

24. Here is the questionnaire about your knowledge, attitude and practices regarding dengue fever.

25. This questionnaire has 3 parts: 29-item knowledge (dengue symptoms, modes of transmission, preventive practices and disease management), 3-item attitudes (seriousness, risk and prevention) and 12-item practices (mosquito-man contact and eliminating breeding sites).

26. Please put your answer by checking in the appropriate column. Some parts are "yes" or no questions, if you don't know the answer, check I don't know column.

27. Other parts are in a scale of 1 to 5 (Strongly agree, agree, not sure, disagree, strongly disagree) and scale of 1 to 4 (Never, sometimes, always or never).

28. Do you have questions? (If none, please tell the patient to start)

29. If you have questions about the items, please don't hesitate to ask me.

NOTE: If the patient cannot write, ask his/her parent, guardian or LAR to write (only) his/her answers.

-Once finished, check if all items were answered. If there are missed items, ask the patients to answer it.

-Give the dengue pamphlet to the patient and discuss the information in it.

-Ask the patient if they want to receive a copy of the output of this study. If yes, ask for their email address.

- Give a copy of the informed consent to the patient.

-Lastly, give incentives to the patient.

30. Thank you for joining in our study!

NOTE: Do not leave any form with the patient's identifiable information

Supplementary File 2

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Subheading of article
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract *The design, case-control study was mentioned in the abstract*	*Abstract*
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found *A structured abstract that includes background, method, results and conclusion parts which contain balanced and informative summary*	*Abstract*
Introduction			
Background /rationale	2	Explain the scientific background and rationale for the investigation being reported *We explained in the background that assessing knowledge, attitude and practices (KAP) is deemed necessary, yet, at present, to the best of our knowledge, no study has been done to assess the KAP regarding DF in Metro Manila. We also stated that most of KAP studies have included only community-based samples and investigation on samples with clinical or serologically-confirmed DF diagnosis remains inadequate. To our knowledge, only two community-based case-control studies have been done, however, the methods had limitations, collection procedure and self-report bias. Thus, we tried to address these limitations by doing a hospital-based face-to-face interview surveillance among patients with DF through the use of a questionnaire. This would also allow us to capture patients' knowledge and attitude and their family's/household's practices against DF during the onset of the infection. We assumed that during this time, they haven't acquired knowledge on DF and changed their attitude or behaviour toward DF. Moreover, studying this group will provide important benchmark information on identifying and confirming which of the three KAP domains plays a vital role in the presence and spread of disease which, in turn, would help structure more targeted and proactive community-wide disease prevention and control programs.*	*Background*
Objectives	3	State specific objectives, including any prespecified hypotheses *This study aimed to assess and compare the KAP of patients with DF and controls, identify the predictors of KAP domains, analyse the relationship among them, and identify protective factors against DF. The results will be used as springboard in identifying and recommending structure for more targeted and proactive community-wide DF prevention and control programs.* *We hypothesized that patients with DF would have lower levels of KAP than the controls. Clinical variables would be significant predictors of KAP among the paediatric and adult patients with DF. We also hypothesized that patients' knowledge and attitude on DF would not have significant positive relationship with their practices against DF, compared with that of the controls which would imply that low practice levels exposed the patients to the infection.*	*Background*
Methods			
Study design	4	Present key elements of study design early in the paper *We mentioned "This case-control study involved clinically or serologically confirmed patients (paediatrics n = 233; adults n = 17) and community-based controls (paediatrics n = 233; adults n = 17)" in the first sentence of the study and sampling design.*	*Study and Sampling Design*

Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure (N/A), follow-up (N/A), and data collection *Patients with DF were admitted in 3 public tertiary (>100 beds) hospitals in Metro Manila, Philippines: San Lazaro Hospital, a referral facility for Infectious/ Communicable Diseases, Quezon City General Hospital and; Pasay City General Hospital while the controls were community (adults) and school (paediatrics) based samples. Community-based adult controls were compared with adult patients with DF while paediatric patients with DF were compared with school-based Grade 3 to Grade 12 students (8 to 18 years old). The collection was done during the rainy season from 26th July to 26th November 2017 in Metro Manila, Philippines.*	*Study and Sampling Design*
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Paediatric (18 years old and below) and adult in-patients (19 years old and above) had serology-confirmed or clinically diagnosed DF, who were conscious and able to read and write. Excluded were those who were not able to comply with consent procedures, or with life-threatening comorbidities. Controls were sampled individuals who had no signs and clinical symptoms of DF and who had no family member hospitalized for or diagnosed with DF at the time of interview.* *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	*Participant Inclusion and Exclusion Criteria*
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case *We used the 1:1 ratio (one case patient/ one control) with an assumed odds-ratio of ≥2, power (1-ß) of 0.80, 0.05 significance level, Z_{α}=1.96. Community-based adult controls were compared with adult patients with DF while paediatric patients with DF were compared with school-based Grade 3 to Grade 12 students (8 to 18 years old). However, we failed to control potential confounders by matching them in terms of age, gender, grade level because availability and participation rates among the controls were low.*	*Study and Sampling Design*
Variables	7	Clearly define all outcomes, exposures (N/A), predictors, potential confounders (N/A), and effect modifiers(N/A). Give diagnostic criteria, if applicable *Outcome or Response variables are: knowledge (dengue symptoms, modes of transmission, preventive practices and disease management), attitudes (perceived seriousness, risk and prevention) and practices (mosquito-man contact and eliminating breeding sites). Explanatory variables or predictors: age, civil status, gender, educational attainment or employment status, family monthly income and family, self DF history, admitting diagnosis, serologic test results (NS1Ag and BLOT: IgG and IgM), platelet count, DF phase (acute: febrile to critical and recovery phase) and clinical symptoms.*	*Explanatory variables and Response variables*
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group *We used consistent pre-determined instructions and questions using structured forms and pre-tested self-report questionnaire for both the patients and controls.*	*Ethical considerations and data collection procedures*
Bias	9	Describe any efforts to address potential sources of bias *To avoid bias, interviews were done with a consistent pre-determined instructions and questions using structured forms and pre-tested self-report questionnaire. This was done to expect a fairly consistent data from one participant to another.*	*Ethical considerations and data collection procedures*
Study size	10	Explain how the study size was arrived at *All the patients in the three hospitals during the data collection period (July to November) were recruited in the study based from the inclusion criteria.*	

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why *Explanatory variables or predictors were divided into three categories: socio-demographic profile, clinical parameters and clinical data. Each of the variable was divided into categories. For linear regression analysis, the categorical variables were transformed to dummy variables [i.e., 0 or 1]to identify the predictors of KAP domains which are continuous data. Outcome or Response variables, knowledge, attitude and practice were measured by mean score.*	*Statistical and Data Analysis*
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding *Multiple linear regression analysis was done by inputting all explanatory variables in the model using a stepwise method in backward selection to identify significant (P < 0.05) predictors of KAP among patients with DF.*	*Statistical and Data Analysis*
		(*b*) Describe any methods used to examine subgroups and interactions *We compared the groups: paediatric patients and paediatric controls, and adult patients and adult controls by their mean scores in each KAP domain using independent samples t-test.*	*Statistical and Data Analysis*
		(*c*) Explain how missing data were addressed *Data from participants with incomplete or missing responses were not included in the final analysis.*	*Statistical and Data Analysis*
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *We matched the patients with controls according to the total number of patients in the two age-groups (pediatric and adults) but we failed to match them by the frequency in each age category, gender, grade level, etc.* *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	*Study and Sampling Design*
		(*e*) Describe any sensitivity analyses *We did not do any sensitivity analyses in this study. However, we did expert validation and measured the internal consistency of the KAP domains using Cronbach's alpha.*	

Results

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed *Initially, there were 350 patients with DF participated in the study. However, we have excluded those who had incomplete responses (n = 15, 4.3%) and those whose responses came from a family member instead of the patient himself (n = 85, 24.3%).*	*Socio-demographic Profile, clinical parameters and symptoms*
		(b) Give reasons for non-participation at each stage *We have excluded those who had incomplete responses and those whose responses came from a family member instead of the patient himself*	*Socio-demographic Profile, clinical parameters and symptoms*
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders *Please see Table 1. Socio-demographic profile, clinical parameters and clinical symptoms among paediatric and adult patients with DF and paediatric and adult controls*	*Socio-demographic Profile, clinical parameters and symptoms*

		(b) Indicate number of participants with missing data for each variable of interest *We included participants who provided complete responses. We have the same number of participants in all response or outcome variables.*	*Socio-demographic Profile, clinical parameters and symptoms*
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	
		Case-control study—Report numbers in each exposure category, or summary measures of exposure *We just reported the mean scores obtained by each participant subgroup in all the KAP domains. Please see Table 2 Results of independent t-test for the difference of KAP mean scores between patients and controls*	*Mean score difference of knowledge, attitude and practice between patients and controls*
		Cross-sectional study—Report numbers of outcome events or summary measures	
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included *We did not include unadjusted estimates and confounder-adjusted estimates with precision in our study.*	
		(*b*) Report category boundaries when continuous variables were categorized *We did not categorize the outcome variables.*	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period *We did not estimate relative risk or absolute risk in the study.*	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses *Multiple linear regression analysis found significant regression equations in all KAP domains among paediatric patients with DF* *Spearman rank correlation to measure the correlation values among the KAP domains* *All preventive practices were used in a logistic regression analysis to identify protective factors against DF*	*Predictors of knowledge, attitude and practice* *Correlation among knowledge, attitudes and practices* *Protective factors against DF*
Discussion			
Key results	18	Summarise key results with reference to study objectives *The first paragraph of the discussion summarizes the key results*	*Discussion*
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias *We mentioned the limitations in the last paragraph of the discussion. We mentioned small sample size of adult patients with DF; failure to match patients with controls; confounding effect of economic status and hospitalization, and; false positive responses as threats to external validity of the study findings.*	*Discussion*
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence These are our interpretation sin the key results of our study: *1. Being diagnosed with DF, increased their awareness regarding DF and multiple encounters with different health care providers or other patients might have increased their knowledge about DF.*	*Discussion*

		2. The significantly high score obtained by controls in practice domain implies that they had good practice against DF compared with patients with DF which may explain why controls, in general, did not have DF. *3. Both knowledge and attitude did not correlate with the practices against DF of patients with DF which clearly signifies that the translation of knowledge and attitude to practice among patients was poor and this might have exposed them to higher risk of contracting the disease.*	
Generalisability	21	Discuss the generalisability (external validity) of the study results *Some generalisabilities of the results from this study were discussed especially in the larger context like patients with DF in general, pediatric patients with DF.*	*Discussion*
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based This study was supported by the Japan Society for the Promotion of Science (JSPS) Grant-in-Aid for Scientific Research (17H01624, 19H01144), JSPS Core-to-Core Program B. Asia-Africa Science Platforms, and Endowed Chair Program of the Sumitomo Electric Industries Group Corporate Social Responsibility Foundation, which had no role in the design, data collection, statistical analysis, and writing of this manuscript.	*Funding*

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Supplementary File S3. Informed Consent for KAP (English)

CODE: _____

愛媛大学 EHIME UNIVERSITY Ehime University, Japan

INFORMED CONSENT SHEET

Project Title: **Dengue Infection Knowledge, Attitudes and Practices among Patients with Dengue in the Philippines**

1. Objectives

You (and/or your child) has/have been invited to join this research on the Dengue infection knowledge, attitudes and preventive practices among patients with Dengue fever.

2. Participation

2.1. You (and/or your child) will be asked to answer (by writing on the sheet or asked by the researcher/interviewer):

- **a. Profile Sheet** (Personal Information and Dengue-Related Information), and;
- **b. Questionnaire** on Knowledge, Attitudes, and Practices toward Dengue infection.

2.2. You (and/or your child) will be asked to meet the researcher/interviewer _____ time/s during your stay/visit in this hospital.

2.3. Answering interview questions and questionnaire will take 10-15 minutes of your time.

2.4. Participation in this study is entirely voluntary. You (and/or your child) has/have the right to leave the study at any time, without penalty or loss of your benefit (see Incentives). Withdrawal in this study without justifying your decision will not affect your (and/or your child) medical care.

2.5. Signing this form will give permission to the researcher/interviewer, monitor(s), the review board personnel, and the regulatory authority(ies):

a. access to your (or your child's) medical history (history or existing physiological conditions, if any) and;
b. access to your (or your child's) dengue-related records (CBC results: Dengue test, platelet count, symptoms presented, number of days in hospital, etc.) from you directly or from the hospital records.
c. include the data (tests and interview answers) obtained from the patients to analysis even an unexpected exclusion or withdrawal from the study.

2.6. This study will involve Dengue in-patients (clinically diagnosed or diagnosed using kits) at different hospitals in Metro Manila from July to November, 2017.

3. Benefits

CODE:_____

Participation in this study is expected to benefit the researcher and other professionals (scientists, public health officials, physicians, etc.) from the information that we will find in this study.

4. Risk/s

Participation in the study may pose unknown and unforeseeable risks. However, the objectives, as well as methods (survey and interview) have no to minimal foreseeable risks, inconveniences or any negative impact on your (and/or your child's well-being).

5. Incentives

You will receive a snack and some anti-Dengue materials after the interview.

6. Confidentiality

Your (and/or your child's) name and other information will be used only for this study and never will be used for other purposes. Every effort will be made to keep clinical records, research records, and other personal information confidential during the course of data gathering, analysis and publication of this study:

6.1. Each participant will be given a unique code (001-) for information that you (and/or your child) might be identified (in profile sheets, questionnaires and interview sheets).

6.2. Access to sheets that contain your information, such as names and addresses will be given limited access. Access will only be given to the researcher/interviewer, attending physicians and other regulatory authority(ies).

6.3. Data sheets that contain your name and other information will be stored in locked cabinets that only the researcher/interviewer has access to.

6.4. Data will be encoded in a password-protected computer after the study gathering. After the interview, all data sheets that contain your names and other information will be properly disposed.

7. Results Disclosure

7.1. Results of the questionnaires will be disclosed to you (and/or your child) after the interview in an agreed schedule and manner.

7.2. Findings of this study will be sent to you via email upon your request. Please write your email address: _____.

8. Contacts for Questions/Problems

8.1. If you have questions about the study, any problems, if you (and/or your child) experience any unexpected physical or psychological discomforts, or think that something unusual or unexpected is happening, and other relevant information, please don't hesitate to contact the researcher:

Von Ralph Dane Marquez Herbuela
herbuelavonralphdane@gmail/@yahoo.com
09955216252 (Globe)

8.2. This hospital has approved this study, and may be reached through the following contact for information regarding your rights as participants, including grievances and complaints:

San Lazaro Hospital - Research Ethics and Review Unit (SLH-RERU)
Address: 1/F San Lazaro Hospital, Quiricada St., Sta. Cruz, Manila
Email Addresses: slh.iso.reru@gmail.com
Telephone Numbers: +632 310-32-11

9. Permission to Participate

a. For Children as Participants (with Assent Form by the Child)

As parent or legal guardian, I authorize _____ (child's name) to become a participant in the research study described in this form.

Parent or Legal Guardian's Signature Date

_____
Day/month/year

b. For Parents and/or Legal Guardian as Participants

I have read and understood the entire information about this study described in this form (or have been read to me), which are written in English, a language known and spoken by me, and I voluntarily agree to participate in the interview in behalf of my child _____(child's name).

Further, I understand that I have the right to withdraw at any moment in this study without justifying my decision to do so and without affecting my child's medical care

Name and Signature Date

_____
Day/month/year

c. For Participating Individuals: Children (15 to 18 years old) and Adults

I have read and understood the entire information about this study described in this form (or have been read to me), which are written in English, a language known and spoken by me, and I voluntarily agree to participate in the interview.

Further, I understand that I have the right to withdraw at any moment in this study without justifying my decision to do so and without affecting my medical care

CODE:_____

Name and Signature Date

_____
Day/month/year

d. Witness (if patient cannot read or write):

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions, and the foregoing written in English, a language known and spoken by the participant, I confirm that the individual has given consent freely.

Name and Signature of Witness Date

_____

Day/month/year

e. Principal Investigator:

Name and Signature Date

_____
Day/month/year

---

10. Participation 2.5.c. Permission to include the data (interview and questionnaire answers) obtained from the patients to analysis even an unexpected exclusion or withdrawal from the study has been decided.

a. For Children as Participants

As parent or legal guardian, I authorize the researcher/PI of this study to include the data (interview and questionnaire answers) obtained from my child _____to analysis even an unexpected exclusion or withdrawal from the study has been decided.

Parent or Legal Guardian's Signature Date

_____
Day/month/year

b. For Parents and/or Legal Guardian as Participants

I have read and understood the information about this section (or have been read to me) and I authorize the researcher/PI of this study to include the data (interview and questionnaire answers) obtained from my child _____to analysis even an unexpected exclusion or withdrawal from the study has been decided.

CODE:_____

Name and Signature Date

_____
Day/month/year

c. For Participating Individuals: Children and Adults

I have read and understood the information about this section (or have been read to me) and I authorize the researcher/PI of this study to include the data (interview and questionnaire answers) obtained from me to analysis even an unexpected exclusion or withdrawal from the study has been decided.

Name and Signature Date

_____
Day/month/year

Supplementary File S4. Informed Consent for KAP (Filipino)

愛媛大学 EHIME UNIVERSITY

Ehime University, Japan
Department of Civil and Environmental Engineering

INFORMED CONSENT SHEET

CODE:_____

Kaalaman, Saloobin at Gawi tungkol sa Dengue

1. **Layunin**

Kayo po (at/o ang inyong anak) ay inaanyayahan na maging bahagi ng pag-aaral na ito tungkol sa kaalaman, saloobin at gawi tungkol sa sakit na ito.

2. **Pakikibahagi**

2.1. Kayo po (at/o ang inyong anak) ay inaasahang sagutin ang mga tanong sa mga sumusunod (pagsagot sa talatanungan o tanong mula sa tagapanaliksik/interbyuwer):

a. **Profile Sheet** (Personal na Impormasyon at Impormasyon tungkol sa Dengue);
b. **Talatanungan tungkol sa kaalaman, saloobin at gawi tungkol sa Dengue**

2.2. Kayo po (at/o ang inyong anak) ay inaasahang magingbahagi ng pananaliksik na ito _____ beses habang kayo ay nasa/sa inyong pagbisita ospital na ito.

2.3. Ang iyong pakikibhagi sa pag-aaral na ito ay kusang-loob/boluntaryo. Kayo po (at/o ang inyong anak) ay may karapatang tumigil sa pakikibahagi sa pag-aaral na ito anumang oras na inyong nais.

2.4. Ang pagsagot sa mga talatanungan at tanong sa interbyu ay tatagal ng 10 hanggang 15 minuto.

2.5. Ang pagsang-ayon at pagpirma sa consent sheet na ito ay nagbibigay ng permisyon sa tagapanaliksik/interbyuwer ng inyong (o ng inyong anak):

a. kaalaman at impormasyon tungkol sa inyong kondisyon (nakaraan o kasalukuyang pisikal o sikolohikal na kondisyon) at;
b. impormasyong may kinalaman sa dengue (resulta ng CBC: platelet count, mga sintomas na naranasan/nararanasan, araw na inilagi sa ospital, atbp.) mula sa inyo o sa record ng ospital.

c. na isama ang data (pagsusulit at interbyu sheet) na mula sa pasyente sa pag-aanalisa kahit na ang pag-alis o paghinto ng pakikibahagi sa pag- aaral na ito ay napagdesisyunan na.

2.6. Ang itinakdang bilang ng mga magiging bahagi sap ag-aarala na ito ay isang-daan (365) na mga in- at out-patient na may Dengue (klinikal at confirmed na dayagnosis) sa mga ospital sa Metro Manila mula Hulyo hanggang Oktubre.

3. Benepisyo

Ang iyong pakikibahagi sa pananaliksik na ito ay inaasahang makakatulong sa tagapanaliksik at sa iba pang propesyonal (scientists, psychologists, public health officials, mga doctor atbp.) sa pamamagitan ng mga impormasyon mula sa pag-aaral na ito.

4. Panganib or mga Risk

Ang pag-aaral na ito ay maaring makapagdulot ng hindi inaasahang panganib sa mga makikibahagi. Subalit, and mga layunin, gayundin ang mga paraan ng pagkuha ng impormasyon (surbey at interbyu) ay walang nakikinitang panganib, abala o negatibong epekto sa iyo (at/o sa inyong anak).

5. Insentibo

Kayo po ay makakatanggap ng **kaunting pagkain** mula sa tagapanaliksik/interbyuwer bawat pagkatapos ng interbyu.

6. Pangangalaga sa Impormasyon

Ang inyong pangalan (at/o pangalan ng inyong anak) at iba pang impormasyon ay gagamitin lamang sa pag-aaral na ito at hindi kailanman gagamitin para sa ibang layunin. Ang mga impormasyon tungkol sa inyo (at/o ng inyong anak) ay konpidensyal mula sa pagkalap ng mga data, pagsusuri, at paglalathala ng pag-aaral na ito.

6.1. Ang bawat isang makikibahagi sa pag-aaral na ito ay bibigyan ng isang natatanging code (mula 001 hanggang 100) sa mga parte ng interbyu or surbey na mayroong pagkakakilanlan mula sa inyong mga impormasyon.

6.2. Ang akses o pagkita sa mga material na nalalaman ng inyong pagkakakilanlan (hal. Pangalan at tirahan) ay limitado lamang sa tagapanaliksik/interbyuwer, mga doktor at mga awtoridad.

6.3. and mga data sheets na naglalaman ng inyong mga impormasyon ay itatabi sa cabinet na may susi na ang tagapanaliksik o interbyuwer lamang ang maaaring magbukas.

6.4. and mga impormasyon ay ieencode sa isang kompyuter na may password pagkatapos ng pagkakalap ng mga data. Pagkatapos ng pag-aaral na ito, ang lahat ng material na naglalaman ng inyong impormasyon ay maayos na itatapon.

7. Pagbabahagi ng mga resulta

7.1. ang resulta or iskor sa talatanungan ay ibabahagi sa inyo (at/o inyong anak) pagkatapos ng interbyu sa napagkasunduang oras at araw.

7.2. Kailangan at napagkasunduang aksyon (rekomendasyon sa pagbisita sa psychiatrist) ay gagawin kung ang resulta ng iskor sa talatanungan ay nangangailangan ng atensyong medical/klinikal.

7.3. Ang kabuuang resulta ng pag-aaral na ito ay ibabahagi sa inyo kung inyong nais, sa pamamagitan n g email. Paki-sulat ang inyong e-mail:_____.

8. Para sa mga Katanungan

7.1. Kung kayo po (at/o ang inyong anak) ay may mga katanungan tungkol sa pag-aaral na ito, anumang problema, o nakakaranas ng hindi inaasahang kakulangan sa ginhawang pisikal o sikolohikal, o hindi inaasahang pangyayari, at iba pang kaugnay na impormasyon, huwag magdalawang-isip na kontakin ang tagapanaliksik/interbyuwer:

Von Ralph Dane Marquez Herbuela
herbuelavonralphdane@gmail/@yahoo.com
09955216252 (Globe)

7.2. Ang pag-aaral na ito ay iapprubahan ng ospital na ito. Kung kayo ay may katanungan tungkol sa inyong mga karapatan bilang bahagi ng pag-aaral na ito o mga reklamo, maaring pumunta o tumawag sa:

San Lazaro Hospital - Research Ethics and Review Unit (SLH-RERU)
Address: 1/F San Lazaro Hospital, Quiricada St., Sta. Cruz, Manila
Email Addresses: slh.iso.reru@gmail.com
Telephone Numbers: +632 310-32-11

9. Pahintulot Upang Makibahagi

a. (Para sa aking Anak) (Kasama ng Assent form)

Bilang magulang o legal na tagapangalaga, pinahihintulutan ko ang aking anak na si _____(pangalan ng inyong anak) na makibahagi sa pag-aaral na ito.

Pangalan at Lagda ng Magulang o Legal na Tagapangalaga Petsa

_____ _____

b. (Para sa aking Pakikibahagi bilang Magulang o Legal na Tagapangalaga)

Aking nabasa at naintindihan ang lahat ng impormasyon tungkol sa pag-aaral na inilarawan sa papel na ito (o binasa sa akin) at ako ay kusang-loob/boluntaryong makikibahagi sa surbey at interbyu sa ngalan ng aking anak na si _____
(pangalan ng inyong anak).

At higit pa, naiintindihan ko na ako ay may karapatang bawiin ang aking pakikibahagi anumang oras, nang walang kailangang dahilan at hindi makakaapekto sa pangangailangang medikal ng aking anak

Pangalan at Lagda ng Magulang o Legal na Tagapangalaga Petsa

_____ _____

c. (Para sa aking Pakikibahagi) Para sa mga bata (12 to 15 taong gulang) at 18-taong gulang pataas

Aking nabasa at naintindihan ang lahat ng impormasyon tungkol sa pag-aaral na inilarawan sa papel na ito (o binasa sa akin) at ako ay kusang-loob/boluntaryong makikibahagi sa surbey at interbyu.

At higit pa, naiintindihan ko na ako ay may karapatang bawiin ang aking pakikibahagi anumang oras, nang walang kailangang dahilan at hindi makakaapekto sa aking pangangailangang medikal.

Pangalan at Lagda Petsa

_____ _____

d. Saksi (kung ang pasyente ay hindi nkakabasa o nakakasulat):

Aking nasaksahihanang masusing pagbasa ng informed consent form na ito sa potensyal na makikibahagi sa pag-aaral na ito kung saan siya ay binigyan ng karapatang magtanong. Kinukumpirma ko na ang taong gustong makibahagi sa pag-aaral na ito ay malayang nagbigay ng kanyang pahintulot.

Pangalan at Lagda Petsa

_____ _____

e. PI/Interbyuwer/Tagapanaliksik:

Pangalan at Lagda Petsa

_____

10. Pakikibahagi. 2.5.c. permisyon sa tagapanaliksik/interbyuwer na isama ang data (pagsusulit at interbyu sheet) na mula sa pasyente sa pag-aanalisa kahit na ang pag-alis o paghinto ng pakikibahagi sap ag-aaral na ito ay napagdesisyunan na.

a. (Para sa aking Anak)

Bilang magulang o legal na tagapangalaga, pinahihintulutan ko ang tagapanaliksik/interbyuwer na isama ang data (pagsusulit at interbyu sheet) na mula sa aking anak na si_____sa pag-aanalisa kahit na ang pag-alis o paghinto ng pakikibahagi sa pag-aaral na ito ay napagdesisyunan na.

Pangalan at Lagda ng Magulang o Legal na Tagapangalaga Petsa

_____ _____

b. (Para sa aking Pakikibahagi bilang Magulang o Legal na Tagapangalaga)

Aking nabasa at naintindihan ang lahat ng impormasyon tungkol sa pag-aaral na inilarawan sa papel na ito (o binasa sa akin) at pinahihintulutan ko ang tagapanaliksik/interbyuwer na isama ang data (pagsusulit at interbyu sheet) na mula sa aking anak na si_____sa pag-aanalisa kahit na ang pag- alis o paghinto ng pakikibahagi sa pag-aaral na ito ay napagdesisyunan na.

Pangalan at Lagda ng Magulang o Legal na Tagapangalaga Petsa

_____ _____

a. c. (Para sa aking Pakikibahagi):

Aking nabasa at naintindihan ang lahat ng impormasyon tungkol sa pag-aaral na inilarawan sa papel na ito (o binasa sa akin) at ako ay kusang-loob/boluntaryong makikibahagi sa surbey at interbyu.

At higit pa, naiintindihan ko na ako ay may karapatang bawiin ang aking pakikibahagi anumang oras, nang walang kailangang dahilan at hindi makakaapekto sa aking pangangailangang medikal.

Pangalan at Lagda Petsa

_____ _____

Supplementary File S5. Assent form for children 12 to 15 years old (English)

CODE:_____

愛媛大学 EHIME UNIVERSITY Ehime University, Japan

ASSENT FORM SHEET

(12 to 15 years old)

Dengue Infection Knowledge, Attitudes and Practices among Patients with Dengue in the Philippines

Hi!

We are doing a research study about your knowledge, feelings and preventive practices about Dengue infection.

A research study is a way to learn more about people. If you decide that you want to be part of this study, you will be asked to (by writing on the paper or asked by the researcher/interviewer) to tell things about:

a. yourself, like your name, age, and other information using the Profile Sheet;
b. what you know and how you feel regarding Dengue fever and what did/do you do to prevent yourself from getting it.

There are some things about this study you should know. These are talking with the doctors if you have feeling or thinking things that bother you or keep you from doing things that you like to do/doing based on your answers in the questions.

Not everyone who takes part in this study will benefit. A benefit means that something good happens to you. We think these benefits might be to help you let the doctors, your parents and the researcher know the things that bother or worry you and help you cope with this sickness.

When we are finished with this study we will write a report about it. But, don't worry! We will not include your name or that you were in the study so that no one will know about your answers in the questions.

You do not have to be in this study if you do not want to be. You won't get into any trouble if you say no. Your parent(s)/guardian(s) were asked if it is OK for you to be in this study. Even if they say it's OK, it is still your choice whether or not to take part.

If you decide to stop after we begin, that's okay too. You can ask any questions you have, now or later. If you think of a question later, you or your parents can contact me at 09955216252.

1

CODE:_____

Sign this form only if you:

- have understood what you will be doing for this study;
- have understood the foregoing written in English, a language that you have known and spoken;
- have had all your questions answered;
- have talked to your parent(s)/legal guardian about this project, and;
- agree to take part in this research.

I, _____, want to be in this research study.

_____ _____
(Sign your name here) (Date)

Supplementary File S6. Assent form for children 12 to 15 years old (Filipino)

愛媛大学 EHIME UNIVERSITY Ehime University, Japan
Department of Civil and Environmental Engineering

ASSENT FORM SHEET

(12 -15 taong gulang)

Kaalaman, Saloobin at Gawi tungkol sa Dengue

Kumusta?

Kami ay nag-aaral tungkol sa mga kaalaman, saloobin at gawi tungkol sa Dengue.

Ang pananaliksik ay paraan upang malaman at matutuhan ang mga bagay tungkol sa mga tao. Kung gusto mong maging bahagi ng pag-aaral na ito, ikaw ay inaasahang sumagot (sa pamamagitan ng pagsulat or berbal na pagsagot) sa mga tanong ng interbyuwer o tagapanaliksik tungkol sa:

a. iyong sarili, tulad ng iyong pangalan, edad at iba pang impormasyon na nasa Profile Sheet;
b. kaalaman, saloobin at gawi tungkol sa Dengue.

May mga bagay na dapat mong malaman tungkol sap ag-aaral na ito. Ito ay ang pakikipag-usap sa mga doktor kung ikaw ay may mga nararamdaman o naiisip na iyong ikinababahala o pumipigil sa iyo upang gawin ang mga bagay na iyong nais mula sa iyong mga sagot sa mga tanong.

Hindi lahat ng makikibahagi sap ag-aaral na ito ay makakatanggap ng benepisyo mula sa pag-aaral na ito. Para sa amin, ang pag-aaral na ito ay mkakatulong sa iyo upang malaman ng mga doktor, iyong mga magulang at mga tagapanaliksik ang mga bagay na iyong ikinababahala upang matulungan ka sa iyong karamdaman.

Kami ay susulat ng ulat o report pagkatapos ng pag-aaral na ito. Huwag kang mag-alala! Hindi naming isasama o babanggitin ang iyong pangalan at ibang impormasyon tungkol sa iyo. Walang ibang makakaalam na ikaw ay nakibahagi sap ag-aaral na ito.

Hindi mo kailangang sumali sa pag-aaral na ito kung hindi mo nais. Hindi ka mapapahamak kung ayaw mong makibahagi os umali. Kahit na pumayag ang iyong mga magulang o legal na tagapangalaga sa iyong pagsali sa pag-aaral na ito, ang iyong desisyon pa din ang aming tatanggapin.

Kung nais mong ayaw nang sumali sa gitna ng pag-aaral, sa interbyu o pasagot sa mga talatanungan, ito ay okay lang. Pwede kang magtanong kung may mga bagay

kang hindi maintindihan sa interbyu o tungkol sap ag-aaral na ito. Kung ikaw ay may katanungan, maaring kontakin ang interbyuwer/tagapanaliksik sa 09955216252.

Maaari mo lamang pirmahan ang kasunduan na ito kung:

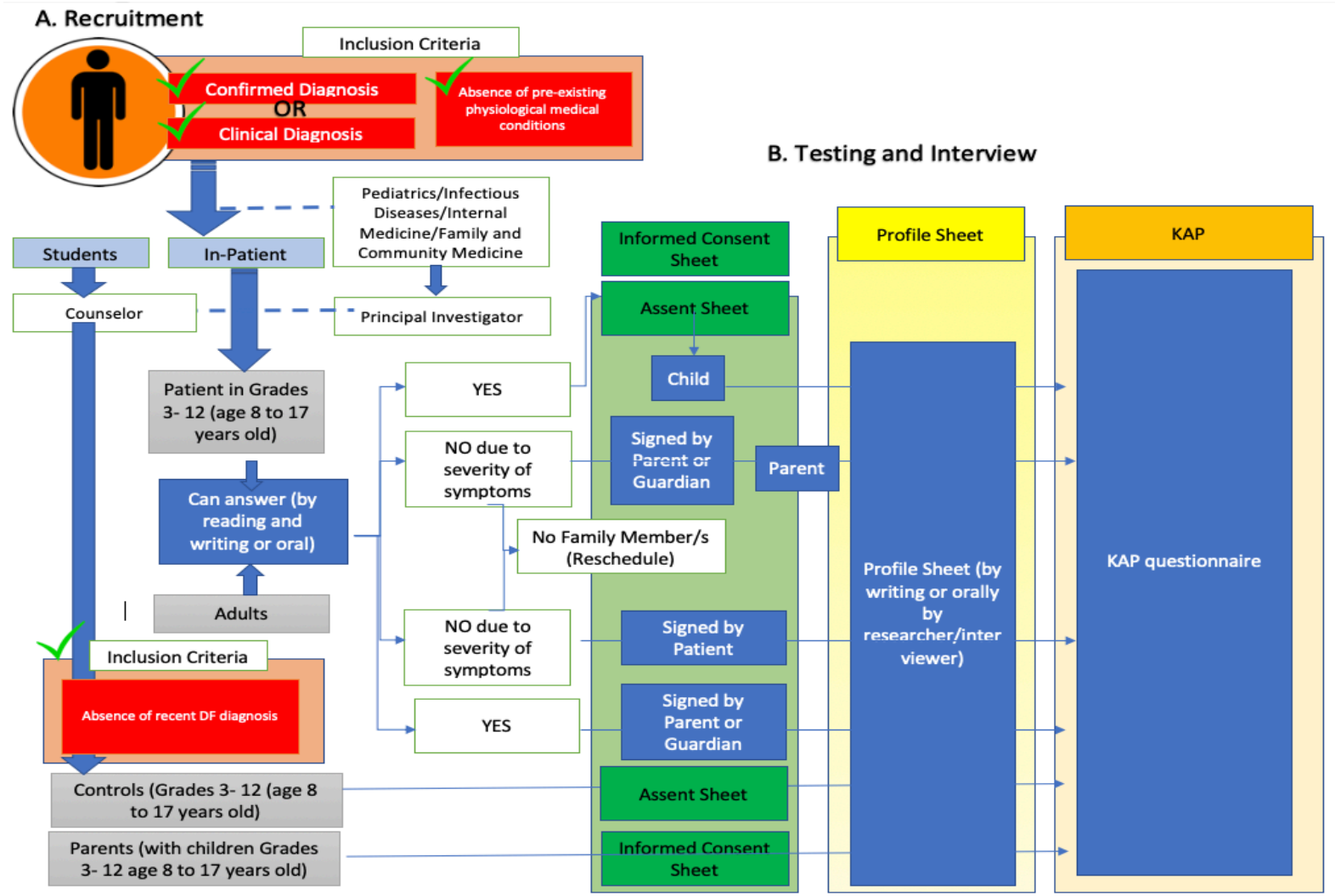
- Iyong naintindihan ang iyong mga gagawin sap ag-aaral na ito,
- Nasagot ang lahat ng iyong mga tanong,
- Nakausap mon a ang iyong magulang o legal na tagapangalaga tungkol sa proyektong ito, at
- Gusto mong makibahagi sap ag-aaral na ito.

Ako si _____ ay nais maging bahagi ng pag-aaral na ito.

_____ _____

(Pangalan at Lagda) (Petsa)

Supplementary Figure S7. Recruitment and testing and interview flow for KAP study.



Supplementary File S8. Patient Profile Sheet

愛媛大学 EHIME UNIVERSITY

Ehime University, Japan
Department of Civil and Environmental Engineering

PATIENT'S PROFILE SHEET

HOSPITAL:_____ **ROOM/BED NUMBER:**_____
ATTENDING PHYSICIAN:_____
DATE OF INTERVIEW/TESTING: (mm/dd/yyyy) ____/_____/____

- ☐ **Admitted (In-Patient)**
- ☐ **Out-Patient**

A. PERSONAL INFORMATION

NAME: (Optional)_____
(Family/Last Name, First/Given Name, Middle Name)

AGE: _____(yrs.) _____(mos.) DATE OF BIRTH: (mm/dd/yyyy) ____/_____/____
CIVIL STATUS: _____ GRADE/YEAR LEVEL OR OCCUPATION:_____
GENDER: M / F LIVING WITH FAMILY: Y / N
FAMILY MEMBERS LIVING WITH: _____ TYPE OF RESIDENCE: _____
HOME ADDRESS: _____
(House number/Unit, Street, Village/Subdivision, Barangay, City,)

SCHOOL/WORK ADDRESS: _____
(House number/Unit, Street, Village/Subdivision, Barangay, City,)
FAMILY MONTHLY INCOME: ____<10,000PHP _____11-20,000PHP ____21-30,000PH
____ 31-40,000PHP ____ 41-50,000PHP ____ > 50,000PHP
IF CHILD, NAME OF PARTICIPATING GUARDIAN/RELATIVE: _____
(Family/Last Name, First/Given Name, Middle Name)
LIVING WITH PATIENT: Y / N IF NO, ADDRESS: _____
RELATIONSHIP WITH PATIENT: _____ AGE: _____ OCCUPATION:_____

B. ANXIETY/DEPRESSION-RELATED INFORMATION

DIAGNOSED WITH MENTAL DISORDER/S OR RELATED CONDITION: Y / N
IF YES, DIAGNOSIS:_____ DATE: (mm/dd/yyyy) ___/____/____
CLINICIAN: _____ CLINIC/HOSPITAL:_____ INTERVENTION:_____

FAMILY MEMBERS WITH MENTAL DISORDER HISTORY OR RELATED SYMPTOMS/DIAGNOSIS:
#: _____ RELATIONSHIP_____ DIAGNOSIS/CASE:_____ YEAR:_____
_____ _____ _____

C. DENGUE-RELATED INFORMATION

ADMITTING DIAGNOSIS: _____BY_____ DATE DIAGNOSED: (mm/dd/yyyy) ___/____/____
DATE ADMITTED: (mm/dd/yyyy) ___/____/____ NUMBER OF DAYS IN HOSP. _____
CURRENT PHASE/STAGE: _____ NUMBER OF DAYS IN HOSP. DURING INT.____

HAS FAMILY MEMBER/S WITH DENGUE: #_____REL.: _____HOSP.:_____
HAS FAMILY MEMBER/S HAD DENGUE: #_____REL.: _____ YEAR:_____
HAD DENGUE BEFORE?: Y / N IF YES, HOW MANY TIMES BEFORE?: _____ YEAR/S:_____

CHIEF COMPLAINTS/ SYMPTOMS PRESENTED (DENGUE-RELATED) AND SEVERITY:
(**Mild (or Grade 1)**: Transient or mild symptoms; no limitation in activity; no intervention required;
]**Moderate (or Grade 2)**: Symptom results in mild to moderate limitation in activity; no or minimal intervention required;
Severe (or Grade 3): Symptom results in significant limitation in activity; medical intervention may be required.)

- ☐ HEADACHE____
- ☐ FEVER (____) _____
- ☐ NAUSEA AND/OR VOMITING____
- ☐ RASH_____
- ☐ PAIN BEHIND EYES
- ☐ MUSCLE AND JOINT PAINS
- ☐ ABDOMINAL PAIN

OTHERS: _____
CBC: _____ PLATELETS: _____

TREATMENT INTERVENTION: _____

Supplementary File S9. Knowledge, Attitude and Practices (KAP) Questionnaire (English)

愛媛大学 EHIME UNIVERSITY

Ehime University, Japan
Department of Civil and Environmental Engineering

INTERVIEW SHEET

Dengue Infection Knowledge, Attitudes and Practices (KAP)

1. Have you prepared to prevent this disease?
   a. Yes b. No

   If yes, What are the things did you do to prevent getting this disease?
   a. Cleaning of house
   b. Getting vaccine
   c. Applying mosquito repellant lotion
   d. Insecticide
   e. Covering containers with water
   f. Putting screen in doors and windows
   g. Mosquito net
   h. Others_____ _____.

B. Dengue Information

2. In your opinion, where do you think you got the disease?
   a. house
   b. school - _____.
   c. Office/workplace
   d. Other place: -
   _____

3. Knowledge of Symptoms (Put a check in your answer)

		YES	NO	I DON'T KNOW
3.1.	Is fever a symptom of dengue?			
3.2.	Is headache a symptom of dengue fever?			
3.3.	Are joint pains a symptom of dengue fever?			
3.4.	Is muscle pain symptom of dengue fever?			
3.5.	Is pain behind the eyes a symptom of dengue fever?			
3.6.	Is rash a symptom of dengue fever?			
3.7.	Is abdominal pain a symptom of dengue fever?			

4. Knowledge of Transmission

		YES	NO	I DON'T KNOW
4.1	Do flies transmit Dengue fever?			
4.2	Do ticks transmit Dengue fever?			
4.3	Do all types of mosquitoes transmit Dengue fever?			
4.4	Do the *Aedes* mosquito transmit Dengue fever?			
4.5	Does person to person contact transmit Dengue fever?			
4.6	Can Dengue fever be transmitted by a blood transfusion?			
4.7	Can Dengue fever be transmitted by a needle stick?			
4.8	Can Dengue fever be transmitted by sexual intercourse?			
4.9	Mosquitoes breed in standing water			
4.10	Window screens and bed nets reduce the risk of being bitten by mosquitoes			
4.11	Insecticide sprays reduce mosquitoes and prevent Dengue			
4.12	Covering water containers reduce mosquitoes			
4.13	Removal of standing water can prevent mosquito Breeding			
4.14	Mosquito repellants prevent mosquitoes			
4.15	Cutting down bushes can reduce mosquitoes and Dengue			
4.16	Pouring chemicals in standing water can kill mosquito Larvae			

4.17. When are the Dengue mosquitoes likely to feed/bite?	
a. Night time	
b. Day time	
c. Both day and night	
d. Don't know	

5. Knowledge of Management

		YES	NO	DON'T KNOW
25.	Would you take Aspirin if you have Dengue?			
26.	Would you get plenty of rest if you have Dengue?			
27.	Would you drink plenty of water if you have Dengue?			

28.	Would you consult a physician if you Dengue			
29.	Is there a treatment for those who have Dengue fever?			

6. Where did you get this/these information? (Please check all that apply)
   - ☐ Social Media (Facebook, Twitter, Instagram, etc.)
   - ☐ TV
   - ☐ Radio
   - ☐ Newspapers
   - ☐ Health brochures
   - ☐ Family
   - ☐ Neighbors
   - ☐ School
   - ☐ Hospitals, doctors and nurses
   - ☐ Barangay and community
   - ☐ Workplace
   - ☐ Health centers
   - ☐ Others_____ _____.

7. Attitude Towards Dengue

		Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
7.1	Dengue is a serious illness					
7.2	You are at risk of getting Dengue					
7.3	Dengue fever can be prevented					

8. Preventive Practices against Dengue fever

	Preventing mosquito-man contact	YES	NO
8.1	Use insecticide sprays to reduce mosquitoes		
8.2	Use professional pest control to reduce mosquitoes		
8.3	Use screen windows to reduce mosquitoes		
8.4	Use fans to reduce mosquitoes		
8.5	Use bed nets to reduce mosquitoes		
8.6	Eliminate standing water around the house to reduce mosquitoes		
8.7	Cut down bushes in the yard to reduce mosquitoes		
8.8	Use mosquito eating fish to reduce mosquitoes		
8.9	Use mosquito coils to reduce mosquitoes		
8.10	Does nothing to reduce mosquitoes		
8.11	Vaccination		

	Eliminating mosquito breeding sites	YES	NO
8.12	Covered water containers in the home		

	Never	Sometimes	Often	Always
8.13. Frequency of cleaning water filled containers and ditches around the house				

Supplementary File S10. Knowledge, Attitude and Practices (KAP) Questionnaire

愛媛大学 EHIME UNIVERSITY

Ehime University, Japan
Department of Civil and Environmental Engineering

INTERVIEW SHEET

Kaalaman, Aktitud at Praktis tungkol sa Dengue Infection

1. Kayo po ba ay naghanda upang makaiwas sa sakit na ito?
   - □ Oo
   - □ Hindi

   Kung Oo, anu-ano ang inyong ginawang paghahanda?
   a. Paglilinis ng bahay
   b. Pagpapabakuna
   c. Pagpapahid ng mosquito repellant lotion
   d. Insecticide
   e. Pagtatakip ng mga imbakan ng tubig
   f. Paglalagay ng screen sa mga bintana
   g. Kulambo
   h. Iba pa_____.

D. Impormasyon tungkol sa Dengue

2. Sa inyong palagay, san po ninyo (o ng inyong anak) nakuha ang Dengue virus/ nakagat ng lamok?
   e. bahay
   f. paaralan - _____.
   g. opisina
   h. ibang lugar: - _____.

3. Kaalaman sa Sintomas (Lagyan ng tsek ang iyong sagot).

	Sintomas ba ng Dengue ang…	Oo	Hindi	Hindi Alam
3.1	lagnat?			
3.2	pananakit ng ulo?			
3.3	pagkirot ng mga kasu-kasuan?			
3.4	pagkirot ng mga kalamnan?			
3.5	pagkirot sa likod ng mga mata?			
3.6	pamamantal?			
3.7	pananakit ng tiyan?			

4. Kaalaman sa Pagkalat

		Oo	Hindi	Hindi Alam
4.1	Naipapasa ba ng langaw ang Dengue?			
4.2	Naipapasa ba ng garapata ang Dengue?			
4.3	Naipapasa ba ng lahat ng klase ng lamok ang Dengue?			
4.4	Naipapasa ba ng lamok na Aedes ang Dengue?			

4.5	Naipapasa ba sa pakikisalamuha sa ibang tao ang Dengue?			
4.6	Naipapasa ba sa pamamagitan ng pagsasalin ng dugo ang Dengue?			
4.7	Naipapasa ba sa pamamagitan ng pagturok ng karayom ang Dengue?			
4.8	Naipapasa ba sa pamamagitan ng pakikipagtalik ang Dengue?			
4.9	Nagpaparami ang mga lamok sa mga nakaimbak na tubig			
4.10	Nababawasan ang panganib na makagat ng mga lamok sa paglalagay ng screen sa mga bintana at sa paggamit ng kulambo			
4.11	Nababawasan ang mga lamok at naiiwasan ang Dengue sa pang-spray ng pamatay-insekto			
4.12	Nababawasan ang mga lamok sa pagtatakip ng lalagyan ng mga tubig			
4.13	Naiiwasan ang pagpaparami ng mga lamok sa pag-aalis ng mga tubig na matagal inimbak			
		Oo	**Hindi**	**Hindi Alam**
4.14	Naiiwasan ang mga lamok sa paggamit ng mosquito repellant			
4.15	Nababawasan ang mga lamok at Dengue sa pagpuputol ng mga talahib			
4.16	Kayang patayin ang mga itlog ng lamok sa pagbubuhos ng kemikal sa naimbak na tubig			

4.17. Kailan nanginginain/nangangagat ang mga lamok na may Dengue?	
a. Sa gabi	☐
b. Sa araw	☐
c. Parehong sa araw at gabi	☐
d. Hindi alam	☐

5. Kaalaman sa Pangangasiwa

		Oo	**Hindi**	**Hindi Alam**
5.1	Iinom ka ba ng Aspirin kung mayroon kang Dengue?			
5.2	Magpapahinga ka ba ng mabuti kung mayroon kang Dengue?			
5.3	Iinom ka ba ng maraming tubig kung mayroon kang Dengue?			
5.4	Kokonsulta ka ba sa doktor kung mayroon kang Dengue?			
5.5	Mayroon na bang gamot para sa mga taong may Dengue?			

6. Saan mo nakuha ang/ang mga impormasyon? (Lagyan ng tsek ang lahat ng naaangkop)

a. Social Media (Facebook, Twitter, Instagram, etc.)
b. Sa TV
c. Radyo
d. Mga pahayagan
e. Brochure tungkol sa kalusugan
f. Pamilya
g. Mga kapitbahay
h. Paaralan
i. Ospital, doctor at nars
j. Barangay at komunidad
k. Lugar ng trabaho
l. Health center
m. Iba pa_____ _.

7. Aktitud patungkol sa Dengue

		Lubos na Di Sumasang-ayon	Di-Sumasang-ayon	Hindi Sigurado	Sumasang-ayon	Lubos na Sumasang-ayon
7.1	Isang malubhang sakit ang Dengue					
7.2	Nasa panganib na makakuha ka ng Dengue					
7.3	Maaaring maiwasan ang Dengue					

8. Praktis para makaiwas laban sa Dengue

	Pag-Iwas sa kontak ng lamok sa tao	Oo	Hindi
8.1	Gumamit ng spray na pamatay-insekto para mabawasan ang mga lamok		
8.2	Gumamit ng propesyonal na pest control upang mabawasan ang mga lamok		
8.3	Gumamit ng screen sa mga bintana upang mabawasan ang mga lamok		
8.4	Gumamit ng pamaypay upang mabawasan ang mga lamok		
8.5	Gumamit ng kulambo upang mabawasan ang mga lamok		
8.6	Tanggalin ang nakaimbak na tubig sa paligid ng bahay upang mabawasan ang mga lamok		
8.7	Putulin ang mga talahib o matataas na damo sa bakuran upang mabawasan ang mga lamok		
8.8	Gumamit ng mga isdang kumakain ng lamok upang mabawasan ang mga lamok		
8.9	Gumamit ng katol upang mabawasan ang mga lamok		
	Pag-Iwas sa kontak ng lamok sa tao	**Oo**	**Hindi**
8.10	Walang ginawa upang mabawasan ang mga lamok		
8.11	Pagpapabakuna		

	Pagtatanggal ng lugar na pinamamahayan ng mga lamok	Oo	Hindi
8.12	Paglalagay ng takip sa mga lalagyan ng tubig sa bahay		

CODE:_____

Sign this form only if you:

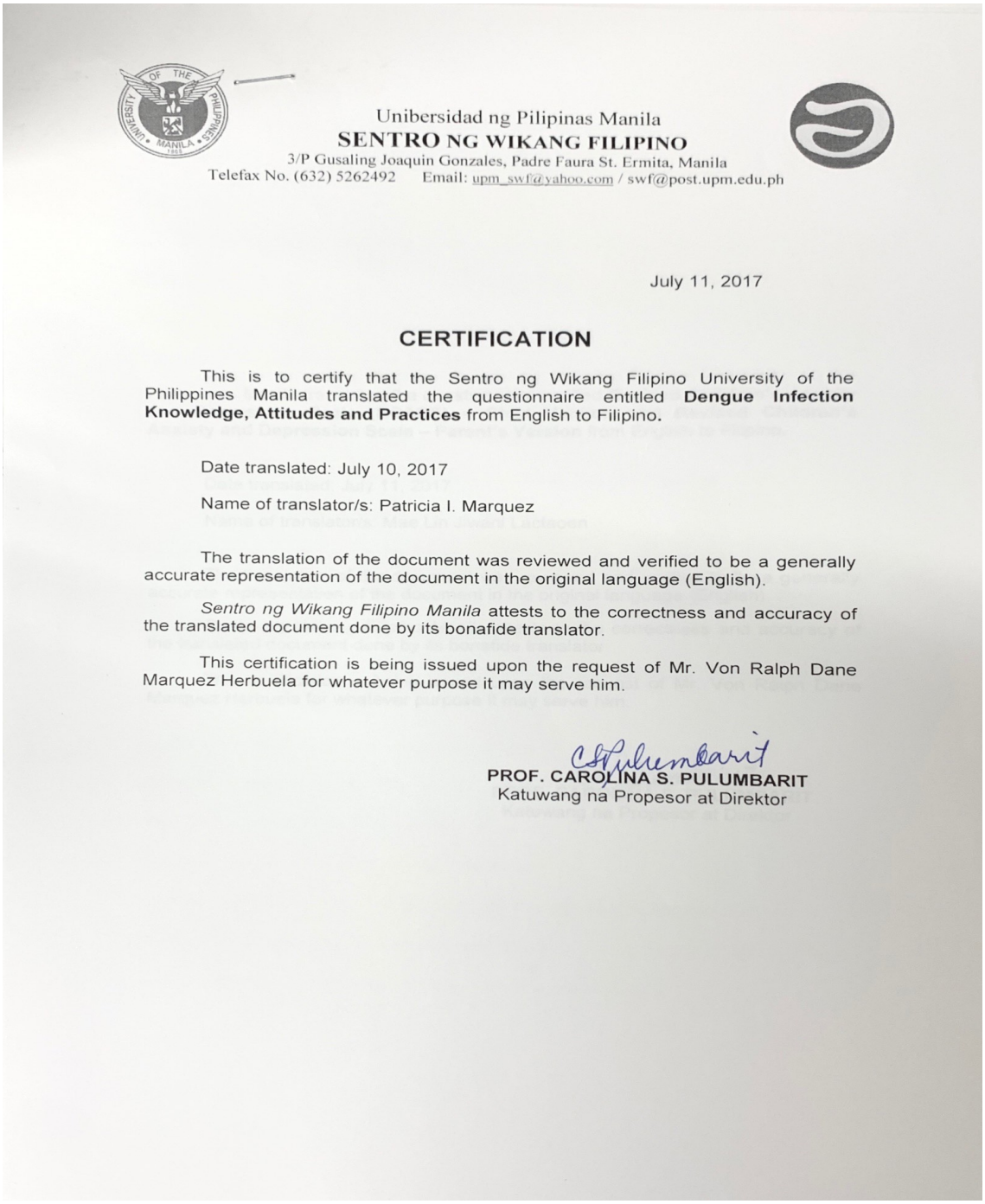
- have understood what you will be doing for this study;
- have understood the foregoing written in English, a language that you have known and spoken;
- have had all your questions answered;
- have talked to your parent(s)/legal guardian about this project, and;
- agree to take part in this research.

I, _____, want to be in this research study.

_____ _____
(Sign your name here) (Date)

	Hindi Kailanman	Minsan	Madalas	Palagi
8.13. Dalas ng paglilinis sa mga lalagyan ng tubig at mga hukay sa paligid ng bahay				

Supplementary File S11. Certificate of Translation (English to Filipino)



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July 11, 2017

CERTIFICATION

This is to certify that the Sentro ng Wikang Filipino University of the Philippines Manila translated the questionnaire entitled **Dengue Infection Knowledge, Attitudes and Practices** from English to Filipino.

Date translated: July 10, 2017

Name of translator/s: Patricia I. Marquez

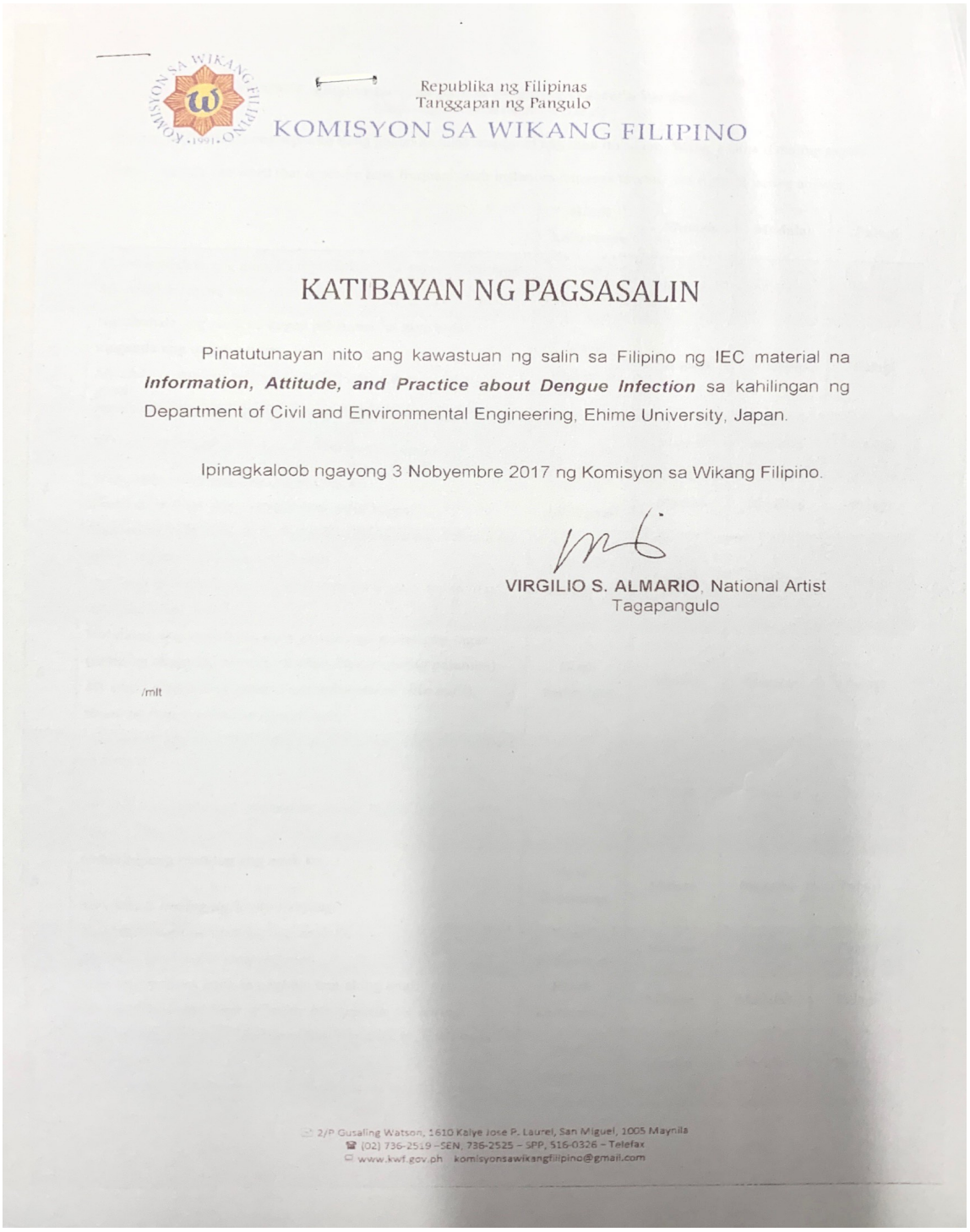
The translation of the document was reviewed and verified to be a generally accurate representation of the document in the original language (English).

Sentro ng Wikang Filipino Manila attests to the correctness and accuracy of the translated document done by its bonafide translator.

This certification is being issued upon the request of Mr. Von Ralph Dane Marquez Herbuela for whatever purpose it may serve him.

PROF. CAROLINA S. PULUMBARIT
Katuwang na Propesor at Direktor

Supplementary File S12. Certificate of Translation (Filipino to English)



Republika ng Filipinas
Tanggapan ng Pangulo
KOMISYON SA WIKANG FILIPINO

KATIBAYAN NG PAGSASALIN

Pinatutunayan nito ang kawastuan ng salin sa Filipino ng IEC material na ***Information, Attitude, and Practice about Dengue Infection*** sa kahilingan ng Department of Civil and Environmental Engineering, Ehime University, Japan.

Ipinagkaloob ngayong 3 Nobyembre 2017 ng Komisyon sa Wikang Filipino.

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Tagapangulo

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Supplementary Figure S13. Dengue Brochure (Patient's Education)

Appendix B

Supplementary File 1. STROBE Statement—checklist of items that should be included in reports of observational studies

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Subheading of article
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract *The design, case-control study was mentioned in the title and the abstract*	*Title and Abstract*
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found *A structured abstract that includes background, method, results and conclusion parts which contain balanced and informative summary*	*Abstract*
Introduction			
Background /rationale	2	Explain the scientific background and rationale for the investigation being reported *We explained in the background that recently, the number of studies reporting this virus to be neurovirulent has increased, associating it with neurological complications in patients with DF. The most prevalent neurological disorder occurring during DF is encephalopathy. Case study reports found that adult patients with DF exhibit delusions with auditory and visual hallucinations, agitation and psychotic symptoms and fears, agitation, irritable affect, psychosis, mania and catatonia. Among the identified encephalopathies, depressive and anxiety symptoms were the most studied among adult patients with DF. Yet, information among pediatric patients with DF remain inadequate. There is still a pressing need to conduct more studies to measure the impact of DF infection on mental health of pediatric patients.*	*Introduction*
Objectives	3	State specific objectives, including any prespecified hypotheses *This study aimed to estimate the prevalence of depressive and anxiety symptoms among pediatric in-patients with DF and compare it with that among healthy school-based youth controls. We also sought to explore the predictors of these symptoms and to identify other self/parent-reported psychiatric manifestations that occur during the infection. We hypothesized that the prevalence of depressive or anxiety symptoms among pediatric patients with DF would be higher than that among youth controls, and predictors would include pain-related DF symptoms including headache, myalgia, arthralgia, retro-/peri-orbital pain and abdominal pain suggesting a causal link between depressive, anxiety and other psychiatric symptoms and DF infection.*	*Introduction*
Methods			
Study design	4	Present key elements of study design early in the paper *We mentioned "This case-control study involved pediatric patients (cases) admitted at three public tertiary (>100 beds) hospitals in Metro Manila, Philippines, from July to November 2017, during the high transmission of DF cases." in the first sentence of the study*	*Study and Sampling Design*

		and sampling design. We also added, "Simultaneously, healthy Grade 3 to 12 students, whose age were similar with the cases, 8 to 17 years old, were also recruited to serve as controls," in the same paragraph.	
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure (N/A), follow-up (N/A), and data collection *Patients with DF were admitted in 3 public tertiary (>100 beds) hospitals in Metro Manila, Philippines: San Lazaro Hospital, a referral facility for Infectious/ Communicable Diseases, Quezon City General Hospital and; Pasay City General Hospital while the controls were compared with school-based Grade 3 to Grade 12 students (8 to 17 years old). The collection was done during the rainy season from July to November 2017 in Metro Manila, Philippines.*	*Study and Sampling Design*
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Paediatric (17 years old and below) who had serology-confirmed or clinically diagnosed DF, who were conscious and able to read and write. Excluded were those who were not able to comply with consent procedures, or with life-threatening comorbidities. Healthy school-based youth controls no current or existing signs and clinical symptoms or diagnosis of DF at the time of interview. Recruitment of the patients and controls was also based on age (age 8–17 years) and grade level (grades 3 to 12) criteria of the Revised Child Anxiety and Depression Scale (RCADS-25), a screening tool for depressive and anxiety symptoms. Eligible participants had no history and/or existing diagnosis of psychiatric and/or medical condition for which they had received medical advice or treatment prior to the interview. Patients with life-threatening comorbidities and controls who were not able to comply with consent procedures were excluded.* *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	*Participant Inclusion and Exclusion Criteria*
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case *We used the 1:1 ratio (one case patient/ one control) with an assumed odds-ratio of ≥2, power (1-β) of 0.80, 0.05 significance level, Z_α=1.96. However, we've included more controls.*	*Study and Sampling Design*
Variables	7	Clearly define all outcomes, exposures (N/A), predictors, potential confounders (N/A), and effect modifiers(N/A). Give diagnostic criteria, if applicable *Outcome or Response variables are: depressive and anxiety symptoms. Explanatory variables or predictors: age, civil status, gender, educational attainment or employment status, family monthly income and family, self DF history, admitting diagnosis, serologic test results (NS1Ag and BLOT: IgG and IgM), platelet count, DF phase (acute: febrile to critical and recovery phase) and clinical symptoms.*	*Explanatory variables and Response variables*

Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group *We used consistent pre-determined instructions and questions using structured forms. We used RCADS-25, a valid and standardized assessment toll for screening depressive and anxiety symptoms in children and adolescents, among cases and controls.*	*Ethical considerations and data collection procedures*
Bias	9	Describe any efforts to address potential sources of bias *To avoid bias, interviews were done with a consistent pre-determined instructions and questions using structured forms and pre-tested self-report questionnaire. This was done to expect a fairly consistent data from one participant to another.*	*Ethical considerations and data collection procedures*
Study size	10	Explain how the study size was arrived at *All the patients in the three hospitals during the data collection period (July to November) were recruited in the study based from the inclusion criteria (grades 3 to 12 and 8 to 17 years old).*	
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why *Explanatory variables or predictors were divided into three categories: socio-demographic profile, clinical parameters and clinical data. Each of the variable was divided into categories. For linear regression analysis, the categorical variables were transformed to dummy variables [i.e., 0 or 1]to identify the predictors of depressive and anxiety symptoms subscales which are continuous data (t-scores).*	*Statistical and Data Analysis*
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding *Multiple linear regression analysis was done by inputting all explanatory variables in the model using a stepwise method in forward selection to identify significant ($P < 0.05$) predictors of depressive and anxiety symptoms among patients with DF.*	*Statistical and Data Analysis*
		(*b*) Describe any methods used to examine subgroups and interactions *We compared the groups: paediatric patients and youth controls by their t-scores n scores in depressive and anxiety subscales using independent samples t-test. We also conducted chi-square analyses and odds-ratio in the prevalence of pediatrics and controls with and without borderline or clinical depressive and anxiety symptoms*	*Statistical and Data Analysis*
		(*c*) Explain how missing data were addressed *Missing responses were addressed during the interview, thus, there's a 100% completion rate among participants as ensured by the primary and co-investigators*	*Statistical and Data Analysis*
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *We matched the patients with controls according to the total number of patients but we failed to match them by the frequency in each age category, gender, grade level, etc.* *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	*Study and Sampling Design*
		(*e*) Describe any sensitivity analyses	

We did not do any sensitivity analyses in this study. However, we did expert validation and measured the internal consistency of the Filipino version of RCADS child and parent forms using Cronbach's alpha among clinical and school-based samples.

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed *Initially, 625 participants (pediatric patients n = 321; youth controls n = 304) were recruited in the study, but only 485 (pediatric patients n = 225; youth controls n = 260) were found eligible, complied to the informed consent procedures and participated in this study.*	*Socio-demographic Profile, clinical parameters and symptoms*
		(b) Give reasons for non-participation at each stage *We have excluded those who were not eligible and did not comply to the informed consent procedures*	*Socio-demographic Profile, clinical parameters and symptoms*
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders *Please see Table 1. Socio-demographic profile, clinical parameters and clinical symptoms among paediatric and youth controls*	*Socio-demographic Profile, clinical parameters and symptoms*
		(b) Indicate number of participants with missing data for each variable of interest *All participants had complete responses. We have the same number of participants in all response or outcome variables.*	*Socio-demographic Profile, clinical parameters and symptoms*
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	
		Case-control study—Report numbers in each exposure category, or summary measures of exposure *We reported the prevalence and mean scores obtained by the participant in depressive and anxiety subscales. Please see Table 2 Prevalence and mean score difference of depressive and anxiety symptoms between pediatric patients with DF and youth controls*	*Mean score difference difference of depressive and anxiety symptoms between pediatric patients with DF and youth controls*
		Cross-sectional study—Report numbers of outcome events or summary measures	
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included *We did not include unadjusted estimates and confounder-adjusted estimates with precision in our study.*	

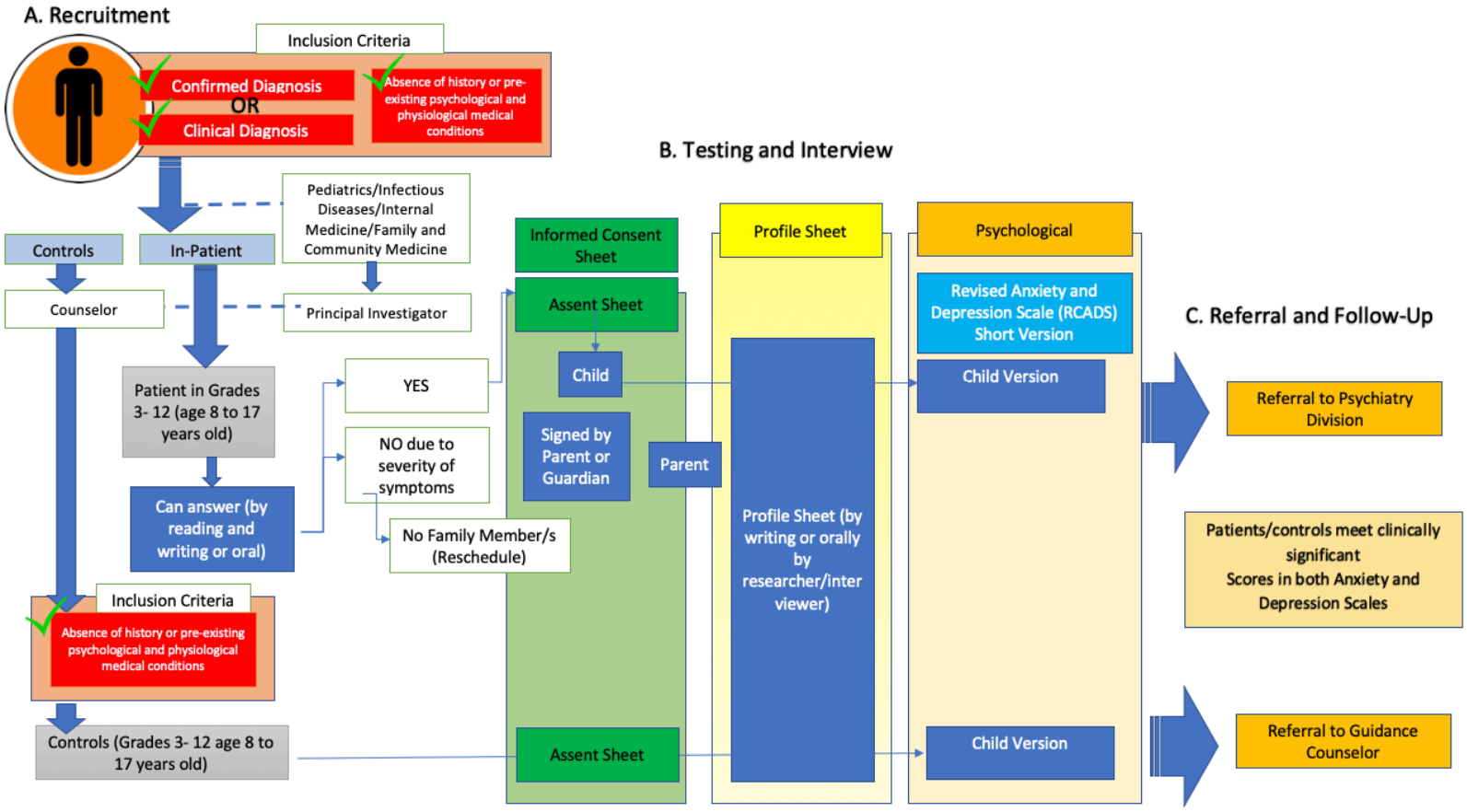
		(*b*) Report category boundaries when continuous variables were categorized *We did not categorize the outcome variables.*	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period *We did not estimate relative risk or absolute risk in the study.*	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses *Multiple linear regression analysis found significant regression equations in depressive and anxiety symptoms subscales domains among paediatric patients with DF* *Patients' reported psychiatric manifestations were analyzed using content analysis, a method that can identify patterns across qualitative data (words or phrases) that can be counted (frequency) for quantitative analyses*	*Predictors of depressive and anxiety symptoms* *Self/parent-reported psychiatric manifestations*
Discussion			
Key results	18	Summarise key results with reference to study objectives *The first paragraph of the discussion summarizes the key results*	*Discussion*
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias *We mentioned the limitations in the last paragraph of the discussion. We mentioned failure to match cases with controls, income and hospital setting, time of collection and lack of further psychiatric assessment by a psychiatrist*	*Discussion*
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence These are our interpretation sin the key results of our study: *1. The prevalence of depressive and anxiety symptoms among pediatric patients with DF was significantly higher than that among youth controls.* *2. The difference between the prevalence of depressive and anxiety symptoms between pediatric patients and youth controls may have brought about by the presence of pain related to myalgia and arthralgia, age, ≤2 days of hospitalization and family history of DF.* *3. The results confirm that similar with adult DF in previous studies, pediatric patients with DF also exhibit psychiatric manifestations like irritable mood/irritability, visual hallucination, agitation and aggressiveness during DF infection*	*Discussion*
Generalisability	21	Discuss the generalisability (external validity) of the study results *Some generalisabilities of the results from this study were discussed especially in the larger context pediatric patients with DF.*	*Discussion*
Other information			

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based *This study was supported by the Japan Society for the Promotion of Science (JSPS) Grant-in-Aid for Scientific Research (17H01624, 19H01144), JSPS Core-to-Core Program B. Asia-Africa Science Platforms, and Endowed Chair Program of the Sumitomo Electric Industries Group Corporate Social Responsibility Foundation, which had no role in the design, data collection, statistical analysis, and writing of this manuscript.*	*Funding*

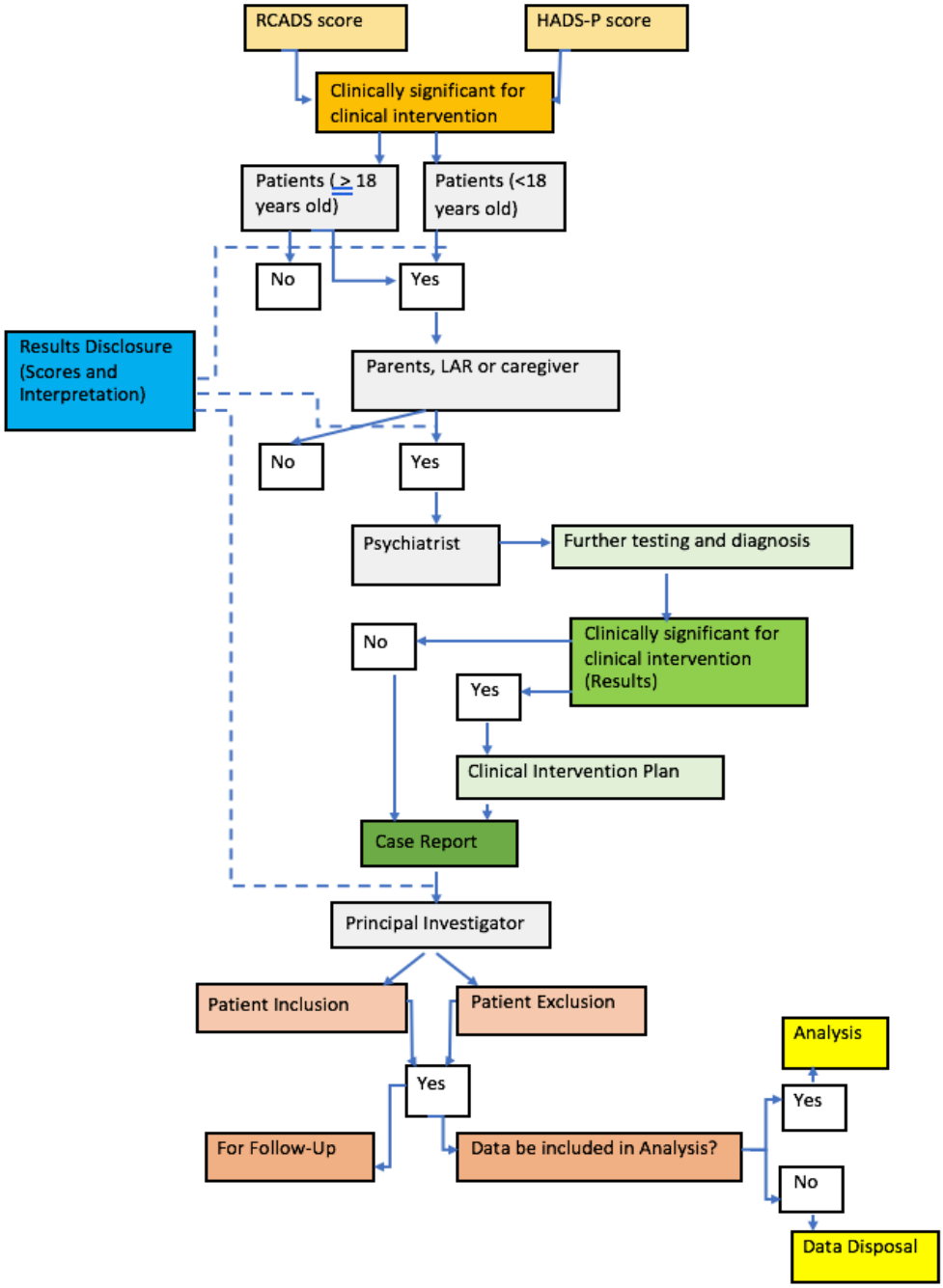
*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Supplementary Figure 2. Recruitment, testing and interview, and referral and follow-up process



Supplementary Figure 3. Recruitment, testing and interview, and referral and follow-up process



Supplementary File 4. Informed consent for depressive and anxiety symptoms (English)

CODE: _____

愛媛大学 EHIME UNIVERSITY Ehime University, Japan

INFORMED CONSENT SHEET

Project Title: **Depressive and anxiety symptoms among pediatric patients with dengue fever**

1. Objectives

You (and/or your child) has/have been invited to join this research on depressive and anxiety symptoms among pediatric patients with dengue fever.

2. Participation

2.1. You (and/or your child) will be asked to answer (by writing on the sheet or asked by the researcher/interviewer):

a. **Profile Sheet** (Personal Information and Dengue-Related Information), and;
b. **Questionnaire** on depressive and anxiety symptoms (Revised Children's Anxiety and Depression Scale – 25 items).

2.2. You (and/or your child) will be asked to meet the researcher/interviewer _____ time/s during your stay/visit in this hospital.

2.3. Answering interview questions and questionnaire will take 10-15 minutes of your time.

2.4. Participation in this study is entirely voluntary. You (and/or your child) has/have the right to leave the study at any time, without penalty or loss of your benefit (see Incentives). Withdrawal in this study without justifying your decision will not affect your (and/or your child) medical care.

2.5. Signing this form will give permission to the researcher/interviewer, monitor(s), the review board personnel, and the regulatory authority(ies):

a. access to your (or your child's) medical history (history or existing physiological conditions, if any) and;
b. access to your (or your child's) dengue-related records (CBC results: Dengue test, platelet count, symptoms presented, number of days in hospital, etc.) from you directly or from the hospital records.
c. include the data (tests and interview answers) obtained from the patients to analysis even an unexpected exclusion or withdrawal from the study.

2.6. This study will involve Dengue in-patients (clinically diagnosed or diagnosed using kits) at different hospitals in Metro Manila from July to November, 2017.

CODE:_____

3. Benefits

Participation in this study is expected to benefit the researcher and other professionals (scientists, public health officials, physicians, etc.) from the information that we will find in this study.

4. Risk/s

Participation in the study may pose unknown and unforeseeable risks. However, the objectives, as well as methods (survey and interview) have no to minimal foreseeable risks, inconveniences or any negative impact on your (and/or your child's well-being).

5. Incentives

You will receive a snack and some anti-Dengue materials after the interview.

6. Confidentiality

Your (and/or your child's) name and other information will be used only for this study and never will be used for other purposes. Every effort will be made to keep clinical records, research records, and other personal information confidential during the course of data gathering, analysis and publication of this study:

6.1. Each participant will be given a unique code (001-) for information that you (and/or your child) might be identified (in profile sheets, questionnaires and interview sheets).

6.2. Access to sheets that contain your information, such as names and addresses will be given limited access. Access will only be given to the researcher/interviewer, attending physicians and other regulatory authority(ies).

6.3. Data sheets that contain your name and other information will be stored in locked cabinets that only the researcher/interviewer has access to.

6.4. Data will be encoded in a password-protected computer after the study gathering. After the interview, all data sheets that contain your names and other information will be properly disposed.

7. Results Disclosure

7.1. Results of the questionnaires will be disclosed to you (and/or your child) after the interview in an agreed schedule and manner.

7.2. Necessary and agreed actions (e.g. referral to psychiatrist) will be considered if scores in questionnaires show significant results impose threat to your (and/or your child's) health and requires immediate medical intervention.

7.3. Findings of this study will be sent to you via email upon your request. Please write your email address: _____.

8. Contacts for Questions/Problems

8.1. If you have questions about the study, any problems, if you (and/or your child) experience any unexpected physical or psychological discomforts, or think that something

unusual or unexpected is happening, and other relevant information, please don't hesitate to contact the researcher:

Von Ralph Dane Marquez Herbuela
herbuelavonralphdane@gmail/@yahoo.com
09955216252 (Globe)

8.2. This hospital has approved this study, and may be reached through the following contact for information regarding your rights as participants, including grievances and complaints:

San Lazaro Hospital - Research Ethics and Review Unit (SLH-RERU)
Address: 1/F San Lazaro Hospital, Quiricada St., Sta. Cruz, Manila
Email Addresses: slh.iso.reru@gmail.com
Telephone Numbers: +632 310-32-11

9. Permission to Participate

a. For Children as Participants (with Assent Form by the Child)

As parent or legal guardian, I authorize _____ (child's name) to become a participant in the research study described in this form.

Parent or Legal Guardian's Signature Date

_____
Day/month/year

b. For Parents and/or Legal Guardian as Participants

I have read and understood the entire information about this study described in this form (or have been read to me), which are written in English, a language known and spoken by me, and I voluntarily agree to participate in the interview in behalf of my child _____(child's name).

Further, I understand that I have the right to withdraw at any moment in this study without justifying my decision to do so and without affecting my child's medical care

Name and Signature Date

_____
Day/month/year

CODE:_____

c. Witness (if patient cannot read or write):

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions, and the foregoing written in English, a language known and spoken by the participant, I confirm that the individual has given consent freely.

Name and Signature of Witness Date

_____

Day/month/year

d. Principal Investigator:

Name and Signature Date

_____

Day/month/year

---

10. Participation 2.5.c. Permission to include the data (interview and questionnaire answers) obtained from the patients to analysis even an unexpected exclusion or withdrawal from the study has been decided.

a. For Children as Participants

As parent or legal guardian, I authorize the researcher/PI of this study to include the data (interview and questionnaire answers) obtained from my child _____to analysis even an unexpected exclusion or withdrawal from the study has been decided.

Parent or Legal Guardian's Signature Date

_____

Day/month/year

b. For Parents and/or Legal Guardian as Participants

I have read and understood the information about this section (or have been read to me) and I authorize the researcher/PI of this study to include the data (interview and questionnaire answers) obtained from my child _____to analysis even an unexpected exclusion or withdrawal from the study has been decided.

Name and Signature Date

_____
Day/month/year

c. For Participating Individuals: Children and Adults

I have read and understood the information about this section (or have been read to me) and I authorize the researcher/PI of this study to include the data (interview and questionnaire answers) obtained from me to analysis even an unexpected exclusion or withdrawal from the study has been decided.

Name and Signature Date

_____
Day/month/year

---

11. Results Disclosure 7.2. Agreement on Necessary and agreed actions (e.g. referral to psychiatrist) will be considered if scores in questionnaires show significant results impose threat to your (and/or your child's) health and requires immediate medical intervention.

a. For Children as Participants

As parent or legal guardian, I agree on necessary and agreed actions (e.g. referral to psychiatrist) that is being considered because my child's _____ scores on the questionnaire show significant results that may impose threat to his/her health and requires immediate medical intervention.

Parent or Legal Guardian's Signature Date

_____
Day/month/year

b. For Parents and/or Legal Guardian as Participants

I have read and understood the information about this section (or have been read to me) and I agree on necessary and agreed actions (e.g. referral to psychiatrist) that is being considered because my child's _____ scores on the questionnaire show significant results that may impose threat to his/her health and requires immediate medical intervention.

Name and Signature Date

_____
Day/month/year

c. For Participating Individuals: Children and Adults

I have read and understood the information about this section (or have been read to me) I agree on necessary and agreed actions (e.g. referral to psychiatrist) will be considered because my

CODE:_____

scores in questionnaires show significant results that may impose threat to my health and requires immediate medical intervention.

Name and Signature Date

_____
Day/month/year

Supplementary File 5. Informed consent for depressive and anxiety symptoms (Filipino)

愛媛大学 EHIME UNIVERSITY

Ehime University, Japan
Department of Civil and Environmental Engineering

INFORMED CONSENT SHEET

CODE:_____

Sikolohikal na sintomas ng mga pasyenteng may Dengue

1. **Layunin**

Kayo po (at/o ang inyong anak) ay inaanyayahan na maging bahagi ng pag-aaral na ito tungkol sa sikolohikal na sintomas na nararanasan ng mga pasyenteng may Dengue at ang kanilang kaalaman, saloobin at gawi tungkol sa sakit na ito.

2. **Pakikibahagi**

2.1. Kayo po (at/o ang inyong anak) ay inaasahang sagutin ang mga tanong sa mga sumusunod (pagsagot sa talatanungan o tanong mula sa tagapanaliksik/interbyuwer):

a. **Profile Sheet** (Personal na Impormasyon at Impormasyon tungkol sa Dengue);
b. **Talatanungan tungkol sa sikolohikal na kalagayan**

2.2. Kayo po (at/o ang inyong anak) ay inaasahang magingbahagi ng pananaliksik na ito _____ beses habang kayo ay nasa/sa inyong pagbisita ospital na ito.

2.3. Ang iyong pakikibhagi sa pag-aaral na ito ay kusang-loob/boluntaryo. Kayo po (at/o ang inyong anak) ay may karapatang tumigil sa pakikibahagi sa pag-aaral na ito anumang oras na inyong nais.

2.4. Ang pagsagot sa mga talatanungan at tanong sa interbyu ay tatagal ng 10 hanggang 15 minuto.

2.5. Ang pagsang-ayon at pagpirma sa consent sheet na ito ay nagbibigay ng permisyon sa tagapanaliksik/interbyuwer ng inyong (o ng inyong anak):

a. kaalaman at impormasyon tungkol sa inyong kondisyon (nakaraan o kasalukuyang pisikal o sikolohikal na kondisyon) at;
b. impormasyong may kinalaman sa dengue (resulta ng CBC: platelet count, mga sintomas na naranasan/nararanasan, araw na inilagi sa ospital, atbp.) mula sa inyo o sa record ng ospital.

c. na isama ang data (pagsusulit at interbyu sheet) na mula sa pasyente sa pag-aanalisa kahit na ang pag-alis o paghinto ng pakikibahagi sa pag- aaral na ito ay napagdesisyunan na.

2.6. Ang itinakdang bilang ng mga magiging bahagi sap ag-aarala na ito ay isang-daan (365) na mga in- at out-patient na may Dengue (klinikal at confirmed na dayagnosis) sa mga ospital sa Metro Manila mula Hulyo hanggang Oktubre.

3. Benepisyo

Ang iyong pakikibahagi sa pananaliksik na ito ay inaasahang makakatulong sa tagapanaliksik at sa iba pang propesyonal (scientists, psychologists, public health officials, mga doctor atbp.) sa pamamagitan ng mga impormasyon mula sa pag-aaral na ito.

4. Panganib or mga Risk

Ang pag-aaral na ito ay maaring makapagdulot ng hindi inaasahang panganib sa mga makikibahagi. Subalit, and mga layunin, gayundin ang mga paraan ng pagkuha ng impormasyon (surbey at interbyu) ay walang nakikinitang panganib, abala o negatibong epekto sa iyo (at/o sa inyong anak).

5. Insentibo

Kayo po ay makakatanggap ng **kaunting pagkain** mula sa tagapanaliksik/interbyuwer bawat pagkatapos ng interbyu.

6. Pangangalaga sa Impormasyon

Ang inyong pangalan (at/o pangalan ng inyong anak) at iba pang impormasyon ay gagamitin lamang sa pag-aaral na ito at hindi kailanman gagamitin para sa ibang layunin. Ang mga impormasyon tungkol sa inyo (at/o ng inyong anak) ay konpidensyal mula sa pagkalap ng mga data, pagsusuri, at paglalathala ng pag-aaral na ito.

6.1. Ang bawat isang makikibahagi sa pag-aaral na ito ay bibigyan ng isang natatanging code (mula 001 hanggang 100) sa mga parte ng interbyu or surbey na mayroong pagkakakilanlan mula sa inyong mga impormasyon.

6.2. Ang akses o pagkita sa mga material na nalalaman ng inyong pagkakakilanlan (hal. Pangalan at tirahan) ay limitado lamang sa tagapanaliksik/interbyuwer, mga doktor at mga awtoridad.

6.3. and mga data sheets na naglalaman ng inyong mga impormasyon ay itatabi sa cabinet na may susi na ang tagapanaliksik o interbyuwer lamang ang maaaring magbukas.

6.4. and mga impormasyon ay ieencode sa isang kompyuter na may password pagkatapos ng pagkakalap ng mga data. Pagkatapos ng pag-aaral na ito, ang lahat ng material na naglalaman ng inyong impormasyon ay maayos na itatapon.

7. Pagbabahagi ng mga resulta

7.1. ang resulta or iskor sa talatanungan ay ibababahagi sa inyo (at/o inyong anak) pagkatapos ng interbyu sa napagkasunduang oras at araw.

7.2. Kailangan at napagkasunduang aksyon (rekomendasyon sa pagbisita sa psychiatrist) ay gagawin kung ang resulta ng iskor sa talatanungan ay nangangailangan ng atensyong medical/klinikal.

7.3. Ang kabuuang resulta ng pag-aaral na ito ay ibabahagi sa inyo kung inyong nais, sa pamamagitan n g email. Paki-sulat ang inyong e-mail:_____.

8. Para sa mga Katanungan

7.1. Kung kayo po (at/o ang inyong anak) ay may mga katanungan tungkol sa pag-aaral na ito, anumang problema, o nakakaranas ng hindi inaasahang kakulangan sa ginhawang pisikal o sikolohikal, o hindi inaasahang pangyayari, at iba pang kaugnay na impormasyon, huwag magdalawang-isip na kontakin ang tagapanaliksik/interbyuwer:

Von Ralph Dane Marquez Herbuela
herbuelavonralphdane@gmail/@yahoo.com
09955216252 (Globe)

7.2. Ang pag-aaral na ito ay iapprubahan ng ospital na ito. Kung kayo ay may katanungan tungkol sa inyong mga karapatan bilang bahagi ng pag-aaral na ito o mga reklamo, maaring pumunta o tumawag sa:

San Lazaro Hospital - Research Ethics and Review Unit (SLH-RERU)
Address: 1/F San Lazaro Hospital, Quiricada St., Sta. Cruz, Manila
Email Addresses: slh.iso.reru@gmail.com
Telephone Numbers: +632 310-32-11

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9. Pahintulot Upang Makibahagi

a. (Para sa aking Anak) (Kasama ng Assent form)

Bilang magulang o legal na tagapangalaga, pinahihintulutan ko ang aking anak na si _____(pangalan ng inyong anak) na makibahagi sa pag-aaral na ito.

Pangalan at Lagda ng Magulang o Legal na Tagapangalaga Petsa

_____ _____

b. (Para sa aking Pakikibahagi bilang Magulang o Legal na Tagapangalaga)

Aking nabasa at naintindihan ang lahat ng impormasyon tungkol sa pag-aaral na inilarawan sa papel na ito (o binasa sa akin) at ako ay kusang-loob/boluntaryong makikibahagi sa surbey at interbyu sa ngalan ng aking anak na si _____
(pangalan ng inyong anak).

At higit pa, naiintindihan ko na ako ay may karapatang bawiin ang aking pakikibahagi anumang oras, nang walang kailangang dahilan at hindi makakaapekto sa pangangailangang medikal ng aking anak

Pangalan at Lagda ng Magulang o Legal na Tagapangalaga Petsa

_____ _____

c. (Para sa aking Pakikibahagi) Para sa mga bata (12 to 15 taong gulang) at 18-taong gulang pataas

Aking nabasa at naintindihan ang lahat ng impormasyon tungkol sa pag-aaral na inilarawan sa papel na ito (o binasa sa akin) at ako ay kusang-loob/boluntaryong makikibahagi sa surbey at interbyu.

At higit pa, naiintindihan ko na ako ay may karapatang bawiin ang aking pakikibahagi anumang oras, nang walang kailangang dahilan at hindi makakaapekto sa aking pangangailangang medikal.

Pangalan at Lagda Petsa

_____ _____

d. Saksi (kung ang pasyente ay hindi nkakabasa o nakakasulat):

Aking nasaksahihanang masusing pagbasa ng informed consent form na ito sa potensyal na makikibahagi sa pag-aaral na ito kung saan siya ay binigyan ng karapatang magtanong. Kinukumpirma ko na ang taong gustong makibahagi sa pag-aaral na ito ay malayang nagbigay ng kanyang pahintulot.

Pangalan at Lagda Petsa

_____ _____

e. PI/Interbyuwer/Tagapanaliksik:

Pangalan at Lagda Petsa

_____

10. Pakikibahagi. 2.5.c. permisyon sa tagapanaliksik/interbyuwer na isama ang data (pagsusulit at interbyu sheet) na mula sa pasyente sa pag-aanalisa kahit na ang pag-alis o paghinto ng pakikibahagi sap ag-aaral na ito ay napagdesisyunan na.

a. (Para sa aking Anak)

Bilang magulang o legal na tagapangalaga, pinahihintulutan ko ang tagapanaliksik/interbyuwer na isama ang data (pagsusulit at interbyu sheet) na mula sa aking anak na si_____sa pag-aanalisa kahit na ang pag-alis o paghinto ng pakikibahagi sa pag-aaral na ito ay napagdesisyunan na.

Pangalan at Lagda ng Magulang o Legal na Tagapangalaga Petsa

_____ _____

b. (Para sa aking Pakikibahagi bilang Magulang o Legal na Tagapangalaga)

Aking nabasa at naintindihan ang lahat ng impormasyon tungkol sa pag-aaral na inilarawan sa papel na ito (o binasa sa akin) at pinahihintulutan ko ang tagapanaliksik/interbyuwer na isama ang data (pagsusulit at interbyu sheet) na mula sa aking anak na si_____sa pag-aanalisa kahit na ang pag- alis o paghinto ng pakikibahagi sa pag-aaral na ito ay napagdesisyunan na.

Pangalan at Lagda ng Magulang o Legal na Tagapangalaga Petsa

_____ _____

a. c. (Para sa aking Pakikibahagi):

Aking nabasa at naintindihan ang lahat ng impormasyon tungkol sa pag-aaral na inilarawan sa papel na ito (o binasa sa akin) at ako ay kusang-loob/boluntaryong makikibahagi sa surbey at interbyu.

At higit pa, naiintindihan ko na ako ay may karapatang bawiin ang aking pakikibahagi anumang oras, nang walang kailangang dahilan at hindi makakaapekto sa aking pangangailangang medikal.

Pangalan at Lagda Petsa

_____ _____

11. Pagbahagi ng mga Resulta 7.2. Kailangan at napagkasunduang aksyon (rekomendasyon sa pagbisita sa psychiatrist) ay gagawin kung ang resulta ng iskor sa talatanungan ay nangangailangan ng atensyong medical/klinikal.

a. (Para sa aking Anak)

Bilang magulang o legal na tagapangalaga, ako ay sumasang-ayon sa kailangan at napagkasunduang aksyon (rekomendasyon sa pagbisita sa psychiatrist) ay gagawin kung ang resulta ng iskor sa talatanungan ng aking anak na si_____ay nangangailangan ng atensyong medikal/klinikal.

Pangalan at Lagda ng Magulang o Legal na Tagapangalaga Petsa

_____ _____

b. (Para sa aking Pakikibahagi bilang Magulang o Legal na Tagapangalaga)

Aking nabasa at naintindihan ang lahat ng impormasyon tungkol sa pag-aaral na inilarawan sa papel na ito (o binasa sa akin) at bilang magulang o legal na tagapangalaga, ako ay sumasang-ayon sa kailangan at napagkasunduang aksyon (rekomendasyon sa pagbisita sa psychiatrist) ay gagawin kung ang resulta ng iskor sa talatanungan ng aking anak na si_____ay nangangailangan ng atensyong medikal/klinikal.

Pangalan at Lagda ng Magulang o Legal na Tagapangalaga Petsa

_____ _____

c. (Para sa aking Pakikibahagi)

Aking nabasa at naintindihan ang lahat ng impormasyon tungkol sa pag-aaral na inilarawan sa papel na ito (o binasa sa akin) at ako ay sumasang-ayon sa kailangan at napagkasunduang aksyon (rekomendasyon sa pagbisita sa psychiatrist) ay gagawin kung ang resulta ng aking iskor sa talatanungan ay nangangailangan ng atensyong medical/klinikal.

Pangalan at Lagda Petsa

_____ _____

Supplementary File 6. Assent form for children 12 to 15 years old (English)

愛媛大学 EHIME UNIVERSITY

Ehime University, Japan
Department of Civil and Environmental Engineering

ASSENT FORM SHEET

(12 to 15 years old)

Project Title: **Depressive and anxiety symptoms among pediatric patients with dengue fever**

Hi!

We are doing a research study about the things that you think and feel.

A research study is a way to learn more about people. If you decide that you want to be part of this study, you will be asked to (by writing on the paper or asked by the researcher/interviewer) to tell things about:

a. yourself, like your name, age, and other information using the Profile Sheet;
b. the things that you feel and think now using the Revised Children's Anxiety and Depression Scale – 25 items.

There are some things about this study you should know. [illegible]se are talking with the doctors if you have feeling or thinking things that bother you or keep you from doing things that you like to do/doing based on your answers in the questions.

Not everyone who takes part in this study will benefit. A benefit means that something good happens to you. We think these benefits might be to help you let the doctors, your parents and the researcher know the things that bother or worry you and help you cope with this sickness.

When we are finished with this study we will write a report about it. But, don't worry! We will not include your name or that you were in the study so that no one will know about your answers in the questions.

You do not have to be in this study if you do not want to be. You won't get into any trouble if you say no. Your parent(s)/guardian(s) were asked if it is OK for you to be in this study. Even if they say it's OK, it is still your choice whether or not to take part.

If you decide to stop after we begin, that's okay too. You can ask any questions you have, now or later. If you think of a question later, you or your parents can contact me at 09955216252.

Sign this form only if you:

- have understood what you will be doing for this study,
- have had all your questions answered,
- have talked to your parent(s)/legal guardian about this project, and
- agree to take part in this research

I, _____, want to be in this research study.

_____ _____

(Sign your name here) (Date)

Supplementary File 7. Assent form for children 12 to 15 years old (Filipino)

愛媛大学 EHIME UNIVERSITY Ehime University, Japan
Department of Civil and Environmental Engineering

ASSENT FORM SHEET

(12 -15 taong gulang)

Sikolohikal na sintomas mga pasyenteng may Dengue

Kumusta?

Kami ay nag-aaral tungkol sa mga bagay na iyong naiisip at nararamdaman.

Ang pananaliksik ay paraan upang malaman at matutuhan ang mga bagay tungkol sa mga tao. Kung gusto mong maging bahagi ng pag-aaral na ito, ikaw ay inaasahang sumagot (sa pamamagitan ng pagsulat or berbal na pagsagot) sa mga tanong ng interbyuwer o tagapanaliksik tungkol sa:

a. iyong sarili, tulad ng iyong pangalan, edad at iba pang impormasyon na nasa Profile Sheet;
b. mga bagay na iyong naiisip at nararamdaman sa kasalukuyan

May mga bagay na dapat mong malaman tungkol sap ag-aaral na ito. Ito ay ang pakikipag-usap sa mga doktor kung ikaw ay may mga nararamdaman o naiisip na iyong ikinababahala o pumipigil sa iyo upang gawin ang mga bagay na iyong nais mula sa iyong mga sagot sa mga tanong.

Hindi lahat ng makikibahagi sap ag-aaral na ito ay makakatanggap ng benepisyo mula sa pag-aaral na ito. Para sa amin, ang pag-aaral na ito ay mkakatulong sa iyo upang malaman ng mga doktor, iyong mga magulang at mga tagapanaliksik ang mga bagay na iyong ikinababahala upang matulungan ka sa iyong karamdaman.

Kami ay susulat ng ulat o report pagkatapos ng pag-aaral na ito. Huwag kang mag-alala! Hindi naming isasama o babanggitin ang iyong pangalan at ibang impormasyon tungkol sa iyo. Walang ibang makakaalam na ikaw ay nakibahagi sap ag-aaral na ito.

Hindi mo kailangang sumali sa pag-aaral na ito kung hindi mo nais. Hindi ka mapapahamak kung ayaw mong makibahagi os umali. Kahit na pumayag ang iyong mga magulang o legal na tagapangalaga sa iyong pagsali sa pag-aaral na ito, ang iyong desisyon pa din ang aming tatanggapin.

Kung nais mong ayaw nang sumali sa gitna ng pag-aaral, sa interbyu o pasagot sa mga talatanungan, ito ay okay lang. Pwede kang magtanong kung may mga bagay

kang hindi maintindihan sa interbyu o tungkol sap ag-aaral na ito. Kung ikaw ay may katanungan, maaring kontakin ang interbyuwer/tagapanaliksik sa 09955216252.

Maaari mo lamang pirmahan ang kasunduan na ito kung:

- Iyong naintindihan ang iyong mga gagawin sap ag-aaral na ito,
- Nasagot ang lahat ng iyong mga tanong,
- Nakausap mon a ang iyong magulang o legal na tagapangalaga tungkol sa proyektong ito, at
- Gusto mong makibahagi sap ag-aaral na ito.

Ako si _____ ay nais maging bahagi ng pag-aaral na ito.

_____ _____

(Pangalan at Lagda) (Petsa)

Supplementary File 8. Patient Profile Sheet

愛媛大学 EHIME UNIVERSITY

Ehime University, Japan
Department of Civil and Environmental Engineering

PATIENT'S PROFILE SHEET

HOSPITAL:_____ **ROOM/BED NUMBER:**_____
ATTENDING PHYSICIAN:_____
DATE OF INTERVIEW/TESTING: (mm/dd/yyyy) ____/_____/____

- ☐ **Admitted (In-Patient)**
- ☐ **Out-Patient**

A. PERSONAL INFORMATION

NAME: (Optional)_____
(Family/Last Name, First/Given Name, Middle Name)

AGE: _____(yrs.) _____(mos.) DATE OF BIRTH: (mm/dd/yyyy) ____/_____/____
CIVIL STATUS: _____ GRADE/YEAR LEVEL OR OCCUPATION:_____
GENDER: M / F LIVING WITH FAMILY: Y / N
FAMILY MEMBERS LIVING WITH: _____ TYPE OF RESIDENCE: _____
HOME ADDRESS: _____
(House number/Unit, Street, Village/Subdivision, Barangay, City,)

SCHOOL/WORK ADDRESS: _____
(House number/Unit, Street, Village/Subdivision, Barangay, City,)
FAMILY MONTHLY INCOME: ____<10,000PHP ____11-20,000PHP ____21-30,000PH
____ 31-40,000PHP ____ 41-50,000PHP ____ > 50,000PHP
IF CHILD, NAME OF PARTICIPATING GUARDIAN/RELATIVE: _____
(Family/Last Name, First/Given Name, Middle Name)
LIVING WITH PATIENT: Y / N IF NO, ADDRESS: _____
RELATIONSHIP WITH PATIENT: _____ AGE: _____ OCCUPATION:_____

B. ANXIETY/DEPRESSION-RELATED INFORMATION

DIAGNOSED WITH MENTAL DISORDER/S OR RELATED CONDITION: Y / N
IF YES, DIAGNOSIS:_____ DATE: (mm/dd/yyyy) ___/____/____
CLINICIAN: _____ CLINIC/HOSPITAL:_____ INTERVENTION:_____

FAMILY MEMBERS WITH MENTAL DISORDER HISTORY OR RELATED SYMPTOMS/DIAGNOSIS:
#: _____ RELATIONSHIP_____ DIAGNOSIS/CASE:_____ YEAR:_____
_____ _____ _____

C. DENGUE-RELATED INFORMATION

ADMITTING DIAGNOSIS: _____BY_____ DATE DIAGNOSED: (mm/dd/yyyy) ___/____/____
DATE ADMITTED: (mm/dd/yyyy) ___/____/____ NUMBER OF DAYS IN HOSP. _____
CURRENT PHASE/STAGE: _____ NUMBER OF DAYS IN HOSP. DURING INT.____

HAS FAMILY MEMBER/S WITH DENGUE: #_____ REL.: _____HOSP.:_____
HAS FAMILY MEMBER/S HAD DENGUE: #_____ REL.: _____ YEAR:_____
HAD DENGUE BEFORE?: Y / N IF YES, HOW MANY TIMES BEFORE?: _____ YEAR/S:_____

CHIEF COMPLAINTS/ SYMPTOMS PRESENTED (DENGUE-RELATED) AND SEVERITY:
(**Mild (or Grade 1)**: Transient or mild symptoms; no limitation in activity; no intervention required;
Moderate (or Grade 2): Symptom results in mild to moderate limitation in activity; no or minimal intervention required;
Severe (or Grade 3): Symptom results in significant limitation in activity; medical intervention may be required.)

- ☐ HEADACHE____
- ☐ FEVER (____) _____
- ☐ NAUSEA AND/OR VOMITING____
- ☐ RASH_____
- ☐ PAIN BEHIND EYES
- ☐ MUSCLE AND JOINT PAINS
- ☐ ABDOMINAL PAIN

OTHERS: _____
CBC: _____ PLATELETS: _____

TREATMENT INTERVENTION: _____

REFERRAL TO PSYCHIATRIST

REFERRED TO PSYCHIATRIC DIVISION: Y / N IF YES, WHY? _____
DATE: (mm/dd/yyyy) ___/____/____ ATTENDING PHYSICIAN:_____
HADS-P SCORE: ANXIETY_____ DEPRESSION:____
RCADS SCORE: ANXIETY_____ DEPRESSION:____
DISCLOSURE TO:

- ☐ PARENTS AND/OR LEGAL REPRESENTATIVE OR GUARDIAN
- ☐ PSYCHIATRISTS

AGREED FOR INTERVENTION:

- ☐ YES (review and understand ICF section 7.2.)
- ☐ NO

CASE REPORT:

- ☐ INCLUSION
- ☐ EXCLUSION, DATA WILL BE: _____KEPT (review and understand ICF section 7.2.)
  _____DISPOSED.

FOLLOW-UP

CASE REPORT:

Supplementary File 9. Revised Child Anxiety and Depression Scale (RCADS) Child Version (English)

Name: _____ Date: _____

RCADS – Short Version

Please put a circle around the word that shows how often each of these things happen to you. There are no right or wrong answers.

1. I feel sad or empty	Never	Sometimes	Often	Always
2. I worry when I think I have done poorly at something	Never	Sometimes	Often	Always
3. I would feel afraid of being on my own at home	Never	Sometimes	Often	Always
4. Nothing is much fun anymore	Never	Sometimes	Often	Always
5. I worry that something awful will happen to someone in my family	Never	Sometimes	Often	Always
6. I am afraid of being in crowded places (like shopping centers, the movies, buses, busy playgrounds)	Never	Sometimes	Often	Always
7. I worry what other people think of me	Never	Sometimes	Often	Always
8. I have trouble sleeping	Never	Sometimes	Often	Always
9. I feel scared if I have to sleep on my own	Never	Sometimes	Often	Always
10. I have problems with my appetite	Never	Sometimes	Often	Always
11. I suddenly become dizzy or faint when there is no reason for this	Never	Sometimes	Often	Always
12. I have to do some things over and over again (like washing my hands, cleaning or putting things in a certain order)	Never	Sometimes	Often	Always
13. I have no energy for things	Never	Sometimes	Often	Always
14. I suddenly start to tremble or shake when there is no reason for this	Never	Sometimes	Often	Always
15. I cannot think clearly	Never	Sometimes	Often	Always
16. I feel worthless	Never	Sometimes	Often	Always
17. I have to think of special thoughts (like numbers or words) to stop bad things from happening	Never	Sometimes	Often	Always
18. I think about death	Never	Sometimes	Often	Always
19. I feel like I don't want to move	Never	Sometimes	Often	Always
20. I worry that I will suddenly get a scared feeling when there is nothing to be afraid of	Never	Sometimes	Often	Always
21. I am tired a lot	Never	Sometimes	Often	Always
22. I feel afraid that I will make a fool of myself in front of people	Never	Sometimes	Often	Always
23. I have to do some things in just the right way to stop bad things from happening	Never	Sometimes	Often	Always
24. I feel restless	Never	Sometimes	Often	Always
25. I worry that something bad will happen to me	Never	Sometimes	Often	Always

Supplementary File 10. Revised Child Anxiety and Depression Scale (RCADS) Child Version (Filipino)

CODE: _____

RCADS-Filipino– Maiksing Bersyon

Pakibilugan ang salitang naglalarawan kung gaano kadalas mangyari sa iyo ang bawat binabanggit. Walang tama o maling sagot.

		Hindi Kailanman	Minsan	Madalas	Palagi
1.	Pakiramdam ko malungkot ako o parang may kulang	Hindi Kailanman	Minsan	Madalas	Palagi
2.	Nag-aalala ako kapag pakiramdam ko hindi ko nagawa nang maayos ang isang bagay	Hindi Kailanman	Minsan	Madalas	Palagi
3.	Natatakot ako kapag mag-isa lang ako sa aming bahay	Hindi Kailanman	Minsan	Madalas	Palagi
4.	Wala nang pwedeng gawin na masaya	Hindi Kailanman	Minsan	Madalas	Palagi
5.	Natatakot ako na may mangyayaring masama sa isang miyembro ng aking pamilya	Hindi Kailanman	Minsan	Madalas	Palagi
6.	Takot akong pumunta sa matataong lugar (tulad ng shopping centers, sinehan, bus, mataong palaruan)	Hindi Kailanman	Minsan	Madalas	Palagi
7.	Iniisip ko kung ano ang sinasabi ng ibang tao tungkol sa akin	Hindi Kailanman	Minsan	Madalas	Palagi
8.	Nahihirapan akong matulog	Hindi Kailanman	Minsan	Madalas	Palagi
9.	Natatakot ako pag mag-isa lang akong matutulog	Hindi Kailanman	Minsan	Madalas	Palagi
10.	Problema ko na wala akong ganang kumain minsan	Hindi Kailanman	Minsan	Madalas	Palagi
11.	Bigla na lang akong nahihilo at nahihimatay nang wala namang dahilan	Hindi Kailanman	Minsan	Madalas	Palagi
12.	Kailangan kong gawin ang ilang bagay ng paulit-ulit (tulad ng paghuhugas ng kamay, paglilinis o pag-aayos ng mga gamit ng may pagkakasunod-sunod)	Hindi Kailanman	Minsan	Madalas	Palagi
13.	Wala akong lakas para sa mga bagay-bagay	Hindi Kailanman	Minsan	Madalas	Palagi
14.	Bigla na lang akong nanginginig nang wala namang dahilan	Hindi Kailanman	Minsan	Madalas	Palagi
15.	Hindi ako makapag-isip ng maayos	Hindi Kailanman	Minsan	Madalas	Palagi
16.	Pakiramdam ko wala akong kwenta	Hindi Kailanman	Minsan	Madalas	Palagi
17.	Kailangan kong mag-isip ng mga magagandang bagay (tulad ng mga numero o salita) upang walang masamang mangyari	Hindi Kailanman	Minsan	Madalas	Palagi
18.	Iniisip ko ang tungkol sa kamatayan	Hindi Kailanman	Minsan	Madalas	Palagi
19.	Pakiramdam ko ayaw kong kumilos	Hindi Kailanman	Minsan	Madalas	Palagi
20.	Nag-aalala ako na bigla akong matatakot kahit wala namang dapat katakutan	Hindi Kailanman	Minsan	Madalas	Palagi
21.	Palagi akong pagod	Hindi Kailanman	Minsan	Madalas	Palagi
22.	Takot akong magmukhang katawa-tawa sa harap ng maraming tao	Hindi Kailanman	Minsan	Madalas	Palagi
23.	Kailangan kong gawin ang ilang bagay sa tamang paraan upang walang masamang mangyari	Hindi Kailanman	Minsan	Madalas	Palagi
24.	Hindi ko kayang pumirmi sa isang lugar	Hindi Kailanman	Minsan	Madalas	Palagi
25.	Natatakot ako na baka may masamang mangyayari sa akin	Hindi Kailanman	Minsan	Madalas	Palagi

Supplementary File 11. Revised Child Anxiety and Depression Scale (RCADS) Parent Version (English)

Name: _____ Date: _____

RCADS-P – Short Version

Please put a circle around the word that shows how often each of these things happen to you. There are no right or wrong answers.

1. My child feels sad or empty	Never	Sometimes	Often	Always
2. My child worries when he/she thinks he/she has done poorly at something	Never	Sometimes	Often	Always
3. My child feels afraid of being alone at home	Never	Sometimes	Often	Always
4. Nothing is much fun for my child anymore	Never	Sometimes	Often	Always
5. My child worries that something awful will happen to someone in the family	Never	Sometimes	Often	Always
6. My child is afraid of being in crowded places (like shopping centers, the movies, buses, busy playgrounds)	Never	Sometimes	Often	Always
7. My child worries what other people think of him/her	Never	Sometimes	Often	Always
8. My child has trouble sleeping	Never	Sometimes	Often	Always
9. My child feels scared to sleep on his/her own	Never	Sometimes	Often	Always
10. My child has problems with his/her appetite	Never	Sometimes	Often	Always
11. My child suddenly becomes dizzy or faint when there is no reason for this	Never	Sometimes	Often	Always
12. My child has to do some things over and over again (like washing hands, cleaning, or putting things in a certain order)	Never	Sometimes	Often	Always
13. My child has no energy for things	Never	Sometimes	Often	Always
14. My child suddenly starts to tremble or shake when there is no reason for this	Never	Sometimes	Often	Always
15. My child cannot think clearly	Never	Sometimes	Often	Always
16. My child feels worthless	Never	Sometimes	Often	Always
17. My child has to think of special thoughts (like numbers or words) to stop bad things from happening	Never	Sometimes	Often	Always
18. My child thinks about death	Never	Sometimes	Often	Always
19. My child feels like he/she doesn't want to move	Never	Sometimes	Often	Always
20. My child worries that he/she will suddenly get a scared feeling when there is nothing to be afraid of	Never	Sometimes	Often	Always
21. My child is tired a lot	Never	Sometimes	Often	Always
22. My child feels afraid that he/she will make a fool of him/herself in front of people	Never	Sometimes	Often	Always
23. My child has to do some things in just the right way to stop bad things from happening	Never	Sometimes	Often	Always
24. My child feels restless	Never	Sometimes	Often	Always
25. My child worries that something bad will happen to him/her	Never	Sometimes	Often	Always

Supplementary File 12. Revised Child Anxiety and Depression Scale (RCADS) Parent Version (Filipino)

CODE: _____

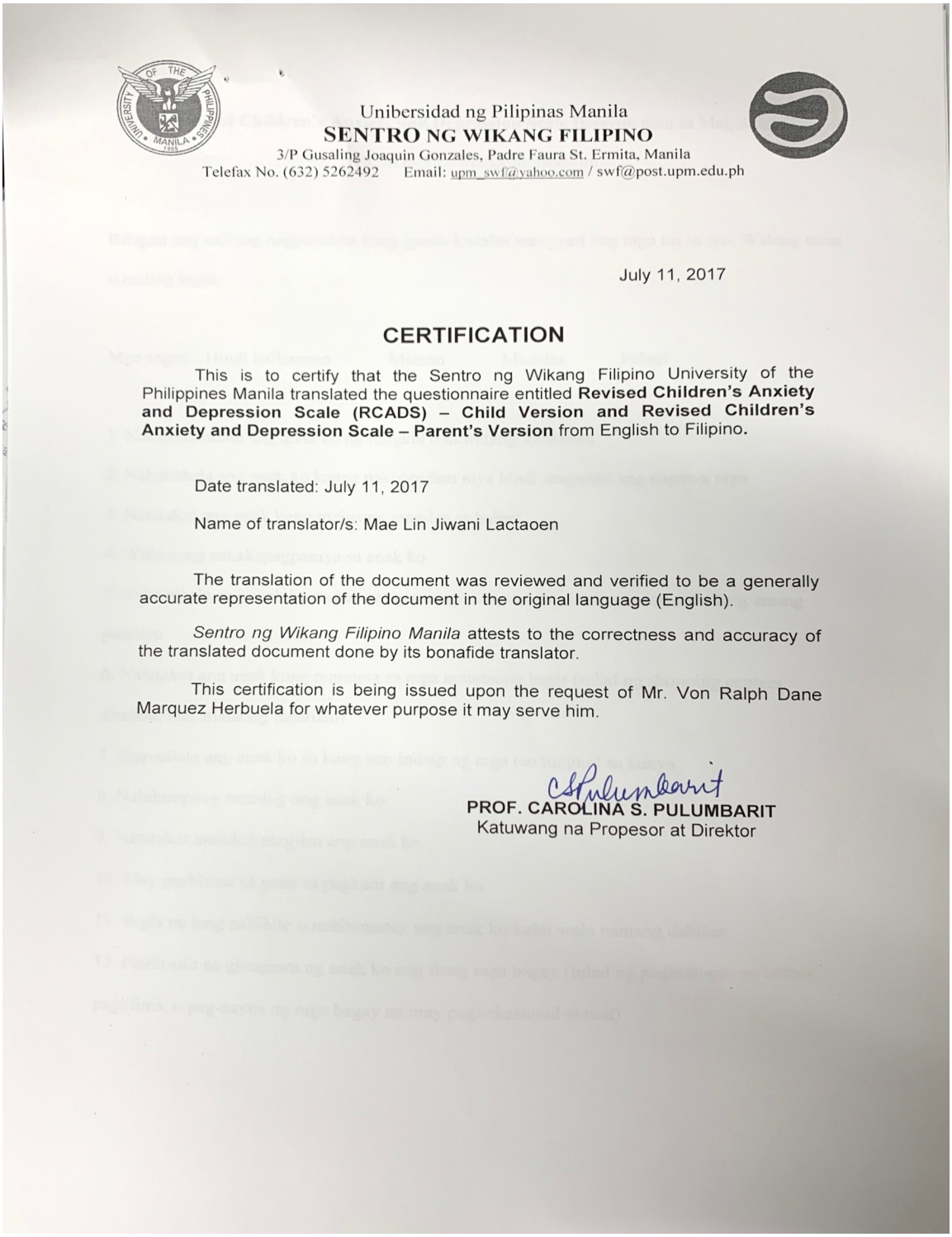
RCADS-P-Filipino-Bersyon para sa Magulang
Maiksing Bersyon

Bilugan ang salitang nagpapakita kung gaano kadalas mangyari ang mga ito sa iyo. Walang tama o maling sagot.

		Hindi kailanman	Minsan	Madalas	Palagi
1.	Nakakaramdam ang anak ko ng lungkot o kawalang-katuturan	Hindi kailanman	Minsan	Madalas	Palagi
2.	Nababahala ang anak ko kapag pakiramdam niya hindi maganda ang nagawa niya	Hindi kailanman	Minsan	Madalas	Palagi
3.	Natatakot ang anak kong maiwang mag-isa sa bahay	Hindi kailanman	Minsan	Madalas	Palagi
4.	Wala nang nakakapagpasaya sa anak ko	Hindi kailanman	Minsan	Madalas	Palagi
5.	Nababahala ang anak ko na baka may mangyaring masama sa isang miyembro ng aming pamilya	Hindi kailanman	Minsan	Madalas	Palagi
6.	Natatakot ang anak kong pumunta sa mga matataong lugar (tulad ng shopping centers, sinehan, bus, mataong palaruan)	Hindi kailanman	Minsan	Madalas	Palagi
7.	Nag-aalala ang anak ko sa kung ano iniisip ng mga tao tungkol sa kanya	Hindi kailanman	Minsan	Madalas	Palagi
8.	Nahihirapang matulog ang anak ko	Hindi kailanman	Minsan	Madalas	Palagi
9.	Natatakot matulog mag-isa ang anak ko	Hindi kailanman	Minsan	Madalas	Palagi
10.	May problema sa gana sa pagkain ang aking anak	Hindi kailanman	Minsan	Madalas	Palagi
11.	Bigla na lang nahihilo o nahihimatay ang anak ko kahit wala namang dahilan	Hindi kailanman	Minsan	Madalas	Palagi
12.	Paulit-ulit na ginagawa ng anak ko ang ilang mga bagay (tulad ng paghuhugas ng kamay, paglilinis, o pag-aayos ng mga bagay na may pagkakasunod-sunod)	Hindi kailanman	Minsan	Madalas	Palagi
13.	Walang lakas ang anak ko para sa ilang bagay	Hindi kailanman	Minsan	Madalas	Palagi
14.	Bigla na lang nanginginig ang anak ko kahit wala namang dahilan	Hindi kailanman	Minsan	Madalas	Palagi
15.	Hindi makapag-isip ng maayos ang anak ko	Hindi kailanman	Minsan	Madalas	Palagi
16.	Pakiramdam ng anak ko wala siyang halaga	Hindi kailanman	Minsan	Madalas	Palagi
17.	Kailangan ng anak kong mag-isip ng mga espesyal na bagay (tulad ng mga numero o salita) upang pigilin ang mga hindi kanais-nais na pangyayari	Hindi kailanman	Minsan	Madalas	Palagi

18.	Iniisip ng anak ko ang tungkol sa kamatayan	Hindi kailanman	Minsan	Madalas	Palagi
19.	Pakiramdam ng anak ko na hindi niya gustong kumilos	Hindi kailanman	Minsan	Madalas	Palagi
20.	Nag-aalala ang anak ko na bigla na lang siyang makakaramdam ng takot kahit na wala namang dapat na ikatakot	Hindi kailanman	Minsan	Madalas	Palagi
21.	Laging pagod ang anak ko	Hindi kailanman	Minsan	Madalas	Palagi
22.	Nakakaramdam ng takot ang anak ko na magmumukha siyang katawa-tawa sa harap ng mga tao	Hindi kailanman	Minsan	Madalas	Palagi
23.	Kailangang gumawa ng tama ang anak ko para mapigilan ang masamang pangyayari	Hindi kailanman	Minsan	Madalas	Palagi
24.	Hindi mapakali ang anak ko	Hindi kailanman	Minsan	Madalas	Palagi
25.	Nag-aalala ang anak ko na baka may masamang mangyayari sa kanya	Hindi kailanman	Minsan	Madalas	Palagi

Supplementary File 13. Certificate of Translation for Revised Child Anxiety and Depression Scale (RCADS) Child and Parent Version (English to Filipino)



Unibersidad ng Pilipinas Manila
SENTRO NG WIKANG FILIPINO
3/P Gusaling Joaquin Gonzales, Padre Faura St. Ermita, Manila
Telefax No. (632) 5262492 Email: upm_swf@yahoo.com / swf@post.upm.edu.ph

July 11, 2017

CERTIFICATION

This is to certify that the Sentro ng Wikang Filipino University of the Philippines Manila translated the questionnaire entitled **Revised Children's Anxiety and Depression Scale (RCADS) – Child Version and Revised Children's Anxiety and Depression Scale – Parent's Version** from English to Filipino.

Date translated: July 11, 2017

Name of translator/s: Mae Lin Jiwani Lactaoen

The translation of the document was reviewed and verified to be a generally accurate representation of the document in the original language (English).

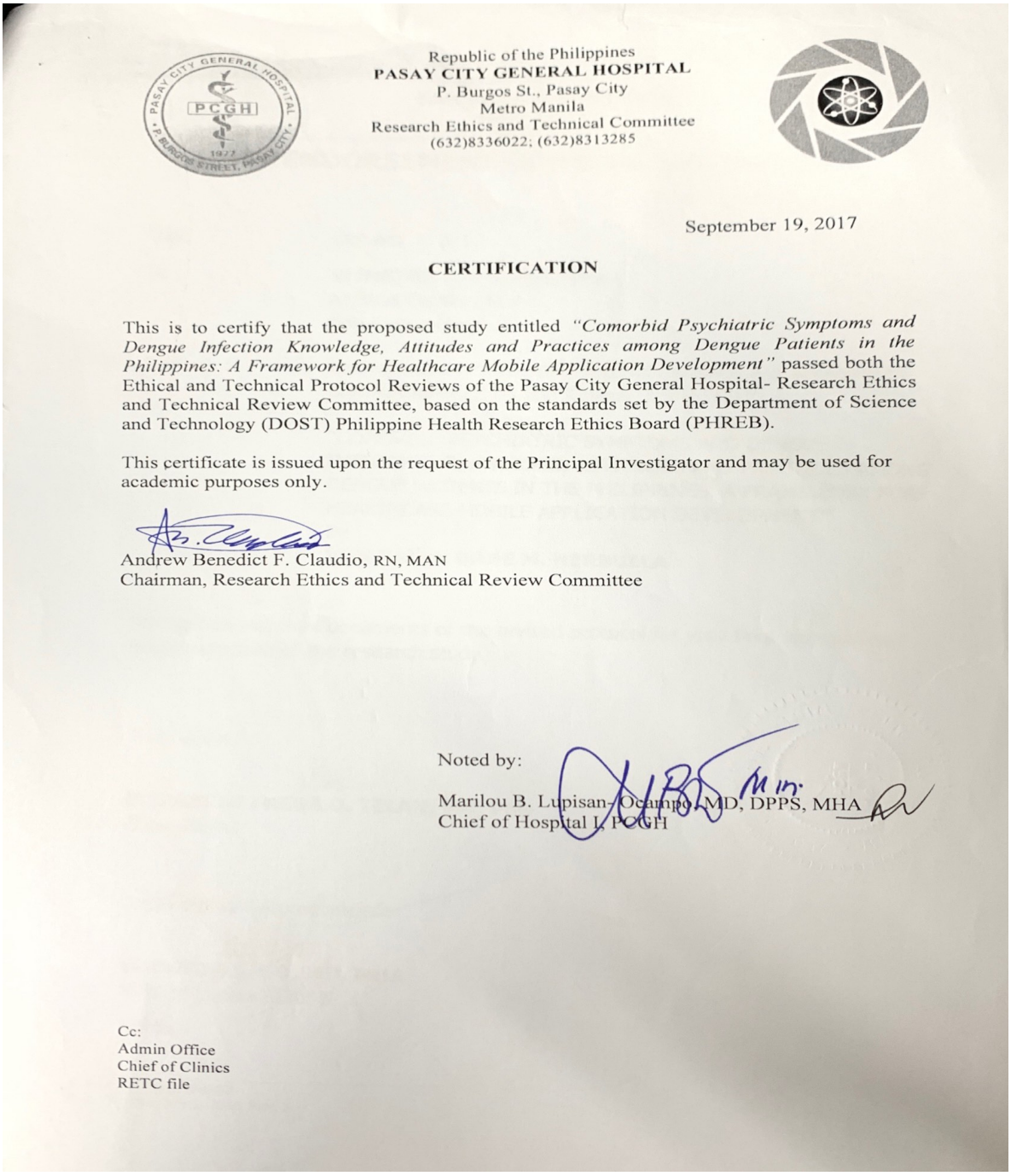
Sentro ng Wikang Filipino Manila attests to the correctness and accuracy of the translated document done by its bonafide translator.

This certification is being issued upon the request of Mr. Von Ralph Dane Marquez Herbuela for whatever purpose it may serve him.

CSPulumbarit

PROF. CAROLINA S. PULUMBARIT
Katuwang na Propesor at Direktor

Supplementary File 14. Certificate of Ethics Approval from Pasay City General Hospital



Republic of the Philippines
PASAY CITY GENERAL HOSPITAL
P. Burgos St., Pasay City
Metro Manila
Research Ethics and Technical Committee
(632)8336022; (632)8313285

September 19, 2017

CERTIFICATION

This is to certify that the proposed study entitled *"Comorbid Psychiatric Symptoms and Dengue Infection Knowledge, Attitudes and Practices among Dengue Patients in the Philippines: A Framework for Healthcare Mobile Application Development"* passed both the Ethical and Technical Protocol Reviews of the Pasay City General Hospital- Research Ethics and Technical Review Committee, based on the standards set by the Department of Science and Technology (DOST) Philippine Health Research Ethics Board (PHREB).

This certificate is issued upon the request of the Principal Investigator and may be used for academic purposes only.

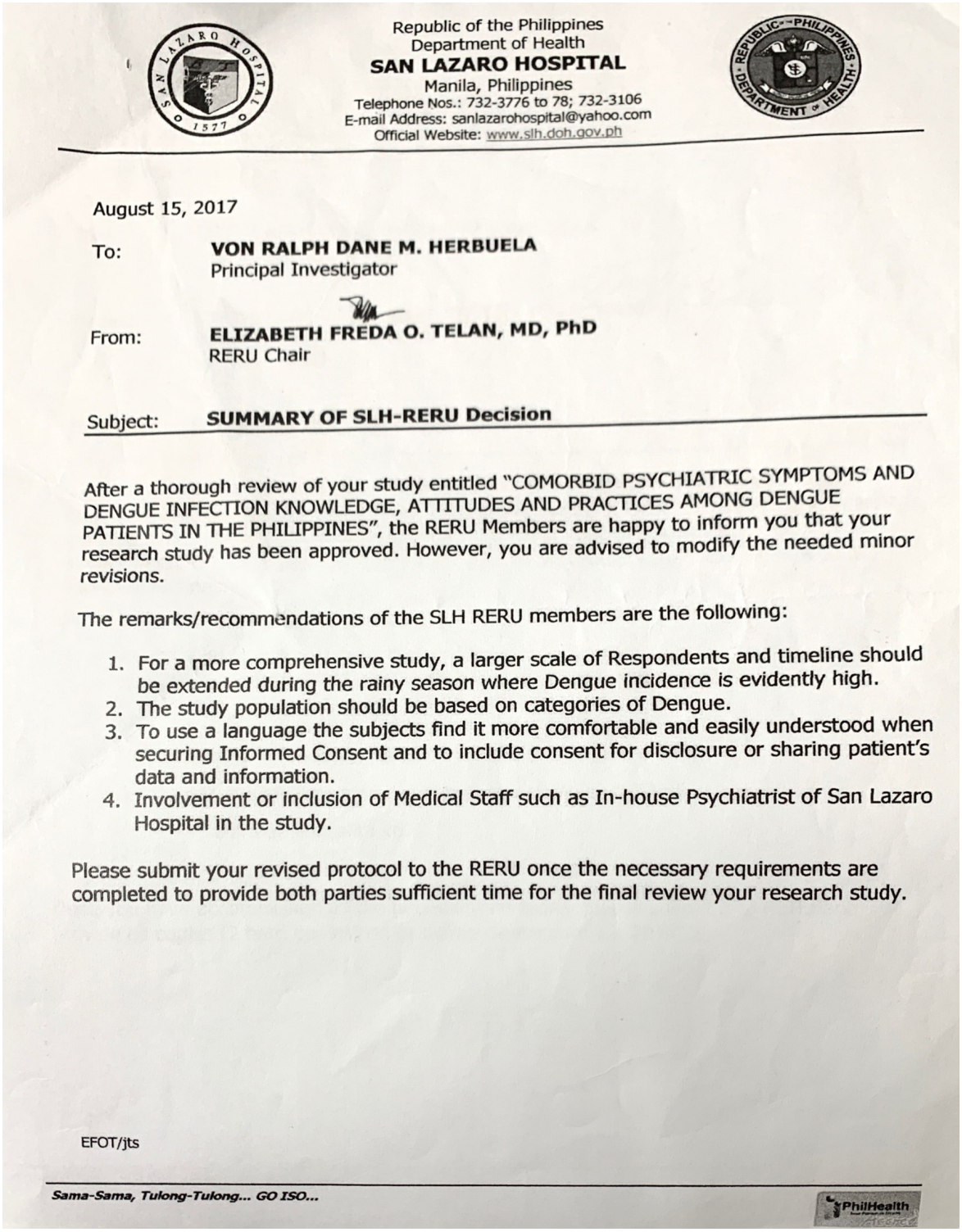
Andrew Benedict F. Claudio, RN, MAN
Chairman, Research Ethics and Technical Review Committee

Noted by:

Marilou B. Lupisan-Ocampo, MD, DPPS, MHA
Chief of Hospital I, PCGH

Cc:
Admin Office
Chief of Clinics
RETC file

Supplementary File 15. Certificate of Ethics Approval from San Lazaro Hospital



Republic of the Philippines
Department of Health
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Manila, Philippines
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Official Website: www.slh.doh.gov.ph

August 15, 2017

To: **VON RALPH DANE M. HERBUELA**
Principal Investigator

From: **ELIZABETH FREDA O. TELAN, MD, PhD**
RERU Chair

Subject: **SUMMARY OF SLH-RERU Decision**

After a thorough review of your study entitled "COMORBID PSYCHIATRIC SYMPTOMS AND DENGUE INFECTION KNOWLEDGE, ATTITUDES AND PRACTICES AMONG DENGUE PATIENTS IN THE PHILIPPINES", the RERU Members are happy to inform you that your research study has been approved. However, you are advised to modify the needed minor revisions.

The remarks/recommendations of the SLH RERU members are the following:

1. For a more comprehensive study, a larger scale of Respondents and timeline should be extended during the rainy season where Dengue incidence is evidently high.
2. The study population should be based on categories of Dengue.
3. To use a language the subjects find it more comfortable and easily understood when securing Informed Consent and to include consent for disclosure or sharing patient's data and information.
4. Involvement or inclusion of Medical Staff such as In-house Psychiatrist of San Lazaro Hospital in the study.

Please submit your revised protocol to the RERU once the necessary requirements are completed to provide both parties sufficient time for the final review your research study.

EFOT/jts

Sama-Sama, Tulong-Tulong... GO ISO...

Appendix C

Multimedia Appendix 1. Mobile Application Rating Scale (MARS)

Mobile Application Rating Scale (MARS)

App Classification

The Classification section is used to collect descriptive and technical information about the app. Please review the app description in Test Flight to access this information.

App Name: _____

Rating this version: _____ **Rating all versions:** _____

Developer: _____

N ratings this version: _____ **N ratings all versions:** _____

Version: _____ **Last update:** _____

Cost - basic version: _____ **Cost - upgrade version:** _____

Platform: ☐☐ iPhone ☐☐ iPad ☐☐ Android

Brief description: _____

_____

Focus: what the app targets (select all that apply)

- ☐☐ Increase Happiness/Well-being
- ☐☐ Mindfulness/Meditation/Relaxation
- ☐☐ Reduce negative emotions
- ☐☐ Depression
- ☐☐ Anxiety/Stress
- ☐☐ Anger
- ☐☐ Behaviour Change
- ☐☐ Alcohol /Substance Use
- ☐☐ Goal Setting
- ☐☐ Entertainment
- ☐☐ Relationships
- ☐☐ Physical health
- ☐☐ Other _____

Theoretical background/Strategies (all that apply)

- ☐☐ Assessment
- ☐☐ Feedback
- ☐☐ Information/Education
- ☐☐ Monitoring/Tracking
- ☐☐ Goal setting
- ☐☐ Advice /Tips /Strategies /Skills training
- ☐☐ CBT - Behavioural (positive events)
- ☐☐ CBT – Cognitive (thought challenging)
- ☐☐ ACT - Acceptance commitment therapy
- ☐☐ Mindfulness/Meditation
- ☐☐ Relaxation
- ☐☐ Gratitude
- ☐☐ Strengths based
- ☐☐ Other _____

Affiliations:

☐☐ Unknown ☐☐ Commercial ☐☐ Government ☐☐ NGO ☐☐ University

Age group (all that apply)

- ☐☐ Children (under 12)
- ☐☐ Adolescents (13-17)
- ☐☐ Young Adults (18-25)
- ☐☐ Adults
- ☐☐ General

Technical aspects of app (all that apply)

- ☐☐ Allows sharing (Facebook, Twitter, etc.)
- ☐☐ Has an app community
- ☐☐ Allows password-protection
- ☐☐ Requires login
- ☐☐ Sends reminders
- ☐☐ Needs web access to function

QUT Queensland University of Technology

Source: Stoyanov, Stoyan R et al. "Mobile app rating scale: a new tool for assessing the quality of health mobile apps." *JMIR mHealth and uHealth* vol. 3,1 e27. 11 Mar. 2015, doi:10.2196/mhealth.3422 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4376132/

YOUNGANDWELL Cooperative Research Centre

Mobile Application Rating Scale (MARS)

App Name: MOZZIFY

App Quality Ratings

The Rating scale assesses app quality on four dimensions. All items are rated on a 5-point scale from "1.Inadequate" to "5.Excellent". Circle the number that most accurately represents the quality of the app component you are rating. Please use the descriptors provided for each response category.

SECTION A

Engagement – fun, interesting, customisable, interactive (e.g. sends alerts, messages, reminders, feedback, enables sharing), well-targeted to audience

1. **Entertainment: Is the app fun/entertaining to use? Does it use any strategies to increase engagement through entertainment (e.g. through gamification)?**
   - 1 Dull, not fun or entertaining at all
   - 2 Mostly boring
   - 3 OK, fun enough to entertain user for a brief time (< 5 minutes)
   - 4 Moderately fun and entertaining, would entertain user for some time (5-10 minutes total)
   - 5 Highly entertaining and fun, would stimulate repeat use

2. **Interest: Is the app interesting to use? Does it use any strategies to increase engagement by presenting its content in an interesting way?**
   - 1 Not interesting at all
   - 2 Mostly uninteresting
   - 3 OK, neither interesting nor uninteresting; would engage user for a brief time (< 5 minutes)
   - 4 Moderately interesting; would engage user for some time (5-10 minutes total)
   - 5 Very interesting, would engage user in repeat use

3. **Customisation: Does it provide/retain all necessary settings/preferences for apps features (e.g. sound, content, notifications, etc.)?**
   - 1 Does not allow any customisation or requires setting to be input every time
   - 2 Allows insufficient customisation limiting functions
   - 3 Allows basic customisation to function adequately
   - 4 Allows numerous options for customisation
   - 5 Allows complete tailoring to the individual's characteristics/preferences, retains all settings

4. **Interactivity: Does it allow user input, provide feedback, contain prompts (reminders, sharing options, notifications, etc.)? Note: these functions need to be customisable and not overwhelming in order to be perfect.**
   - 1 No interactive features and/or no response to user interaction
   - 2 Insufficient interactivity, or feedback, or user input options, limiting functions
   - 3 Basic interactive features to function adequately
   - 4 Offers a variety of interactive features/feedback/user input options
   - 5 Very high level of responsiveness through interactive features/feedback/user input options

5. **Target group: Is the app content (visual information, language, design) appropriate for your target audience?**
   - 1 Completely inappropriate/unclear/confusing
   - 2 Mostly inappropriate/unclear/confusing
   - 3 Acceptable but not targeted. May be inappropriate/unclear/confusing
   - 4 Well-targeted, with negligible issues
   - 5 Perfectly targeted, no issues found

A. Engagement mean score = _____

QUT Queensland University of Technology

Source: Stoyanov, Stoyan R et al. "Mobile app rating scale: a new tool for assessing the quality of health mobile apps." *JMIR mHealth and uHealth* vol. 3,1 e27. 11 Mar. 2015, doi:10.2196/mhealth.3422 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4376132/

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SECTION B

Functionality – app functioning, easy to learn, navigation, flow logic, and gestural design of app

6. **Performance: How accurately/fast do the app features (functions) and components (buttons/menus) work?**

   1 App is broken; no/insufficient/inaccurate response (e.g. crashes/bugs/broken features, etc.)
   2 Some functions work, but lagging or contains major technical problems
   3 App works overall. Some technical problems need fixing/Slow at times
   4 Mostly functional with minor/negligible problems
   5 Perfect/timely response; no technical bugs found/contains a 'loading time left' indicator

7. **Ease of use: How easy is it to learn how to use the app; how clear are the menu labels/icons and instructions?**

   1 No/limited instructions; menu labels/icons are confusing; complicated
   2 Useable after a lot of time/effort
   3 Useable after some time/effort
   4 Easy to learn how to use the app (or has clear instructions)
   5 Able to use app immediately; intuitive; simple

8. **Navigation: Is moving between screens logical/accurate/appropriate/ uninterrupted; are all necessary screen links present?**

   1 Different sections within the app seem logically disconnected and random/confusing/navigation is difficult
   2 Usable after a lot of time/effort
   3 Usable after some time/effort
   4 Easy to use or missing a negligible link
   5 Perfectly logical, easy, clear and intuitive screen flow throughout, or offers shortcuts

9. **Gestural design: Are interactions (taps/swipes/pinches/scrolls) consistent and intuitive across all components/screens?**

   1 Completely inconsistent/confusing
   2 Often inconsistent/confusing
   3 OK with some inconsistencies/confusing elements
   4 Mostly consistent/intuitive with negligible problems
   5 Perfectly consistent and intuitive

B. Functionality mean score = _____

SECTION C

Aesthetics – graphic design, overall visual appeal, colour scheme, and stylistic consistency

10. **Layout: Is arrangement and size of buttons/icons/menus/content on the screen appropriate or zoomable if needed?**

    1 Very bad design, cluttered, some options impossible to select/locate/see/read device display not optimised
    2 Bad design, random, unclear, some options difficult to select/locate/see/read
    3 Satisfactory, few problems with selecting/locating/seeing/reading items or with minor screen-size problems
    4 Mostly clear, able to select/locate/see/read items
    5 Professional, simple, clear, orderly, logically organised, device display optimised. Every design component has a purpose

Source: Stoyanov, Stoyan R et al. "Mobile app rating scale: a new tool for assessing the quality of health mobile apps." *JMIR mHealth and uHealth* vol. 3,1 e27. 11 Mar. 2015, doi:10.2196/mhealth.3422 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4376132/

11. Graphics: How high is the quality/resolution of graphics used for buttons/icons/menus/content?

1 Graphics appear amateur, very poor visual design - disproportionate, completely stylistically inconsistent
2 Low quality/low resolution graphics; low quality visual design – disproportionate, stylistically inconsistent
3 Moderate quality graphics and visual design (generally consistent in style)
4 High quality/resolution graphics and visual design – mostly proportionate, stylistically consistent
5 Very high quality/resolution graphics and visual design - proportionate, stylistically consistent throughout

12. Visual appeal: How good does the app look?

1 No visual appeal, unpleasant to look at, poorly designed, clashing/mismatched colours
2 Little visual appeal – poorly designed, bad use of colour, visually boring
3 Some visual appeal – average, neither pleasant, nor unpleasant
4 High level of visual appeal – seamless graphics – consistent and professionally designed
5 As above + very attractive, memorable, stands out; use of colour enhances app features/menus

C. Aesthetics mean score = _____

SECTION D

Information – Contains high quality information (e.g. text, feedback, measures, references) from a credible source. Select N/A if the app component is irrelevant.

13. Accuracy of app description (in app store): Does app contain what is described?

1 Misleading. App does not contain the described components/functions. Or has no description
2 Inaccurate. App contains very few of the described components/functions
3 OK. App contains some of the described components/functions
4 Accurate. App contains most of the described components/functions
5 Highly accurate description of the app components/functions

14. Goals: Does app have specific, measurable and achievable goals (specified in app store description or within the app itself)?

N/A Description does not list goals, or app goals are irrelevant to research goal (e.g. using a game for educational purposes)
1 App has no chance of achieving its stated goals
2 Description lists some goals, but app has very little chance of achieving them
3 OK. App has clear goals, which may be achievable.
4 App has clearly specified goals, which are measurable and achievable
5 App has specific and measurable goals, which are highly likely to be achieved

15. Quality of information: Is app content correct, well written, and relevant to the goal/topic of the app?

N/A There is no information within the app
1 Irrelevant/inappropriate/incoherent/incorrect
2 Poor. Barely relevant/appropriate/coherent/may be incorrect
3 Moderately relevant/appropriate/coherent/and appears correct
4 Relevant/appropriate/coherent/correct
5 Highly relevant, appropriate, coherent, and correct

16. **Quantity of information: Is the extent coverage within the scope of the app; and comprehensive but concise?**

N/A There is no information within the app
1 Minimal or overwhelming
2 Insufficient or possibly overwhelming
3 OK but not comprehensive or concise
4 Offers a broad range of information, has some gaps or unnecessary detail; or has no links to more information and resources
5 Comprehensive and concise; contains links to more information and resources

17. **Visual information: Is visual explanation of concepts – through charts/graphs/images/videos, etc. – clear, logical, correct?**

N/A There is no visual information within the app (e.g. it only contains audio, or text)
1 Completely unclear/confusing/wrong or necessary but missing
2 Mostly unclear/confusing/wrong
3 OK but often unclear/confusing/wrong
4 Mostly clear/logical/correct with negligible issues
5 Perfectly clear/logical/correct

18. **Credibility: Does the app come from a legitimate source (specified in app store description or within the app itself)?**

1 Source identified but legitimacy/trustworthiness of source is questionable (e.g. commercial business with vested interest)
2 Appears to come from a legitimate source, but it cannot be verified (e.g. has no webpage)
3 Developed by small NGO/institution (hospital/centre, etc.) /specialised commercial business, funding body
4 Developed by government, university or as above but larger in scale
5 Developed using nationally competitive government or research funding (e.g. Australian Research Council, NHMRC)

19. **Evidence base: Has the app been trialled/tested; must be verified by evidence (in published scientific literature)?**

N/A The app has not been trialled/tested
1 The evidence suggests the app does not work
2 App has been trialled (e.g., acceptability, usability, satisfaction ratings) and has partially positive outcomes in studies that are not randomised controlled trials (RCTs), or there is little or no contradictory evidence.
3 App has been trialled (e.g., acceptability, usability, satisfaction ratings) and has positive outcomes in studies that are not RCTs, and there is no contradictory evidence.
4 App has been trialled and outcome tested in 1-2 RCTs indicating positive results
5 App has been trialled and outcome tested in $\geq$ 3 high quality RCTs indicating positive results

D. Information mean score =_____*

* Exclude questions rated as "N/A" from the mean score calculation.

Source: Stoyanov, Stoyan R et al. "Mobile app rating scale: a new tool for assessing the quality of health mobile apps." *JMIR mHealth and uHealth* vol. 3,1 e27. 11 Mar. 2015, doi:10.2196/mhealth.3422 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4376132/

App subjective quality

SECTION E

20. Would you recommend this app to people who might benefit from it?

1	**Not at all**	I would not recommend this app to anyone
2		There are very few people I would recommend this app to
3	**Maybe**	There are several people whom I would recommend it to
4		There are many people I would recommend this app to
5	**Definitely**	I would recommend this app to everyone

21. How many times do you think you would use this app in the next 12 months if it was relevant to you?

1 **None**
2 1-2
3 3-10
4 10-50
5 >50

22. Would you pay for this app?

1 No
3 Maybe
5 Yes

23. What is your overall star rating of the app?

1	★★	One of the worst apps I've used
2	★★★★	
3	★★★★★★	Average
4	★★★★★★★★	
5	★★★★★★★★★★	One of the best apps I've used

Scoring

App quality scores for

SECTION

A: Engagement Mean Score = _____

B: Functionality Mean Score = _____

C: Aesthetics Mean Score = _____

D: Information Mean Score = _____

App quality mean Score = _____

App subjective quality Score = _____

App-specific

These added items can be adjusted and used to assess the perceived impact of the app on the user's knowledge, attitudes, intentions to change as well as the likelihood of actual change in the target health behaviour.

SECTION F

1. Awareness – This app has increased my awareness of the importance of addressing Dengue Fever symptoms, hospital that caters Dengue fever patients, Dengue Fever hotspots, prevention and treatment

Strongly disagree — Strongly Agree

1 2 3 4 5

2. Knowledge – This app has increased my knowledge/understanding of Dengue Fever symptoms, hospital that caters Dengue fever patients, Dengue Fever hotspots, prevention and treatment

Strongly disagree — Strongly Agree

1 2 3 4 5

3. Attitudes – The app has changed my attitudes toward improving practices against Dengue Fever

Strongly disagree — Strongly Agree

1 2 3 4 5

4. Intention to change – The app has increased my intentions/motivation to address behavior change (practicing preventive measures against Dengue Fever).

Strongly disagree — Strongly Agree

1 2 3 4 5

5. Help seeking – Use of this app is likely to encourage further help seeking for clinical assessment when I have Dengue Fever symptoms (if it's required)

Strongly disagree — Strongly Agree

1 2 3 4 5

6. Behaviour change – Use of this app will increase the practice of preventive measures against Dengue Fever

Strongly disagree — Strongly Agree 5

1 2 3 4

Further comments about the app?

THANK YOU!

Queensland University of Technology

Source: Stoyanov, Stoyan R et al. "Mobile app rating scale: a new tool for assessing the quality of health mobile apps." JMIR mHealth and uHealth vol. 3,1 e27. 11 Mar. 2015, doi:10.2196/mhealth.3422 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4376132/

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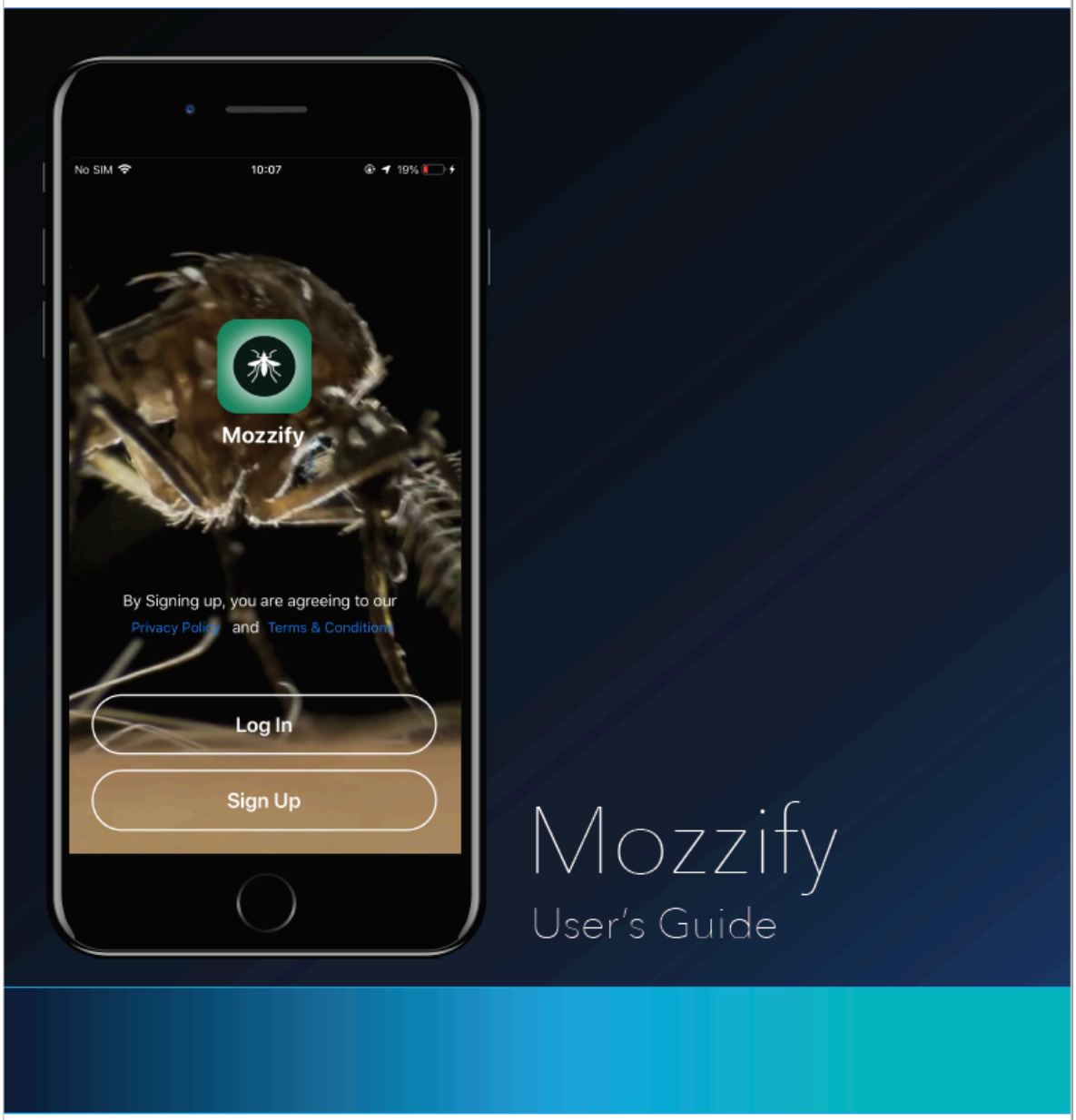
Multimedia Appendix 2. Mozzify User Guide



Mozzify User Guide. June 2019 version 1.0

Contents

1.1. Mozzify Mobile Application

Application Name: Mozzify

Version: 1

Platform: iOS iPhone (Apple)

Device Requirements: iPhone (iOS 11.0 and above)

Affiliations: Department of Civil and Environmental Engineering, Ehime University, Japan

Cost/In-App Purchase/Free: Free

Advertising: None

Brief description: This is an app that shows Dengue Fever (DF) cases and mosquito bite reports to identify DF hotspots. This has also a DF symptoms checker and hospital directions features. This informs users about DF by videos, news and websites of local and international health agencies. Users can also share their concerns and questions on DF using this app. Lastly, the app aims to help users to practice measures against DF using the Reminders feature.

Target/s: Physical health, Behavior change

Theoretical background/ Strategies: Assessment, Feedback, Information/Education, Monitoring/Tracking, Advice/ tips/Strategies/Skills training

Developer: Von Ralph Dane M. Herbuela (Academic, Non-Commercial)

Email: herbuelavonralphdane@gmail.com

Contact number: +81- 080-3925-2523

1.2. Main Features

1. Case Reporting to identify Dengue Hotspots using ArcGIS Map

a. Case reporting. The main feature of this application is the use of data from ArcGIS. The map shows the prevalence of probable (User-reported), confirmed Dengue fever (DF) (Hospital-reported) cases and mosquito bites (User-reported). Probable cases are in blue pins (after a user shows symptoms of DF by checking the symptoms in the app) while confirmed DF cases are in red pins. Orange pins are mosquito bite reports from users.

b. DF Hotspots. Users will be able to see the prevalence (dark-colored) of probable and confirmed DF cases and mosquito bites in the map.

2. Symptoms Checker and Hospital Directions

a. User Profile. Users can make a profile which include personal information (e.g. age, gender, address, etc. and health history information (e.g. DF history, family DF history, medical conditions, DF vaccine etc.).

b. Signs and Symptoms. Users who manifest DF signs and symptoms can check the list of DF warning signs and symptoms. The app will detect if the warning signs will require the user to seek medical assessment by a physician in a hospital.

c. Hospital Directions. If the user qualifies as a probable DF patient, the app will alert him/her to go to the nearest hospital that caters DF cases (including those hospitals that cater Dengvaxia-vaccinated individuals) by showing directions.

3. Education and information Sharing

a. Educational Videos. Users can watch videos on DF virus, symptoms, diagnosis and treatment

b. News about latest issues on DF and other mosquito-borne diseases.

c. Websites of international and local health agencies (e.g. WHO and Department of Health).

d. Timeline: shows posts of events, concerns, and questions on DF among users.

4. Behavior Modification (Preventive practices against DF)

Reminder Alerts. (within device) Another function of this feature is the Reminder alerts program based from the COMBI (Communication for Behavioral Intervention) on the preventive practices against DF. This is expected to develop or improve users' behavior on the practice of preventive measures against DF.

1.3. Privacy Policy

Effective date: June 17, 2019

Mozzify ("us", "we", or "our") operates the Mozzify mobile application (hereinafter referred to as the "Service").

This page informs you of our policies regarding the collection, use and disclosure of personal data when you use our Service and the choices you have associated with that data.

We use your data to provide and improve the Service. By using the Service, you agree to the collection and use of information in accordance with this policy. Unless otherwise defined in this Privacy Policy, the terms used in this Privacy Policy have the same meanings as in our Terms and Conditions.

Definitions

Service
Service is the Mozzify mobile application operated by Mozzify
Personal Data
Personal Data means data about a living individual who can be identified from those data (or from those and other information either in our possession or likely to come into our possession).
Usage Data
Usage Data is data collected automatically either generated by the use of the Service or from the Service infrastructure itself (for example, the duration of a page visit).
Cookies
Cookies are small files stored on your device (computer or mobile device).

Information Collection and Use

We collect several different types of information for various purposes to provide and improve our Service to you.

Types of Data Collected

Personal Data

While using our Service, we may ask you to provide us with certain personally identifiable information that can be used to contact or identify you ("Personal Data"). Personally identifiable information may include, but is not limited to:

- Email address
- First name and last name
- Phone number
- Address, State, Province, ZIP/Postal code, City

- Cookies and Usage Data

Usage Data

When you access the Service with a mobile device, we may collect certain information automatically, including, but not limited to, the type of mobile device you use, your mobile device unique ID, the IP address of your mobile device, your mobile operating system, the type of mobile Internet browser you use, unique device identifiers and other diagnostic data ("Usage Data").

Location Data

We may use and store information about your location if you give us permission to do so ("Location Data"). We use this data to provide features of our Service, to improve and customise our Service.

You can enable or disable location services when you use our Service at any time by way of your device settings.

Tracking Cookies Data

We use cookies and similar tracking technologies to track the activity on our Service and we hold certain information.

Cookies are files with a small amount of data which may include an anonymous unique identifier. Cookies are sent to your browser from a website and stored on your device. Other tracking technologies are also used such as beacons, tags and scripts to collect and track information and to improve and analyse our Service.

You can instruct your browser to refuse all cookies or to indicate when a cookie is being sent. However, if you do not accept cookies, you may not be able to use some portions of our Service. Examples of Cookies we use:

- Session Cookies. We use Session Cookies to operate our Service.
- Preference Cookies. We use Preference Cookies to remember your preferences and various settings.
- Security Cookies. We use Security Cookies for security purposes.

Use of Data

Mozzify uses the collected data for various purposes:

- To provide and maintain our Service
- To notify you about changes to our Service
- To allow you to participate in interactive features of our Service when you choose to do so
- To provide customer support
- To gather analysis or valuable information so that we can improve our Service
- To monitor the usage of our Service
- To detect, prevent and address technical issues

Transfer of Data

Your information, including Personal Data, may be transferred to - and maintained on - computers located outside of your state, province, country or other governmental jurisdiction where the data protection laws may differ from those of your jurisdiction.

If you are located outside Japan and choose to provide information to us, please note that we transfer the data, including Personal Data, to Japan and process it there.

Your consent to this Privacy Policy followed by your submission of such information represents your agreement to that transfer.

Mozzify will take all the steps reasonably necessary to ensure that your data is treated securely and in accordance with this Privacy Policy and no transfer of your Personal Data will take place to an organisation or a country unless there are adequate controls in place including the security of your data and other personal information.

Disclosure of Data

Legal Requirements

Mozzify may disclose your Personal Data in the good faith belief that such action is necessary to:

- To comply with a legal obligation
- To protect and defend the rights or property of Mozzify
- To prevent or investigate possible wrongdoing in connection with the Service
- To protect the personal safety of users of the Service or the public
- To protect against legal liability

Security of Data

The security of your data is important to us but remember that no method of transmission over the Internet or method of electronic storage is 100% secure. While we strive to use commercially acceptable means to protect your Personal Data, we cannot guarantee its absolute security.

Service Providers

We may employ third party companies and individuals to facilitate our Service ("Service Providers"), provide the Service on our behalf, perform Service-related services or assist us in analysing how our Service is used.

These third parties have access to your Personal Data only to perform these tasks on our behalf and are obligated not to disclose or use it for any other purpose.

Analytics

We may use third-party Service Providers to monitor and analyse the use of our Service.

Firebase

Firebase is an analytics service provided by Google Inc.

You may opt-out of certain Firebase features through your mobile device settings, such as your device advertising settings or by following the instructions provided by Google in their Privacy Policy: https://policies.google.com/privacy?hl=en

We also encourage you to review the Google's policy for safeguarding your data: https://support.google.com/analytics/answer/6004245.
For more information on what type of information Firebase collects, please visit the Google Privacy Terms web page: https://policies.google.com/privacy?hl=en

Links to Other Sites

Our Service may contain links to other sites that are not operated by us. If you click a third party link, you will be directed to that third party's site. We strongly advise you to review the Privacy Policy of every site you visit.

We have no control over and assume no responsibility for the content, privacy policies or practices of any third party sites or services.

Children's Privacy

Our Service does not address anyone under the age of 18 ("Children").
We do not knowingly collect personally identifiable information from anyone under the age of 18. If you are a parent or guardian and you are aware that your Child has provided us with Personal Data, please contact us. If we become aware that we have collected Personal Data from children without verification of parental consent, we take steps to remove that information from our servers.

Changes to This Privacy Policy

We may update our Privacy Policy from time to time. We will notify you of any changes by posting the new Privacy Policy on this page.

We will let you know via email and/or a prominent notice on our Service, prior to the change becoming effective and update the "effective date" at the top of this Privacy Policy.

You are advised to review this Privacy Policy periodically for any changes. Changes to this Privacy Policy are effective when they are posted on this page.

Contact Us

If you have any questions about this Privacy Policy, please contact us:

- By email: herbuelavonralphdane@gmail.com
- By phone number: +818039252523

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1.4. Terms and Conditions

Last updated: June 17, 2019

These Terms and Conditions ("Terms", "Terms and Conditions") govern your relationship with Mozzify mobile application (the "Service") operated by Mozzify ("us", "we", or "our"). Please read these Terms and Conditions carefully before using our Mozzify mobile application (the "Service").

Your access to and use of the Service is conditioned on your acceptance of and compliance with these Terms. These Terms apply to all visitors, users and others who access or use the Service. By accessing or using the Service you agree to be bound by these Terms. If you disagree with any part of the terms then you may not access the Service.

Content

Our Service allows you to post, link, store, share and otherwise make available certain information, text, graphics, videos, or other material ("Content"). You are responsible for the Content that you post to the Service, including its legality, reliability, and appropriateness.

By posting Content to the Service, you grant us the right and license to use, modify, publicly perform, publicly display, reproduce, and distribute such Content on and through the Service. You retain any and all of your rights to any Content you submit, post or display on or through the Service and you are responsible for protecting those rights. You agree that this license includes the right for us to make your Content available to other users of the Service, who may also use your Content subject to these Terms.

You represent and warrant that: (i) the Content is yours (you own it) or you have the right to use it and grant us the rights and license as provided in these Terms, and (ii) the posting of your Content on or through the Service does not violate the privacy rights, publicity rights, copyrights, contract rights or any other rights of any person.

Accounts

When you create an account with us, you must provide us information that is accurate, complete, and current at all times. Failure to do so constitutes a breach of the Terms, which may result in immediate termination of your account on our Service.

You are responsible for safeguarding the password that you use to access the Service and for any activities or actions under your password, whether your password is with our Service or a third-party service.

You agree not to disclose your password to any third party. You must notify us immediately upon becoming aware of any breach of security or unauthorized use of your account.

You may not use as a username the name of another person or entity or that is not lawfully available for use, a name or trade mark that is subject to any rights of another person or entity

other than you without appropriate authorization, or a name that is otherwise offensive, vulgar or obscene.

Links To Other Web Sites

Our Service may contain links to third-party web sites or services that are not owned or controlled by Mozzify.

Mozzify has no control over, and assumes no responsibility for, the content, privacy policies, or practices of any third party web sites or services. You further acknowledge and agree that Mozzify shall not be responsible or liable, directly or indirectly, for any damage or loss caused or alleged to be caused by or in connection with use of or reliance on any such content, goods or services available on or through any such web sites or services.

We strongly advise you to read the terms and conditions and privacy policies of any third-party web sites or services that you visit.

Termination

We may terminate or suspend your account immediately, without prior notice or liability, for any reason whatsoever, including without limitation if you breach the Terms.

Upon termination, your right to use the Service will immediately cease. If you wish to terminate your account, you may simply discontinue using the Service.

Limitation Of Liability

In no event shall Mozzify, nor its directors, employees, partners, agents, suppliers, or affiliates, be liable for any indirect, incidental, special, consequential or punitive damages, including without limitation, loss of profits, data, use, goodwill, or other intangible losses, resulting from (i) your access to or use of or inability to access or use the Service; (ii) any conduct or content of any third party on the Service; (iii) any content obtained from the Service; and (iv) unauthorized access, use or alteration of your transmissions or content, whether based on warranty, contract, tort (including negligence) or any other legal theory, whether or not we have been informed of the possibility of such damage, and even if a remedy set forth herein is found to have failed of its essential purpose.

Disclaimer

Your use of the Service is at your sole risk. The Service is provided on an "AS IS" and "AS AVAILABLE" basis. The Service is provided without warranties of any kind, whether express or implied, including, but not limited to, implied warranties of merchantability, fitness for a particular purpose, non-infringement or course of performance.

Mozzify its subsidiaries, affiliates, and its licensors do not warrant that a) the Service will function uninterrupted, secure or available at any particular time or location; b) any errors or defects will be corrected; c) the Service is free of viruses or other harmful components; or d) the results of using the Service will meet your requirements.

Our failure to enforce any right or provision of these Terms will not be considered a waiver of those rights. If any provision of these Terms is held to be invalid or unenforceable by a court, the remaining provisions of these Terms will remain in effect. These Terms constitute the entire agreement between us regarding our Service, and supersede and replace any prior agreements we might have between us regarding the Service.

Changes

We reserve the right, at our sole discretion, to modify or replace these Terms at any time. If a revision is material we will try to provide at least 30 days notice prior to any new terms taking effect. What constitutes a material change will be determined at our sole discretion.

By continuing to access or use our Service after those revisions become effective, you agree to be bound by the revised terms. If you do not agree to the new terms, please stop using the Service.

Contact Us

If you have any questions about these Terms, please contact us.

This Terms and Conditions was generated using Termsfeed.com services:

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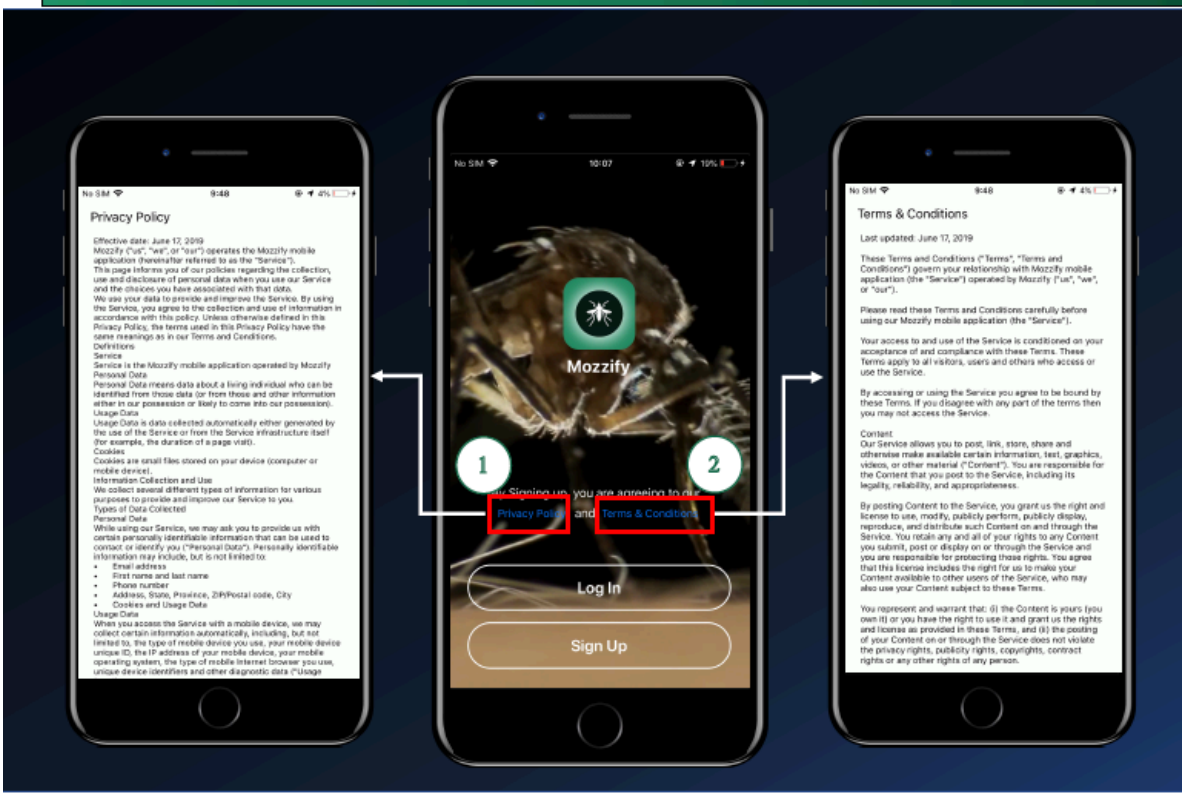
2. Agreements

Privacy Policy and Terms and Conditions

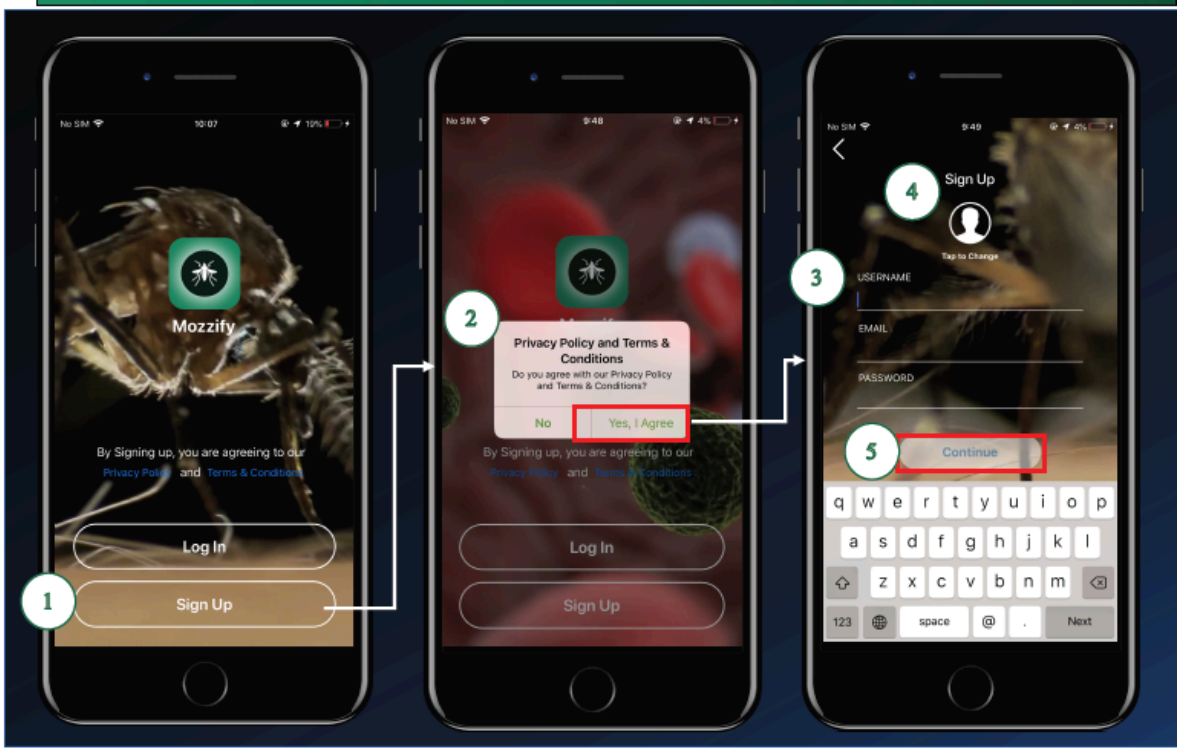


By signing-up, you are agreeing to our **Privacy Policy and Terms and Conditions**.

1. Click the ***Privacy Policy*** button to read the **Privacy Policy** statement. Scroll down the page and click the ***Mozzify icon*** button to go back to the main menu.

2. Click the ***Terms and Conditions*** button to read the **Terms & Conditions** statement. Scroll down the page and click the ***Mozzify icon*** button to go back to the main menu.

3. Sign-Up



1. Click ***Sign Up*** button.

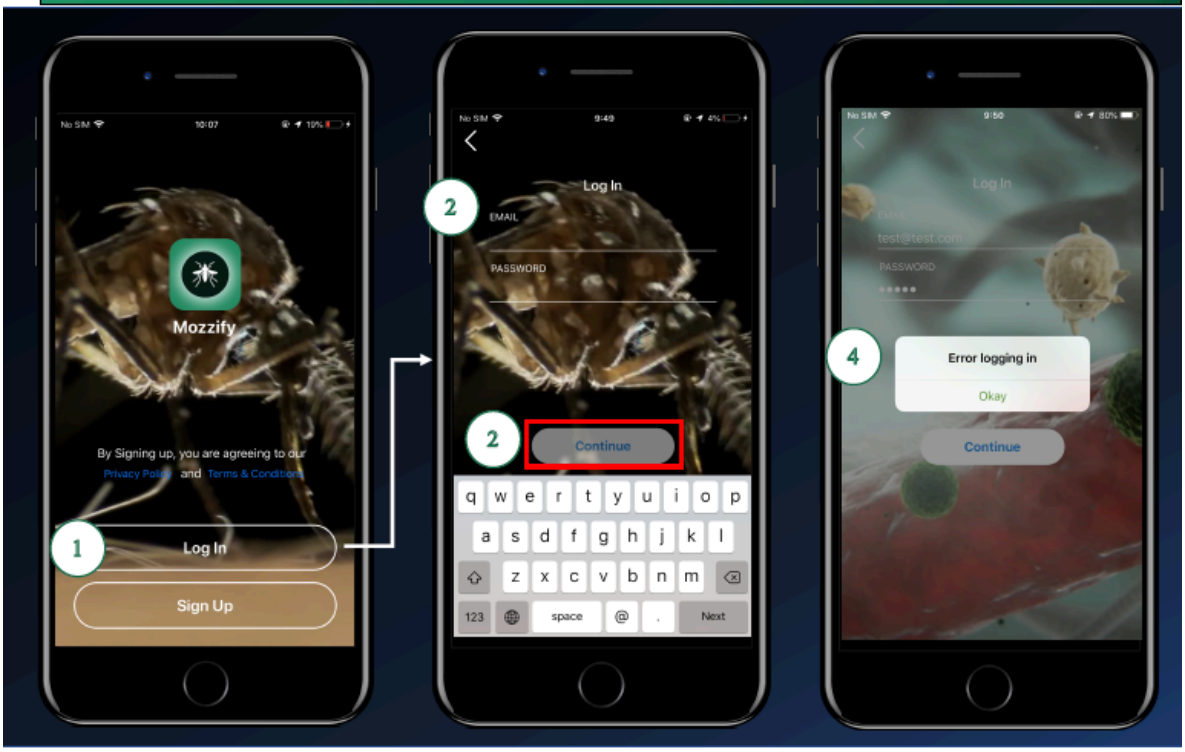
2. Click the ***Yes, I Agree*** button if you agree with the **Privacy Policy and Terms and Conditions.**

3. Enter your preferred **username**, **email address** and **password** in the text fields.

4. Click the  button to upload your profile picture. Then select an image from your photo gallery.

5. Click ***Continue*** button to sign-up. **Error** alert will pop-up if the email address was already registered.

4. Log-In

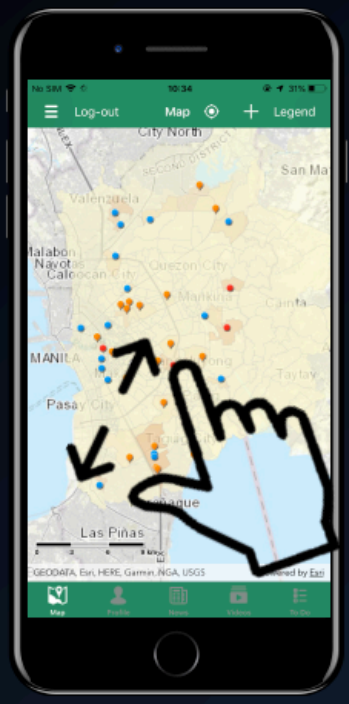


1. Click ***Log In*** button.

2. Enter the same **email address** and **password** used during Sign-up.

3. Click ***Continue*** button to log-in.

4. **Error** alert will pop-up if the **email address** and/or **password** your provided was/were wrong or not yet registered.

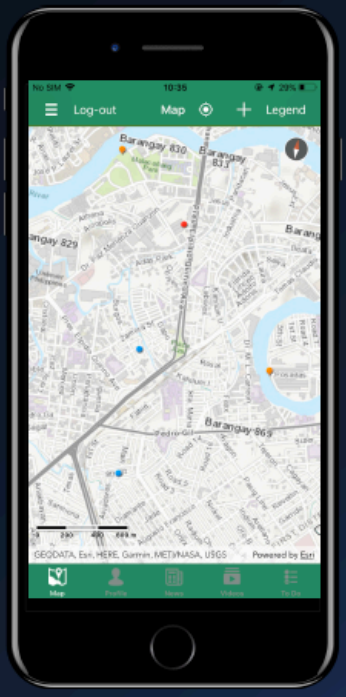


City Level:
9km in Scale line
You will see:

1. Map pins
2. Disease Hotspots (in brown)

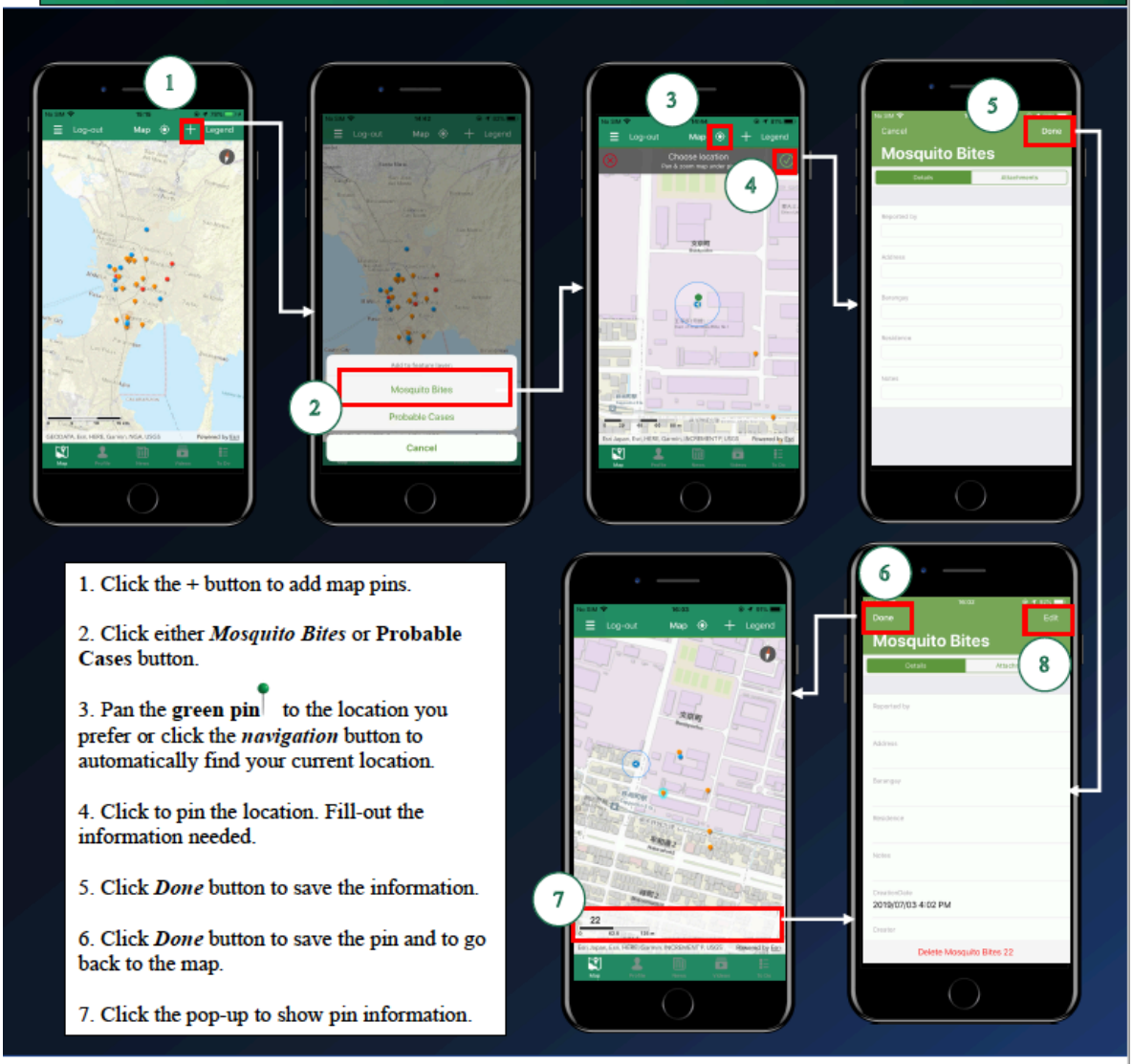
Barangay (Village) Level:
1.5km in Scale line
You will see:

1. Map pins
2. Disease Hotspots (in brown)
3. Barangay (village) names and boundaries



Street Level:
600m in Scale line
You will see:

1. Map pins
2. Barangay (village) names
3. Street names
4. Houses and buildings
5. Land use (e.g. park, schools, etc.)



1. Click the + button to add map pins.

2. Click either ***Mosquito Bites*** or **Probable Cases** button.

3. Pan the **green pin** to the location you prefer or click the ***navigation*** button to automatically find your current location.

4. Click to pin the location. Fill-out the information needed.

5. Click ***Done*** button to save the information.

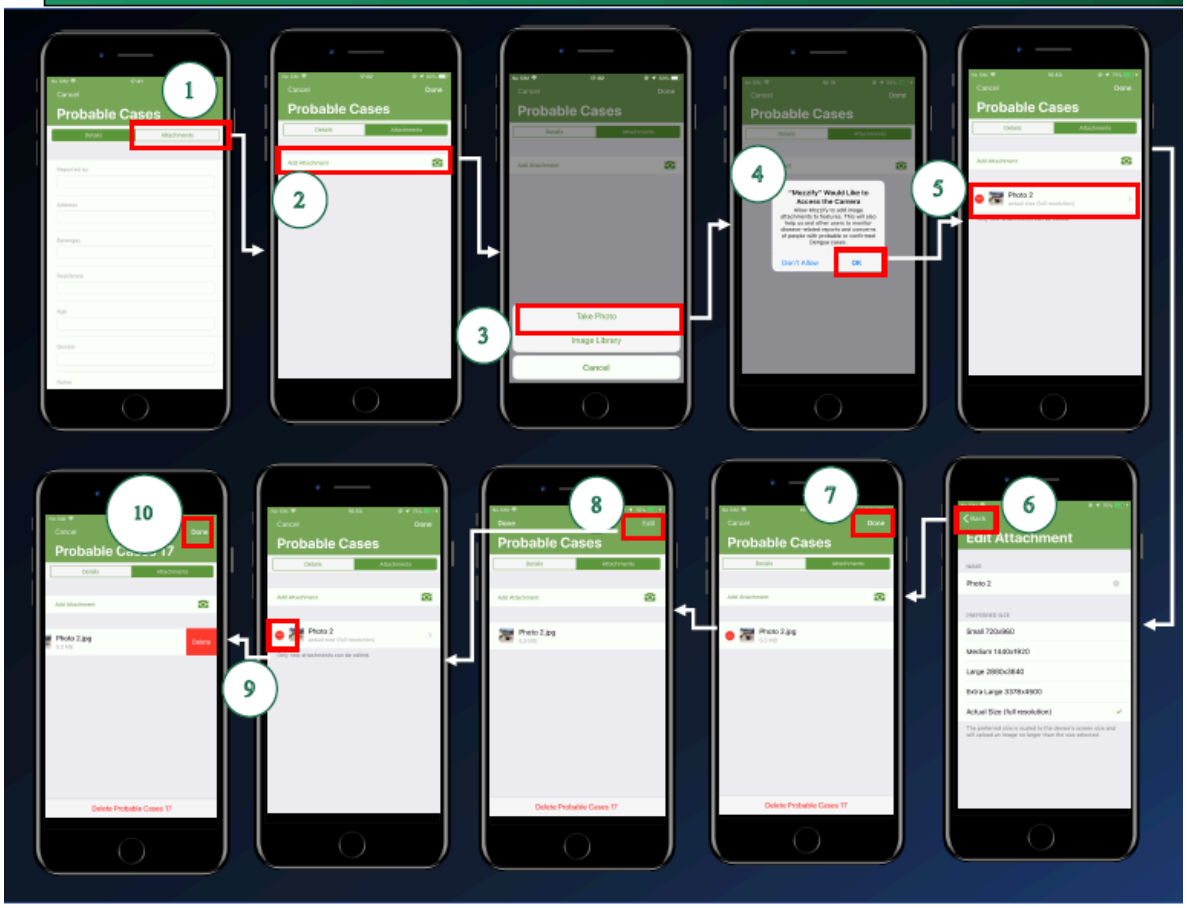
6. Click ***Done*** button to save the pin and to go back to the map.

7. Click the pop-up to show pin information.

To Edit:

7. Click the pop-up to show pin information.

8. Click ***Edit*** button and click ***Done*** button to save it.



Refer to section 6.2. Adding map pins (probable and mosquito bites) and follow the steps 1 to 4.

1. Click ***Attachments*** button.

2. Click ***Add Attachment*** button.

3. Click ***Take Photo*** or ***Image Library*** option.

4. Click OK to allow Mozzify access your **Camera** or **Image Library**.

5. Click the attachment to edit its **name** and choose **preferred size**.

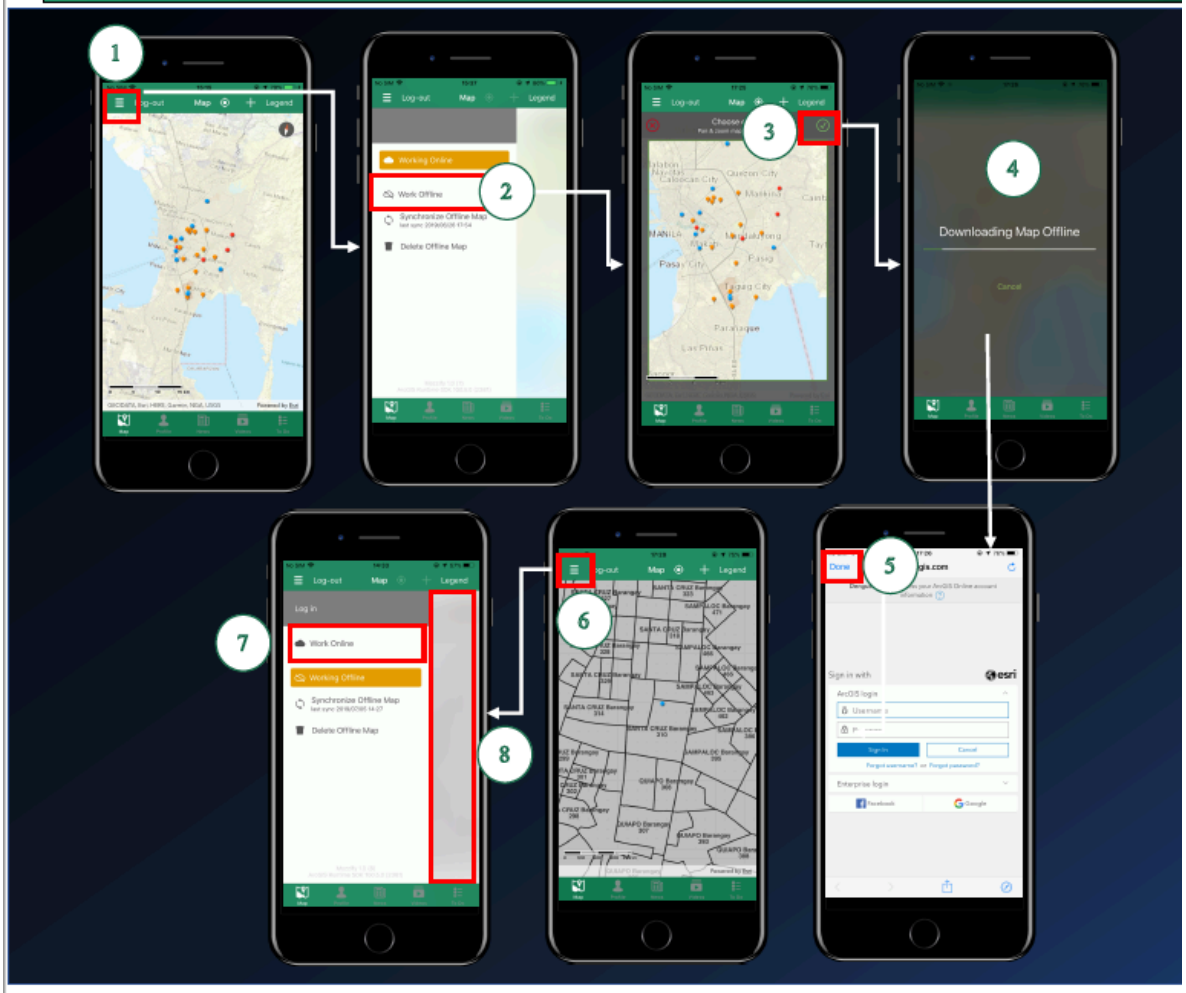
6. Click ***Back*** button.

7. Click ***Done*** button to save the record.

<u>To Delete an image:</u>
8. Click ***Edit*** button.

9. Click – button and click ***Delete*** button

10. Click ***Done*** button to save and click ***Done.***



1. Click to show the drawer.

2. Click ***Work Offline*** button.

3. Zoom-in or pan the map to the location you prefer and click the ***green check*** button to download.

4. Download **Map Offline**.

5. Click ***Done*** (Do not enter username or password).

<u>To go back to Online Map:</u>

6. Click to show the drawer.

7. Click ***Work Online*** button.

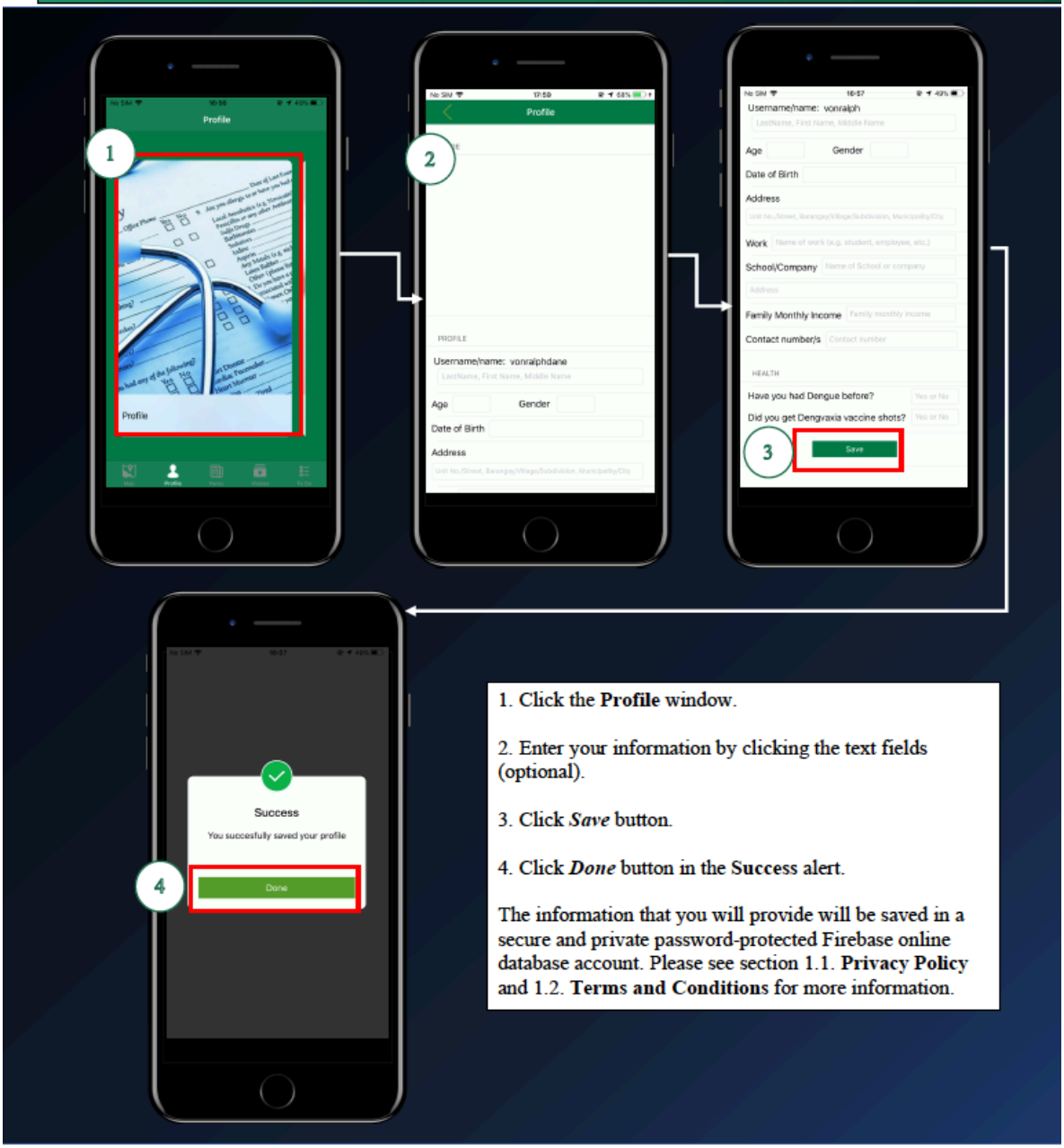
8. Click to show online map

While in Offline Map:

1. Click to show the drawer.
2. Click ***Synchronize Offline Map*** button.
3. Synchronizing Offline Map.

To Delete Offline Map:

4. Click ***Delete Offline Map*** button.
5. Click **Delete** option in the alert.
6. Click to see the go back to **online map**.



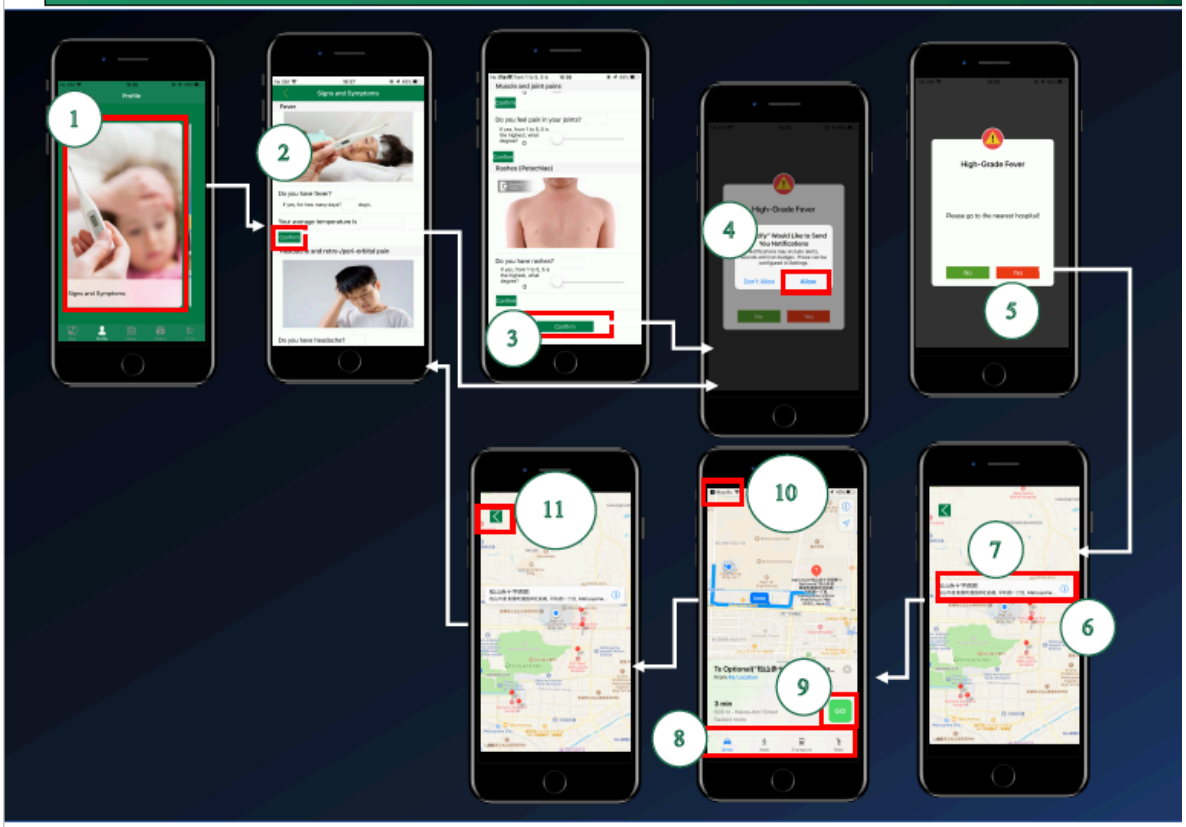
1. Click the **Profile** window.

2. Enter your information by clicking the text fields (optional).

3. Click ***Save*** button.

4. Click ***Done*** button in the **Success** alert.

The information that you will provide will be saved in a secure and private password-protected Firebase online database account. Please see section 1.1. **Privacy Policy** and 1.2. **Terms and Conditions** for more information.



1. Click **Signs and Symptoms** window.

2. Answer all the questions and click the ***Confirm*** button in each symptom. If your condition requires immediate clinical assessment, the app will alert you to go to a nearest hospital.

3. Finish answering all the questions in all the symptoms and click ***Confirm***.

4. Click ***Allow*** button to send you notifications.

5. Click ***Yes*** button in the alert to show hospitals around you.

6. Click the **red** pin to show the hospital information.

7. Click to show directions.

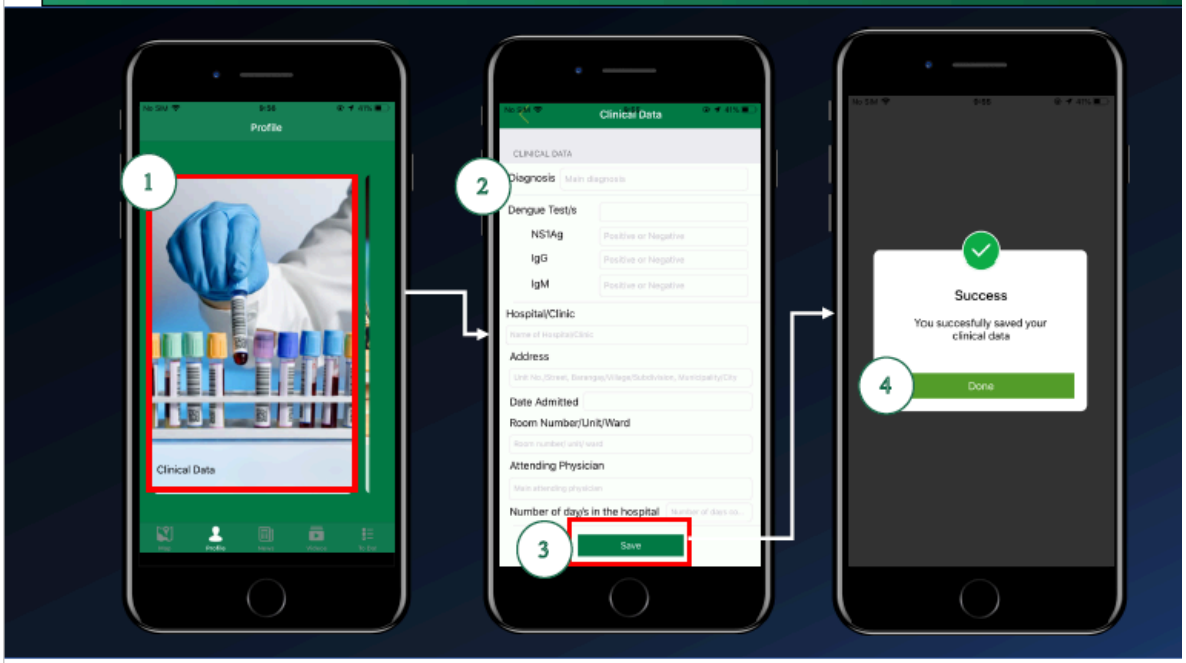
8. Choose among the **options**.

9. Click ***GO*** button to start route.

10. Click the **Mozzify** in the upper leftmost part of the screen to go back.

11. Click ***back arrow*** button to go back.

6. Profile
6.3. Clinical Data



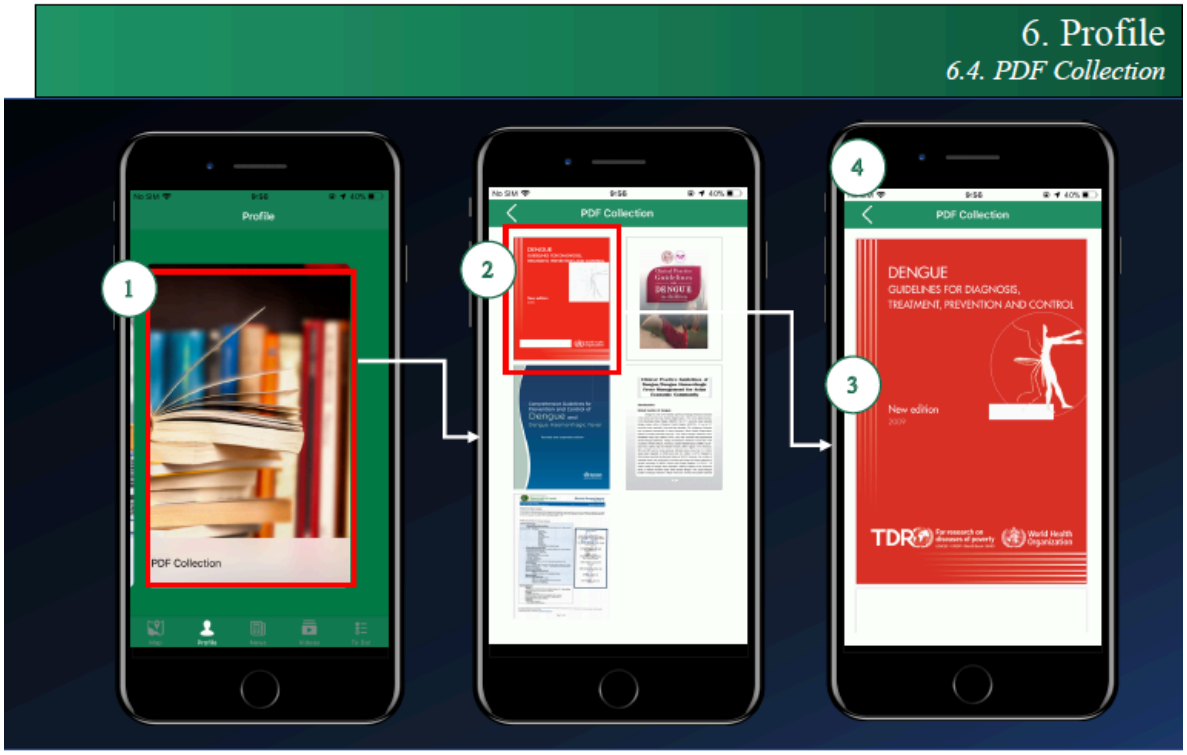
1. Click the **Clinical Data** window.

2. Enter your information by clicking the text fields (optional).

3. Click ***Save*** button.

4. Click ***Done*** button in the **Success** alert.

The information that you will provide will be saved in a secure and private password-protected Firebase online database account. Please see section 1.1. **Privacy Policy** and 1.2. **Terms and Conditions** for more information.



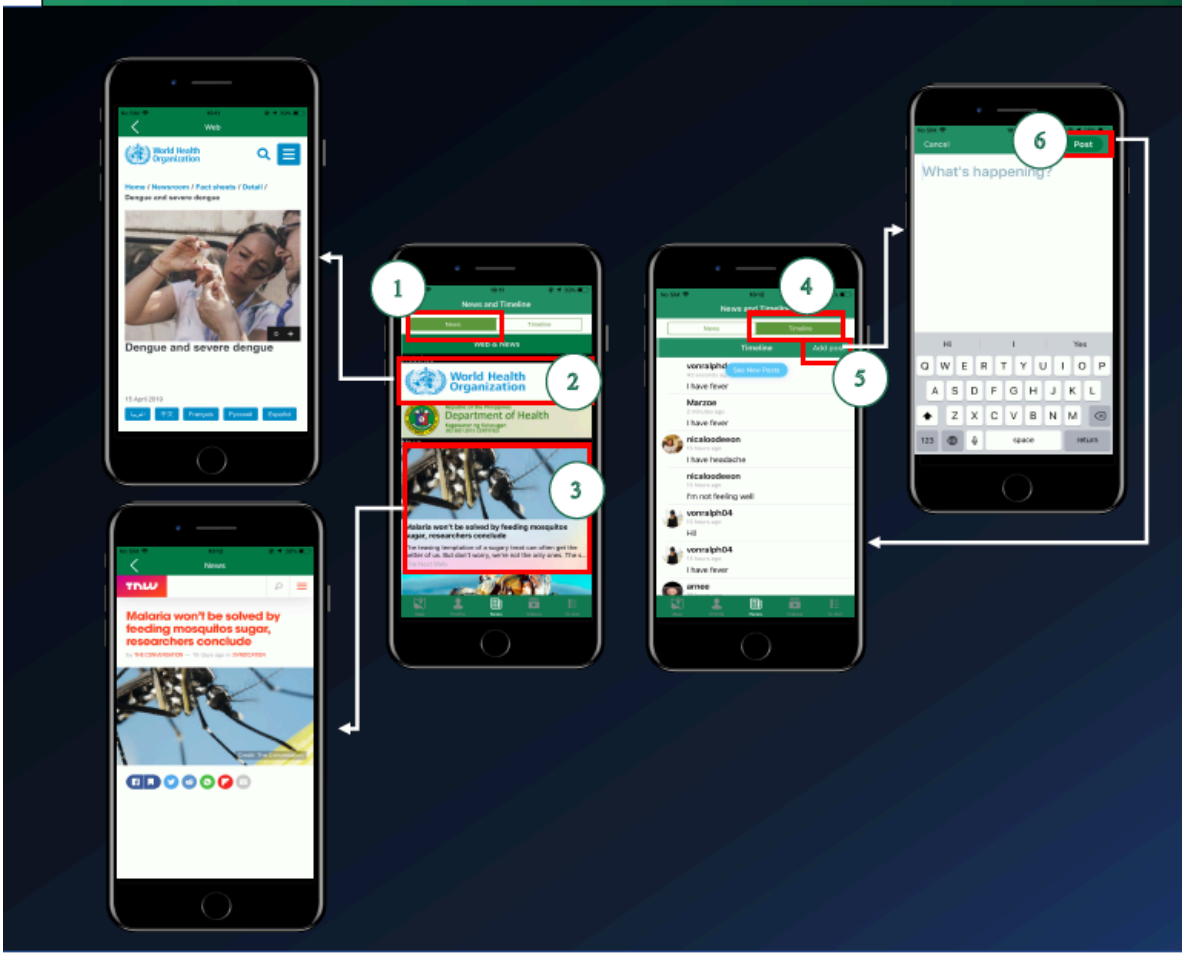
1. Click the **PDF Collection** window.

2. Click PDF icon to open.

3. Scroll down to turn pages, you can also zoom-in or zoom-out the pages.

4. Click ***back arrow*** button to go back.

7. News and Timeline



News

1. Click **News** tab button.

2. Click the WHO (or Department of Health) logo to go to their website.

3. Scroll down and click news boxes to see the latest news about mosquitoes, dengue fever, etc.

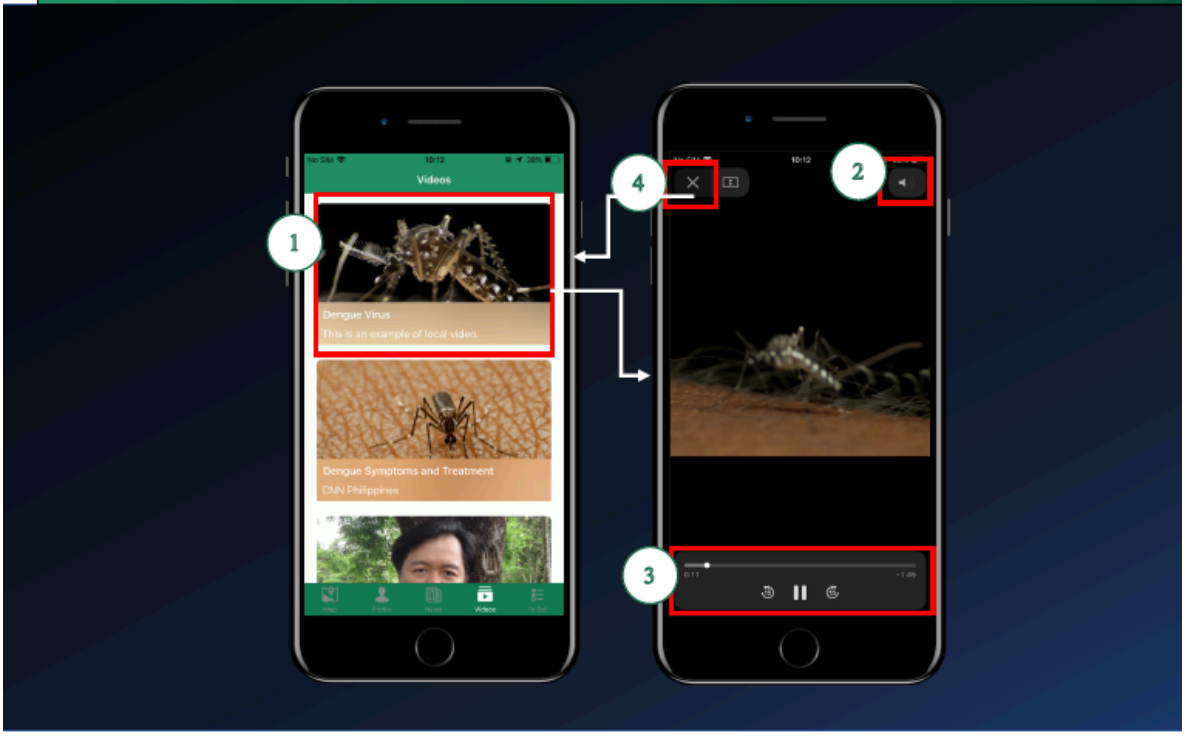
Timeline

4. Click ***Timeline*** button.

5. To add new post (present dengue-related events e.g.fogging, mosquito breeding sites, questions about symptoms and prevention, etc.]) click ***Add post*** button.

6. Click **Post** to post to timeline.

8. Videos

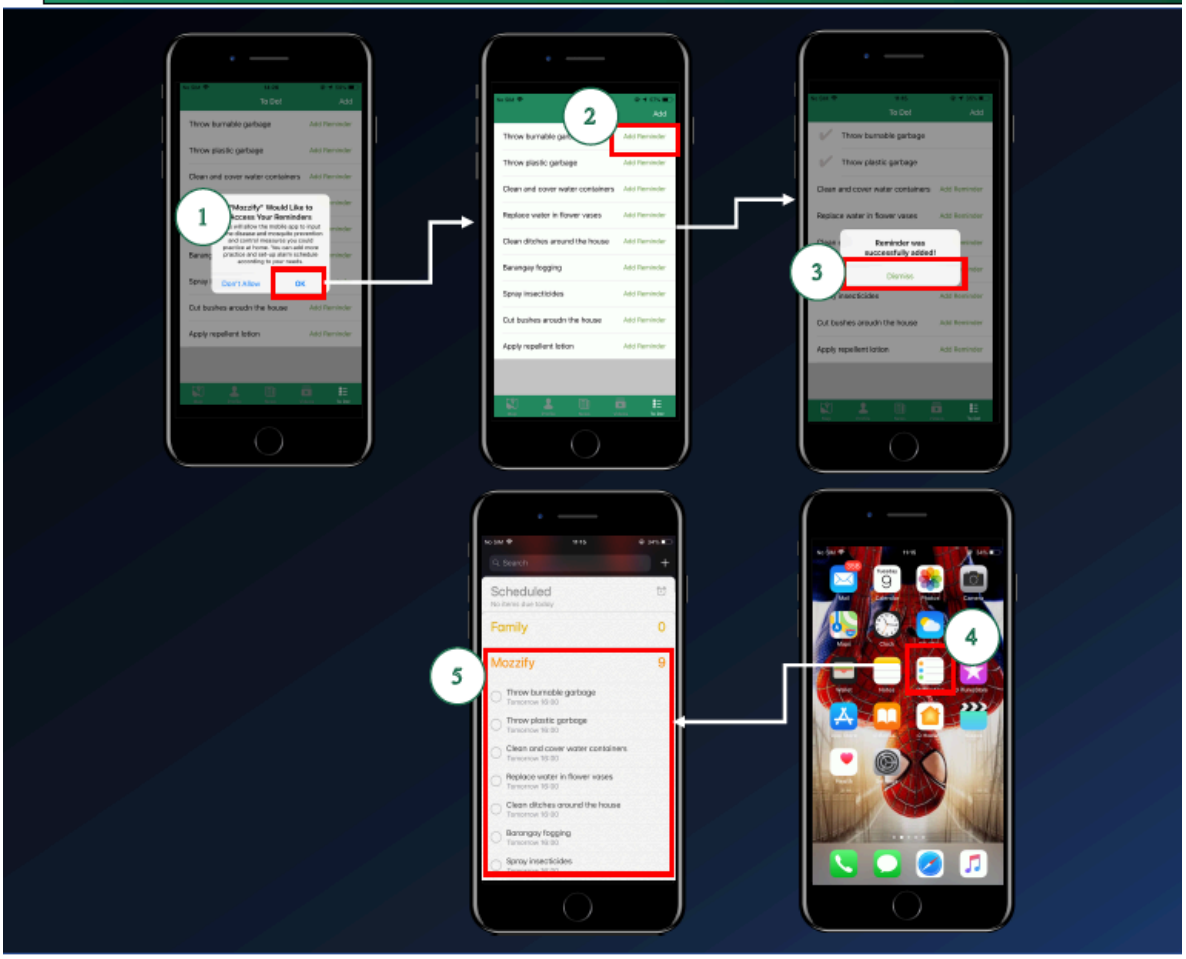


1. Scroll and click the **video icon image** button to play video.

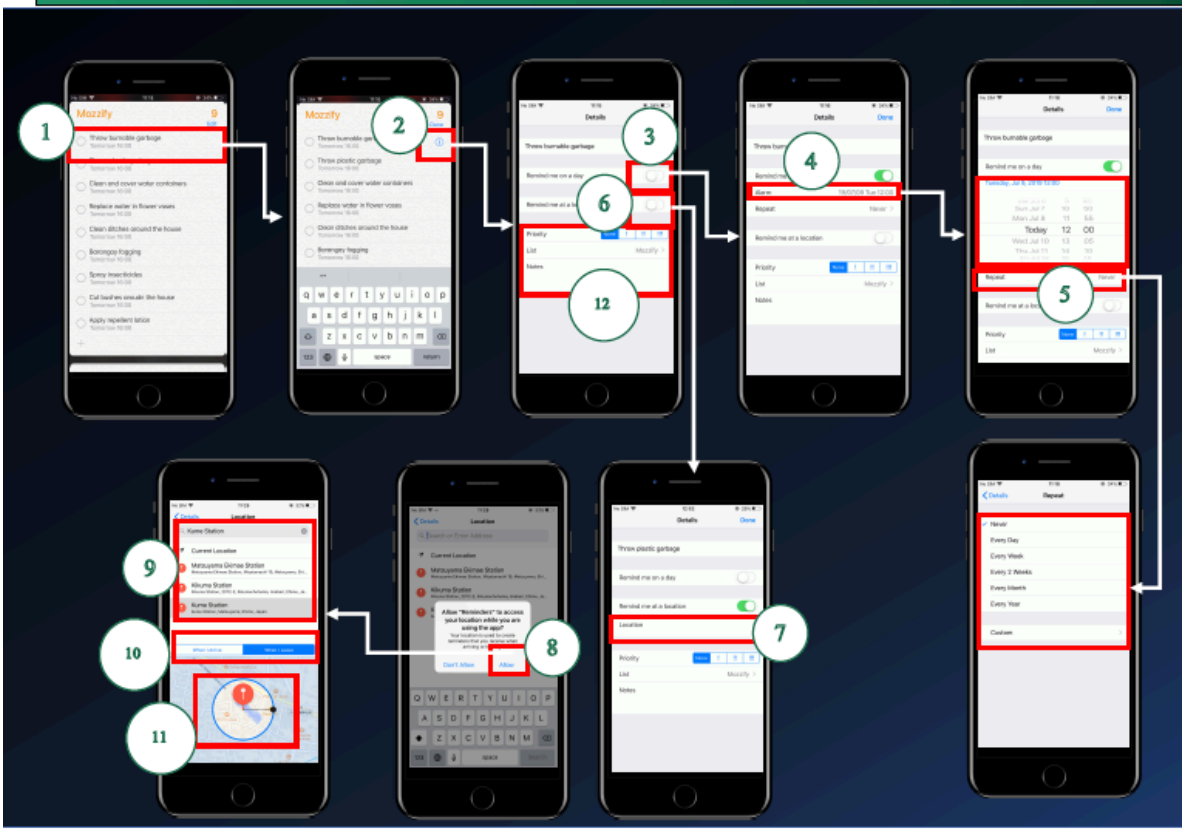
2. Adjust **sound**.

3. Click ***play or pause*** buttons, and ***fast forward or back*** buttons to go back and forth the video.

4. Click *x* button or **drag down** the view to go back.



1. Click ***OK*** button to allow **Mozzify** to make a reminder list.
2. Click ***Add Reminder*** button to add each preventive practice to the reminder list.
3. Click ***Dismiss*** button for the alert to disappear.
4. Go to the **Reminders app** in your mobile phone.
5. **Mozzify** reminder list will be added to your reminders.



1. Click the **preventive practice** that you want to edit settings.

2. Click to show **information**.

3. Click to set **day**.

4. Click to set **date and time**.

5. Click to edit **Repeat** options.

6. Click to set **location**.

7. Click to go to **location settings**.

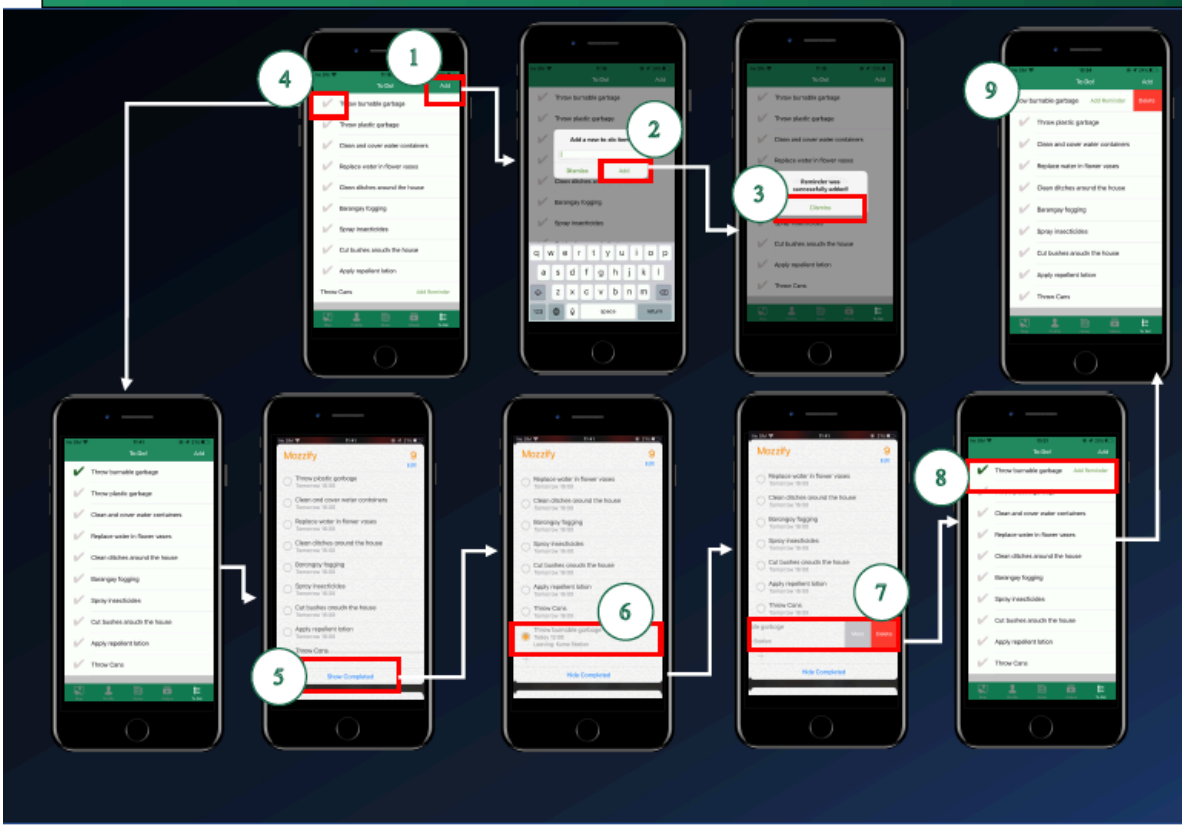
8. Click ***Allow*** to proceed to location settings.

9. Choose among the **options** or **enter a new location** or click **current location**.

10. Choose either set the reminder to **When I arrive** or **When I leave**.

11. Set the **vicinity radius** by tapping and holding the **black dot** in the **blue circle** then click ***Details*** button to go back.

12. Set **Priority** and add **Notes**, then click **Done** button to save.



Adding new practice:

1. Click ***Add*** button

2. Enter **new practice** in the text field and click ***Add***.

3. Click ***Dismiss.***

Completing a practice:

4. Click the checkmark button.

5. Go to Reminders app then click Show Completed button.

6. The completed practice is ticked.

Deleting a practice:

In the Reminders app:

7. Swipe the practice to the left then click ***Delete*** button.

In the Mozzify app:

8. Go back to Mozzify app and see the deleted practice has ***Add Reminder*** button again.

9. Swipe the practice left then click ***Delete***.

10. References

ArcGIS ESRI Map (Data Collection)
https://github.com/Esri/data-collection-ios

ArcGIS Runtime Toolkit
https://github.com/Esri/arcgis-runtime-toolkit-ios

News (News-App)
https://github.com/johnnyperdomo/News-App

Video (My Videos), File: 30DSC-Youtube-Day2-UITableView
Youtube: https://www.youtube.com/watch?v=RAFsNJ-qjsg

Videos (Youtube)
https://www.youtube.com/watch?v=VC9Kl182E-E&t=13s
https://www.youtube.com/watch?v=pABkc9mX_0M&t=10s
https://www.youtube.com/watch?v=uw-TgokvEi4
https://www.youtube.com/watch?v=cnU-npubpKw
https://www.youtube.com/watch?v=rEyslDif1o4&t=17s
https://www.youtube.com/watch?v=o9y-5VKJRiQ
https://www.youtube.com/watch?v=I2G2o-oJHl0
https://www.youtube.com/watch?v=WUNDs3RLN-U&t=316s
https://www.youtube.com/watch?v=VC9Kl182E-E&t=2s
https://www.youtube.com/watch?v=9KzMjjgFmKc&t=23s

LoginView and Timeline
Part 1https://www.youtube.com/watch?v=UPKCULKi0-A
Part 2 https://www.youtube.com/watch?v=gWZP0vDgMtg
Part 3 https://www.youtube.com/watch?v=n6eR9lJDivY
Part 4 https://www.youtube.com/watch?v=csz_mFklOek
Part 5 https://www.youtube.com/watch?v=R95eeehl8Ck
Part 6 https://www.youtube.com/watch?v=vgoYNswX6C8
Part 7 https://www.youtube.com/watch?v=-qoCHVwGn18
Part 8 https://www.youtube.com/watch?v=4y_NLkYT6NU
Part 9 https://www.youtube.com/watch?v=nSBWySBDj3E

To Do: Reminder App
https://www.raywenderlich.com/2291-eventkit-tutorial-making-a-calendar-reminder

PDF Reader
https://github.com/taminhtu/PDFReader

Carousel Effect:

https://www.youtube.com/watch?v=JG7mWFcU0vk

Slider:
https://www.youtube.com/watch?v=yHzaMR5Rwow

App icon:
https://www.youtube.com/watch?v=zHq3zBjCMtY

Map Directions
https://www.youtube.com/watch?v=rmafKbCHKe0

Storing Data (User defaults)
https://www.youtube.com/watch?v=S69sxZELJRQ&t=322s

Segmented control:
https://www.youtube.com/watch?v=S69sxZELJRQ&t=322s

PDF
https://www.who.int/tdr/publications/documents/dengue-diagnosis.pdf

http://www.pgh.gov.ph/static/media/uploads/documents/clinicaldepartments/pediatrics/denguelecture/6clinical.pdf

http://www.pidsphil.org/home/wp-content/uploads/2017/06/2017_Dengue_CPG_Final.pdf

http://apps.searo.who.int/PDS_DOCS/B4751.pdf

https://www.doh.gov.ph/sites/default/files/statistics/Dengue%20Monthly%20Report_MW1-MW30_2018_No.7.pdf

Multimedia Appendix 3. Mozzify Advertisement

Multimedia Appendix 4. Ethics Approval Certificate from Ehime University Faculty of Engineering

第３号様式（第１２条関係）

受付番号	K19-001

令和元年７月９日

理工学研究科生産環境工学専攻環境建設工学コース
教授　渡辺　幸三　殿

愛媛大学大学院理工学研究科
工学系長　高橋　寛　印

審　査　結　果　通　知　書

課題名　　デング熱監視モバイルアプリケーションの開発と検証
研究代表者　所属・職・氏名
理工学研究科生産環境工学専攻環境建設工学コース・教授・渡辺　幸三

申請のあった研究課題について，令和元年6月19日，7月3日，7月8日の愛媛大学大学院理工学研究科（工学系）研究倫理審査委員会で審査し，下記のとおり判定したので，通知します。

記

判　　定	承認　条件付承認　改善命令　不承認
理　　由　（承認以外の場合） 愛媛大学大学院理工学研究科（工学系）における人を対象とする研究倫理審査規程の第８条に定められた審査基準のうち，第２項第５号 インフォームド・コンセントの手続きについて以下の懸念がある。 アプリを使用したデータ収集において，インフォームド・コンセントに記載されていない個人情報（モバイル装置のIDやOS等）が同時に収集されている。これらが収集されることは当該アプリのPrivate Policyに書かれており，それに被験者が同意する手続きが採られているが，インフォームド・コンセントへの同意を求められる時点では，上記の情報が収集されることが予見できない。 したがって，申請者らが収集する全てのデータをインフォームド・コンセントに追記するべきである。この対応が採られることを条件として承認する。	

審査結果に異議がある場合は，本通知書を受領した日の翌日から起算して１４日以内に，再審査を１回に限り申請することができます。再審査申請書（第４号様式）により申請して下さい。

Multimedia Appendix 5. Informed Consent Sheet

補足資料 1

愛媛大学
EHIME UNIVERSITY

INFORMED CONSENT SHEET

Project Title: **Development and validation of a proactive information system and dengue cases surveillance monitoring mobile application**

1. Objectives

You (and/or your child) have been invited to join this research on the validation of a proactive information system and dengue cases surveillance monitoring mobile application.

2. Participation

2.1. You will be asked to:

- **a.** Fill-out **Profile Sheet** (Personal Information);
- **b.** Download and use the **Dengue App** on your mobile phone (iPhone), and;
- **c.** Answer the **Mobile Application Rating Scale (MARS)**, and;

2.2. Informed consent signing, mobile application use and answering the MARS will take 20-30 minutes of your time.

2.3. You will be asked to provide the following in order to use the mobile application:

a. email address and password;
b. username and photo (optional);
c. Profile (name, address, age, gender, school/university, contacts [phone number and email address], dengue fever and dengue vaccine history) (optional).

2.4. Participation in this study is entirely voluntary. You have the right to leave the study at any time, without penalty. Withdrawal in this study without justifying your decision will not affect you in any way.

2.5. Signing this form will give permission to the researcher/interviewer, monitor(s), the review board personnel, and the regulatory authority(ies):

a. access to your personal information if you chose to disclose your personal information and;
b. access to the data transmitted from the mobile application to the database and from the electronic survey (MARS) to the online database (Survey Monkey)
c. collect certain information automatically, including, but not limited to, the type of mobile device you use, your mobile device unique ID, the IP address of your mobile device, your mobile operating system, the type of mobile Internet browser you use, unique device identifiers and other diagnostic data or usage data as stated in our Privacy Policy.
d. include the data (personal information and answers in MARS) obtained from the you to analysis even an unexpected exclusion or withdrawal from the study.

2.6. This study will involve approximately 50 participants (students of Ehime University whose age is from 18 years old and above and who uses an iPhone) June 2019.

3. Benefits

Participation in this study is expected to benefit the researcher and other professionals (scientists, public health officials, physicians, etc.) from the information that we will find in this study in the distribution and validation of the mobile application in the Philippines.

4. Risk/s

Participation in the study may pose unknown and unforeseeable risks. However, the methods (survey and interview) and results (outcomes) **have no to minimal foreseeable risks,** inconveniences or any negative impact on your well-being.

5. Incentives

The study will not provide any incentive (monetary or material) for your participation in this study.

6. Confidentiality

Your names and other information will be used only for this study and never will be used for other purposes. Every effort will be made to keep clinical records, research records, and other personal information confidential during the course of data gathering, analysis and publication of this study:

a. Providing personal information like name, age, gender, etc. is optional;
b. Each participant will be given a unique code (001-) in forms with identifiable information (informed consent, profile sheets, rating scale);
c. Access to sheets that contain your information, such as names and age will be given limited access. Access will only be given to the PI, and other regulatory authority(ies);
d. Electronic data will be stored in password-protected databases and computer after the interview. After that, all data sheets that contain their names and other information will be properly disposed/deleted.
e. Analysis and results of data will not include any identifiable information to any of the participants.

7. Results Disclosure

6.1. Results of the survey will be disclosed to you after the interview in an agreed schedule and manner.

6.2. Findings of this study will be sent to you via email upon your request. Please write your email address: _____.

8. Contacts for Questions/Problems

7.1. If you have questions about the study, any problems, if you (and/or your child) experience any unexpected physical or psychological discomforts, or think that something unusual or unexpected is happening, and other relevant information, please don't hesitate to contact the Primary Investigator:

Von Ralph Dane Marquez Herbuela
herbuelavonralphdane@gmail/@yahoo.com
080-3925-2523

8.2. This faculty has approved this study, and may be reached through the following contact for information regarding your rights as participants, including grievances and complaints:

Name of MD or IRB Chair
Address:
Email:
Tel:
Mobile:

9. Permission to Participate

a. For Participating Individuals: Adults (18 years old and above)

I have read and understood the entire information about this study described in this form (or have been read to me), which are written in English, a language known and spoken by me, and I voluntarily agree to participate in the survey and interview.

Further, I understand that I have the right to withdraw at any moment in this study without justifying my decision to do so and without affecting my academic standing in the university.

Name and Signature Date

_____
Day/month/year

b. Primary Investigator:

Name and Signature Date

_____
Day/month/year

10. Participation

Permission to include the data (personal information and answers in MARS) **obtained from you to analysis even an unexpected exclusion or withdrawal from the study has been decided.**

a. For Participating Individuals: Adults (18 years old and above)

I have read and understood the information about this section (or have been read to me) and I authorize the researcher/PI of this study to include the data (tests and interview answers) obtained from me to analysis even an unexpected exclusion or withdrawal from the study has been decided.

Name and Signature Date

_____
Day/month/year

Appendix D

Supplementary File S1. Informed Consent (English)

CODE:_____

愛媛大学 EHIME UNIVERSITY

Ehime University, Japan
Department of Civil and Environmental Engineering

INFORMED CONSENT SHEET

Project Title: **Validation of Mozzify, a real-time Dengue case reporting and mapping system, health communication and behavior modification mobile application**

1. Objectives

You are invited to join this study on the validation of Mozzify app, a real-time Dengue case reporting and mapping system, health communication and behavior modification mobile application.

2. Participation

2.1. You will be asked to:

- **a.** Sign the electronic **Informed Consent** (by clicking Yes, I agree)
- **b.** Download and use the **Mozzify App** on your mobile phone (iPhone), and;
- **c.** Answer the **Mobile Application Rating Scale professional version (MARS) OR the user version (uMARS)**, and;

2.2. The entire process will take **20-30 minutes** of your time.

2.3. You will be asked to provide the following in order to use the mobile application:

a. email address and password;
b. username and photo (optional).

2.4. You will also be asked to provide the following before answering the MARS/uMARS survey:

a. name, age (optional), civil status, occupation, gender, home and school or work address, family monthly income and self and family history of DF.

2.5. Participation in this study is entirely voluntary. You have the right to leave the study at any time, without penalty. Withdrawal in this study without justifying your decision will not affect you in any way.

2.6. Signing this form will give permission to the researcher/interviewer, monitor(s), the review board personnel, and the regulatory authority(ies):

a. access to your personal information if you chose to disclose your personal information and;

b. access to the data transmitted from the mobile application to the Firebase database (online) and from the electronic survey (MARS/uMARS) to Google Forms;

c. collect certain information automatically, including, but not limited to, the type of mobile device you use, your mobile device unique ID, the IP address of your mobile device, your mobile operating system, the type of mobile Internet

browser you use, unique device identifiers and other diagnostic data or usage data as stated in our Privacy Policy.

d. include the data (personal information and answers in MARS/uMARS) obtained from the you to analysis even an unexpected exclusion or withdrawal from the study.

2.7. This study will involve approximately 1000 participants (students, faculty and staff of Trinity University of Asia whose age is from 18 years old and above and who uses an iPhone) from August to September 2019.

3. Benefits

The results of this study will help healthcare practitioners and experts to identify the different DF hotspots in the Metro Manila, improving awareness, knowledge, attitude, help-seeking behavior and behavior change among Filipinos. This may also be of great help to community health service providers especially on dengue infection information dissemination to prevent or lessen the risk of high number of incidence in their community. Most importantly, the validation data will serve as springboard information in the distribution of the mobile application in the Philippines.

4. Risk/s

Participation in the study may pose unknown and unforeseeable risks. However, the methods (survey) and results (outcomes) **have no to minimal foreseeable risks,** inconveniences or any negative impact on your well-being.

5. Incentives

We will provide a token for your participation in this study.

6. Confidentiality

Your names and other information will be used only for this study and never will be used for other purposes. Every effort will be made to keep research records, and other personal information confidential during the course of data gathering, analysis and publication of this study:

6.1. Providing personal information like name and age is optional;

6.2. Each participant will be given a unique code (001-) in forms with identifiable information (informed consent and survey form);

6.3. Access to sheets that contain your information, such as names and age will be given limited access. Access will only be given to the PI, and other regulatory authority(ies);

6.4. Electronic data will be stored in password-protected databases and computer after the data gathering. After that, all data sheets that contain their names and other information will be properly disposed/deleted.

6.5. Analysis and results of data will not include any identifiable information to any of the participants.

CODE:_____

7. Results Disclosure

7.1. Results of the survey will be disclosed to you after your participation upon your request through email. Please write your email address: _____.

7.2. Findings of this study will be sent to you via email upon your request. Please write your email address: _____.

8. Contacts for Questions/Problems

8.1. If you have questions about the study, any problems, if you experience any unexpected physical or psychological discomforts, or think that something unusual or unexpected is happening, and other relevant information, please don't hesitate to contact the Primary Investigator:

Von Ralph Dane Marquez Herbuela
herbuelavonralphdane@gmail/@yahoo.com
Ehime University, Japan
080-3925-2523

8.2. This study is supported by the Unit For Environmental Research And Health Studies In Southeast Asia, Ehime University Research Unit Program.

8.3. The Trinity University of Asia's Institutional Ethics Review Committee (IERC) has approved this study, and may be reached through the following contact for information regarding your rights as participants, including grievances and complaints:

Name of MD or IRB Chair
Address:
Email:
Tel:
Mobile:

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9. Permission to Participate

a. For Participating Individuals: Adults (18 years old and above)

I have read and understood the entire information about this study described in this form (or have been read to me), which are written in English, a language known and spoken by me, and I voluntarily agree to participate in the survey and interview.

Further, I understand that I have the right to withdraw at any moment in this study without justifying my decision to do so and without affecting my academic standing in the university.

Name and Signature Date

_____
Day/month/year

CODE:_____

b. Primary Investigator:

Name and Signature Date

_____
Day/month/year

---

10. Participation

Permission to include the data (personal information and answers in MARS/uMARS) **obtained from you to analysis even an unexpected exclusion or withdrawal from the study has been decided.**

a. For Participating Individuals: Adults (18 years old and above)

I have read and understood the information about this section (or have been read to me) and I authorize the researcher/PI of this study to include the data (personal information and answers in MARS/uMARS) obtained from me to analysis even an unexpected exclusion or withdrawal from the study has been decided.

Name and Signature Date

_____
Day/month/year

Supplementary File S2. Informed Consent (Filipino)

CODE:_____

愛媛大学 EHIME UNIVERSITY

Ehime University, Japan
Department of Civil and Environmental Engineering

INFORMED CONSENT SHEET

Pag-validate ng Mozzify, isang real-time na pagrereport at pag-mamapa ng mga Dengue case, komunikasyon pangkalusugan at pagbabago ng ugali na mobile application

1. **Layunin**

Ikaw ay inaanyayahan na maging bahagi ng pag-aaral na ito tungkol sa pag-validate ng Mozzify, isang real-time na pagrereport at pag-mamapa ng mga Dengue case, komunikasyon pangkalusugan at pagbabago ng ugali na mobile application

2. **Pakikibahagi**

2.1. Kayo po ay inaasahang gawin o sagutin ang mga tanong sa mga sumusunod :

- **a.** Pagpirma sa **Informed Consent** (sa pmamagitan ng pag-click ng "OO, ako ay sumasang-ayon");
- **b.** I-download at gamitin ang **Mozzify App** sa inyong mobile phone (iPhone), at;
- **c.** **Sagutan ang talatanungang Mobile Application Rating scale** (para sa mga eksperto at propesyunal) o ang uMARS (para sa mga users).

2.2. Ang buong proseso ay inaasahang tatagal lamang ng **20-30** minuto.

2.3. Ang mga sumusunod ay mga kailangan para magamit ang mobile application:

a. email address at password;
b. username at larawan (opsiyonal).

2.4. Ang mga sumusunod ay mga kailangan bago sagutin ang talatanungang MARS/uMARS:

a. pangalan, edad (opsiyonal), civil status, hanapbuhay, kasarian, address ng tahanan o/at paraalan o hanapbuhay, buwanang kita ng pamilya at kung ikaw ba at/o sino man sa miyembro ng iyong pamilya ay nagkaroon na ng Dengue.

2.5. Ang iyong pakikibhagi sa pag-aaral na ito ay kusang-loob/boluntaryo. Kayo po ay may karapatang tumigil sa pakikibahagi sa pag-aaral na ito anumang oras na inyong nais.

2.6. Ang pagsang-ayon at pagpirma sa consent sheet na ito ay nagbibigay ng permisyon sa tagapanaliksik/interbyuwer, monitor, auditor at Ethics Review panel ng:

a. akses kaalaman at impormasyon tungkol sa inyong personal na impormasyon;

b. impormasyong naipapadala mula sa mobile application papaunta sa Firebase (database na online) at mula sa talatanungang elektroniko (MARS/uMARS) papunta sa Google Forms.

c. awtomatikong maglipon ng mga impormasyon, kabilang ang, ngunit hindi limitado sa uri ng mobile device na iyong ginagamit, natatanging mobile device ID, IP address ng iyong mobile device, mobile operating system, mobile internat

browser na inyong ginagamit, at natatanging device identifiers at iba pang diagnostic data o data ng paggamit na nakasaad sa aming Patakaran sa Pagkapribado (Privacy Policy).

d. na isama ang data (personal na impormasyon at mga sagot sa MARS/uMARS) na inyong ibinahagi sa pag-aanalisa kahit na ang pag-alis o paghinto ng pakikibahagi sa pag-aaral na ito ay napagdesisyunan na.

2.7. Ang itinakdang bilang ng mga magiging bahagi sa pag-aarala na ito ay mahigit kumulang na isang libo (1000) (na mga mag-aaral, faculty at kawani ng Trinity University of Asia na edad 18 pataas at gumagamit ng iPhone) mula Agosto hanggang Setyembre, 2019.

3. Benepisyo

Ang mga resulta ng pag-aaral na ito ay tutulong sa mga healthcare practitioner at eksperto na malaman ang iba't ibang mga lugar na may mataas na bilang ng taong may DF o DF hotspot sa Metro Manila, pagpapabuti ng kamalayan, kaalaman, saloobin, pag-uugali ng paghahanap ng tulong at pag-uugali ng pag-uugali sa mga Pilipino. Ito ay maaari ring malaking tulong sa mga tagapagkaloob ng serbisyong pangkalusugan ng komunidad lalo na sa pagpapakalat ng impormasyon sa impeksiyon ng dengue upang maiwasan o mabawasan ang panganib ng mataas na bilang ng saklaw sa kanilang komunidad. Pinakamahalaga, ang data ng pagpapatunay ay magsisilbing impormasyon sa pamamahagi ng mobile application sa Pilipinas..

4. Panganib or mga Risk

Ang pag-aaral na ito ay maaring makapagdulot ng hindi inaasahang panganib sa mga makikibahagi. Subalit, and mga layunin, gayundin ang mga paraan ng pagkuha ng impormasyon (surbey) ay walang nakikinitang panganib, abala o negatibong epekto sa iyo kagalingan.

5. Insentibo

Magbibigay kami ng isang token para sa iyong pakikilahok sa pag-aaral na ito.

6. Pangangalaga sa Impormasyon

Ang inyong pangalan at iba pang impormasyon ay gagamitin lamang sa pag-aaral na ito at hindi kailanman gagamitin para sa ibang layunin. Ang mga impormasyon tungkol sa inyo ay konpidensyal mula sa pagkalap ng mga data, pagsusuri, at paglalathala ng pag-aaral na ito.

a. Ang pagbabahagi ng inyong personal na impormasyon katulad ng pangalan at edad ay opsiyonal;

b. Ang bawat isang makikibahagi sa pag-aaral na ito ay bibigyan ng isang natatanging code (mula 001) sa mga forms na mayroong pagkakakilanlan mula sa inyong mga impormasyon.

c. Ang akses o pagkita sa mga materyal na nalalaman ng inyong pagkakakilanlan (hal. Pangalan at tirahan) ay limitado lamang sa tagapanaliksik/interbyuwer at mga awtoridad.

d. Ang elektronikong data ay itatabi sa mga database at computer na protektado ng password pagkatapos ng pagtitipon ng data. Pagkatapos nito, ang lahat ng mga data sheet na naglalaman ng kanilang mga pangalan at iba pang impormasyon ay maayos na itatapon / buburahin

e. Ang pagsusuri at mga resulta ng data ay hindi magsasama ng anumang nakikilalang impormasyon sa alinman sa mga kalahok.

7. Pagbabahagi ng mga resulta

7.1. Ang mga resulta ng talatanungan ay ibabahagi sa iyo pagkatapos ng iyong pakikilahok sa iyong kahilingan sa pamamagitan ng email. Mangyaring isulat ang iyong email address_____.

7.2. Ang mga natuklasan ng pag-aaral na ito ay ipapadala sa iyo sa pamamagitan ng email sa iyong kahilingan. Mangyaring isulat ang iyong email address_____.

8. Para sa mga Katanungan

8.1. Kung kayo po ay may mga katanungan tungkol sa pag-aaral na ito, anumang problema, o nakakaranas ng hindi inaasahang kakulangan sa ginhawang pisikal o sikolohikal, o hindi inaasahang pangyayari, at iba pang kaugnay na impormasyon, huwag magdalawang-isip na ipagbigay-alam sa tagapanaliksik/interbyuwer:

Von Ralph Dane Marquez Herbuela
herbuelavonralphdane@gmail/@yahoo.com
Ehime University, Japan
09955216252 (Globe)

8.2. Ang pag-aaral na ito ay suportado ng Unit For Environmental Research And Health Studies In Southeast Asia, Ehime University Research Unit Program.

8.3. Ang pag-aaral na ito ay iapprubahan ng Institutional Ethics Committee (IERC) ng Trinity University of Asia. Kung kayo ay may katanungan tungkol s a inyong mga karapatan bilang bahagi ng pag-aaral na ito o mga reklamo, maaring pumunta o tumawag sa:

Pangalan MD or IRB Chair
Address:
Email:
Tel:
Mobile:

---

9. Pahintulot Upang Makibahagi

a. (Para sa aking Pakikibahagi): 18 taong gulang pataas

Aking nabasa at naintindihan ang lahat ng impormasyon tungkol sa pag-aaral na inilarawan sa papel na ito (o binasa sa akin) na nakasulat sa Filipino (Tagalog), ang wika na alam at sinasalita ko, at ako ay kusang-loob/boluntaryong makikibahagi sa surbey at interbyu.

At higit pa, naiintindihan ko na ako ay may karapatang bawiin ang aking pakikibahagi anumang oras, nang walang kailangang dahilan at hindi makakaapekto sa aking pangangailangang medikal.

CODE:_____

Pangalan at Lagda Petsa

_____ _____

b. PI/Interbyuwer/Tagapanaliksik:

Pangalan at Lagda Petsa

_____ _____

---

10. Permisyon sa tagapanaliksik/interbyuwer na isama ang data (personal na impormasyon at mga sagot sa MARS o uMARS) sa pag-aanalisa kahit na ang pag-alis o paghinto ng pakikibahagi sap ag-aaral na ito ay napagdesisyunan na.

a. (Para sa aking Pagsang-ayon): 18 taong gulang pataas

Aking nabasa at naintindihan ang lahat ng impormasyon tungkol sa pag-aaral na inilarawan sa papel na ito (o binasa sa akin) at ako ay kusang-loob/boluntaryong makikibahagi sa surbey at interbyu.

At higit pa, naiintindihan ko na ako ay may karapatang bawiin ang aking pakikibahagi anumang oras, nang walang kailangang dahilan at hindi makakaapekto sa aking pag-aaral.

Pangalan at Lagda Petsa

_____ _____

Supplementary File S3. Withdrawal Sheet (English)

愛媛大学 EHIME UNIVERSITY

Ehime University, Japan
Department of Civil and Environmental Engineering

WITHDRAWAL SHEET

Project Title: **Validation of Mozzify, a real-time Dengue case reporting and mapping system, health communication and behavior modification mobile application**

To the PI,

I want to end my participation in this study. Ending my participation means the research team may only use and share the information as indicated below:

I want to (please choose one):

[ ] **End my participation in the study and not let the research team collect any more information about me (revoke my Authorization).** The information that I've provided in the mobile application may not be used by the research team.

[ ] **End my active participation in the study, but let the research team continue to collect my information.** The research team may continue collecting information that I have provided in the mobile application as needed for the study.

Optional:
I am ending my participation in this study because: _____

I will receive confirmation of this notice.

_____ _____
Signature of Participant Date

Supplementary File S4. Withdrawal Sheet (Filipino)

愛媛大学 EHIME UNIVERSITY

Ehime University, Japan
Department of Civil and Environmental Engineering

WITHDRAWAL SHEET

CODE:_____

Pag-validate ng Mozzify, isang real-time na pagrereport at pag-mamapa ng mga Dengue case, komunikasyon pangkalusugan at pagbabago ng ugali na mobile application

Sa Tagapanaliksik/Interbyuwer/PI,

Nais ko nang ihinto ang aking pakikibahagi sap ag-aaral na ito. Ang paghinto ng aking pakikibahagi ay nangangahulugan na ang tagapanaliksik/interbyuwer or PI ay maaring gamitin ang mga impormasyon tungkol sa akin ayon sa:

Nais kong (pumili ng isa):

[ ] Ihinto ang aking pakikibahagi sap ag-aaral na ito kasabay ng paghinto ng pagkakalap ng impormasyon tungkol sa akin (Pagbawi ng aking Pahintulot). Ang mga impormasyon ay hindi na maaring gamitin sa pag-aaral na ito.

[ ] Ihinto ang aking aktibong pakikibahagi sa pag-aaral na ito at pinahihintulutan ko ang tagapanalikisk, interbyuwer/PI na ipagpatuloy ang pagkalap ng mga impormasyon tungkol sa akin na kailangn sa pag-aaral na ito.

Opsyonal:
Nais ko nang ihinto ang pakikibahagi sap ag-aaral na ito sa kadahilanang:
_____

Tatanggap ako ng kumpirmasyon sa paunawang ito.

_____ _____
Lagda Petsa

Supplementary File S5. Profile Sheet

Appendix 4

愛媛大学 EHIME UNIVERSITY

Ehime University, Japan
Department of Civil and Environmental Engineering

PROFILE SHEET

PERSONAL INFORMATION

NAME: (Optional)_____
(Family/Last Name, First/Given Name, Middle Name)

AGE: _____(yrs.) _____(mos.)

CIVIL STATUS: _____ GRADE/YEAR LEVEL OR OCCUPATION:_____

GENDER: M / F

HOME ADDRESS: _____
(House number/Unit, Street, Village/Subdivision, Barangay, City,)

SCHOOL/WORK ADDRESS: _____
(House number/Unit, Street, Village/Subdivision, Barangay, City,)

FAMILY MONTHLY INCOME: ____<10,000PHP _____11-20,000PHP ____21-30,000PH
____ 31-40,000PHP ____ 41-50,000PHP ____ > 50,000PHP

Have you had Dengue before? Yes No

Has someone in your immediate family had Dengue before? Yes No

Supplementary File S6. Mobile Application Rating Scale – user version (uMARS)

Mobile Application Rating Scale: user version (uMARS)

App Name: MOZZIFY

Circle the number that most accurately represents the quality of the app you are rating. All items are rated on a 5-point scale from "1.Inadequate" to "5.Excellent". Select N/A if the app component is irrelevant.

App Quality Ratings

SECTION A

Engagement – fun, interesting, customisable, interactive, has prompts (e.g. sends alerts, messages, reminders, feedback, enables sharing)

1. **Entertainment: Is the app fun/entertaining to use? Does it have components that make it more fun than other similar apps?**
   1 Dull, not fun or entertaining at all
   2 Mostly boring
   3 OK, fun enough to entertain user for a brief time (< 5 minutes)
   4 Moderately fun and entertaining, would entertain user for some time (5-10 minutes total)
   5 Highly entertaining and fun, would stimulate repeat use

2. **Interest: Is the app interesting to use? Does it present its information in an interesting way compared to other similar apps?**
   1 Not interesting at all
   2 Mostly uninteresting
   3 OK, neither interesting nor uninteresting; would engage user for a brief time (< 5 minutes)
   4 Moderately interesting; would engage user for some time (5-10 minutes total)
   5 Very interesting, would engage user in repeat use

3. **Customisation: Does it allow you to customise the settings and preferences that you would like to (e.g. sound, content and notifications)?**
   1 Does not allow any customisation or requires setting to be input every time
   2 Allows little customisation and that limits app's functions
   3 Basic customisation to function adequately
   4 Allows numerous options for customisation
   5 Allows complete tailoring the user's characteristics/preferences, remembers all settings

4. **Interactivity: Does it allow user input, provide feedback, contain prompts (reminders, sharing options, notifications, etc.)?**
   1 No interactive features and/or no response to user input
   2 Some, but not enough interactive features which limits app's functions
   3 Basic interactive features to function adequately
   4 Offers a variety of interactive features, feedback and user input options
   5 Very high level of responsiveness through interactive features, feedback anduser input options

5. **Target group: Is the app content (visuals, language, design) appropriate for the target audience?**

   1 Completely inappropriate, unclear or confusing
   2 Mostly inappropriate, unclear or confusing
   3 Acceptable but not specifically designed for the target audience. May be inappropriate/ unclear/confusing at times
   4 Designed for the target audience, with minor issues
   5 Designed specifically for the target audience, no issues found

SECTION B

Functionality – app functioning, easy to learn, navigation, flow logic, and gestural design of app

6. **Performance: How accurately/fast do the app features (functions) and components (buttons/menus) work?**

   1 App is broken; no/insufficient/inaccurate response (e.g. crashes/bugs/broken features, etc.)
   2 Some functions work, but lagging or contains major technical problems
   3 App works overall. Some technical problems need fixing, or is slow at times
   4 Mostly functional with minor/negligible problems
   5 Perfect/timely response; no technical bugs found, or contains a 'loading time left' indicator (if relevant)

7. **Ease of use: How easy is it to learn how to use the app; how clear are the menu labels, icons and instructions?**

   1 No/limited instructions; menu labels, icons are confusing; complicated
   2 Takes a lot of time or effort
   3 Takes some time or effort
   4 Easy to learn (or has clear instructions)
   5 Able to use app immediately; intuitive; simple (no instructions needed)

8. **Navigation: Does moving between screens make sense; Does app have all necessary links between screens?**

   1 No logical connection between screens at all /navigation is difficult
   2 Understandable after a lot of time/effort
   3 Understandable after some time/effort
   4 Easy to understand/navigate
   5 Perfectly logical, easy, clear and intuitive screen flow throughout, and/or has shortcuts

9. **Gestural design: Do taps/swipes/pinches/scrolls make sense? Are they consistent across all components/screens?**

   1 Completely inconsistent/confusing
   2 Often inconsistent/confusing
   3 OK with some inconsistencies/confusing elements
   4 Mostly consistent/intuitive with negligible problems
   5 Perfectly consistent and intuitive

SECTION C

Aesthetics – graphic design, overall visual appeal, colour scheme, and stylistic consistency

10. **Layout: Is arrangement and size of buttons, icons, menus and content on the screen appropriate?**
    1 Very bad design, cluttered, some options impossible to select, locate, see or read
    2 Bad design, random, unclear, some options difficult to select/locate/see/read
    3 Satisfactory, few problems with selecting/locating/seeing/reading items
    4 Mostly clear, able to select/locate/see/read items
    5 Professional, simple, clear, orderly, logically organised

11. **Graphics: How high is the quality/resolution of graphics used for buttons, icons, menus and content?**
    1 Graphics appear amateur, very poor visual design - disproportionate, stylistically inconsistent
    2 Low quality/low resolution graphics; low quality visual design – disproportionate
    3 Moderate quality graphics and visual design (generally consistent in style)
    4 High quality/resolution graphics and visual design – mostly proportionate, consistent in style
    5 Very high quality/resolution graphics and visual design - proportionate, consistent in style throughout

12. **Visual appeal: How good does the app look?**
    1 Ugly, unpleasant to look at, poorly designed, clashing, mismatched colours
    2 Bad – poorly designed, bad use of colour, visually boring
    3 OK – average, neither pleasant, nor unpleasant
    4 Pleasant – seamless graphics – consistent and professionally designed
    5 Beautiful – very attractive, memorable, stands out; use of colour enhances app features/menus

SECTION D

Information – Contains high quality information (e.g. text, feedback, measures, references) from a credible source

13. **Quality of information: Is app content correct, well written, and relevant to the goal/topic of the app?**
    N/A There is no information within the app
    1 Irrelevant/inappropriate/incoherent/incorrect
    2 Poor. Barely relevant/appropriate/coherent/may be incorrect
    3 Moderately relevant/appropriate/coherent/and appears correct
    4 Relevant/appropriate/coherent/correct
    5 Highly relevant, appropriate, coherent, and correct

14. **Quantity of information: Is the information within the app comprehensive but concise?**
    N/A There is no information within the app
    1 Minimal or overwhelming
    2 Insufficient or possibly overwhelming
    3 OK but not comprehensive or concise
    4 Offers a broad range of information, has some gaps or unnecessary detail; or has no links to more information and resources
    5 Comprehensive and concise; contains links to more information and resources

15. **Visual information: Is visual explanation of concepts – through charts/graphs/images/videos, etc. – clear, logical, correct?**

N/A There is no visual information within the app (e.g. it only contains audio, or text)
1 Completely unclear/confusing/wrong or necessary but missing
2 Mostly unclear/confusing/wrong
3 OK but often unclear/confusing/wrong
4 Mostly clear/logical/correct with negligible issues
5 Perfectly clear/logical/correct

16. **Credibility of source: does the information within the app seem to come from a credible source?**

N/A There is no information within the app
1 Suspicious source
2 Lacks credibility
3 Not suspicious but legitimacy of source is unclear
4 Possibly comes from a legitimate source
5 Definitely comes from a legitimate/specialised source

App subjective quality

SECTION E

17. **Would you recommend this app to people who might benefit from it?**

1	Not at all	I would not recommend this app to anyone
2		There are very few people I would recommend this app to
3	Maybe	There are several people I would recommend this app to
4		There are many people I would recommend this app to
5	Definitely	I would recommend this app to everyone

18. **How many times do you think you would use this app in the next 12 months if it was relevant to you?**

1 None
2 1-2
3 3-10
4 10-50
5 >50

19. **Would you pay for this app?**

1 Definitely not
2
3
4
5 Definitely yes

20. **What is your overall (star) rating of the app?**

1	★	One of the worst apps I've used
2	★★	
3	★★★	Average
4	★★★★	
5	★★★★★	One of the best apps I've used

Perceived impact

SECTION F

1. **Awareness – This app has increased my awareness of the importance of addressing Dengue Fever symptoms, hospital that caters Dengue fever patients, Dengue Fever hotspots, prevention and treatment**

Strongly disagree				Strongly Agree
1	2	3	4	5

2. Knowledge – This app has increased my knowledge/understanding of Dengue Fever symptoms, hospital that caters Dengue fever patients, Dengue Fever hotspots, prevention and treatment

Strongly disagree				Strongly Agree
1	2	3	4	5

3. Attitudes – The app has changed my attitudes toward improving practices against Dengue Fever

Strongly disagree				Strongly Agree
1	2	3	4	5

4. Intention to change – The app has increased my intentions/motivation to address behavior change (practicing preventive measures against Dengue Fever).

Strongly disagree				Strongly Agree
1	2	3	4	5

5. Help seeking – Use of this app is likely to encourage further help seeking for clinical assessment when I have Dengue Fever symptoms (if it's required)

Strongly disagree				Strongly Agree
1	2	3	4	5

6. Behaviour change – Use of this app will increase the practice of preventive measures against Dengue Fever

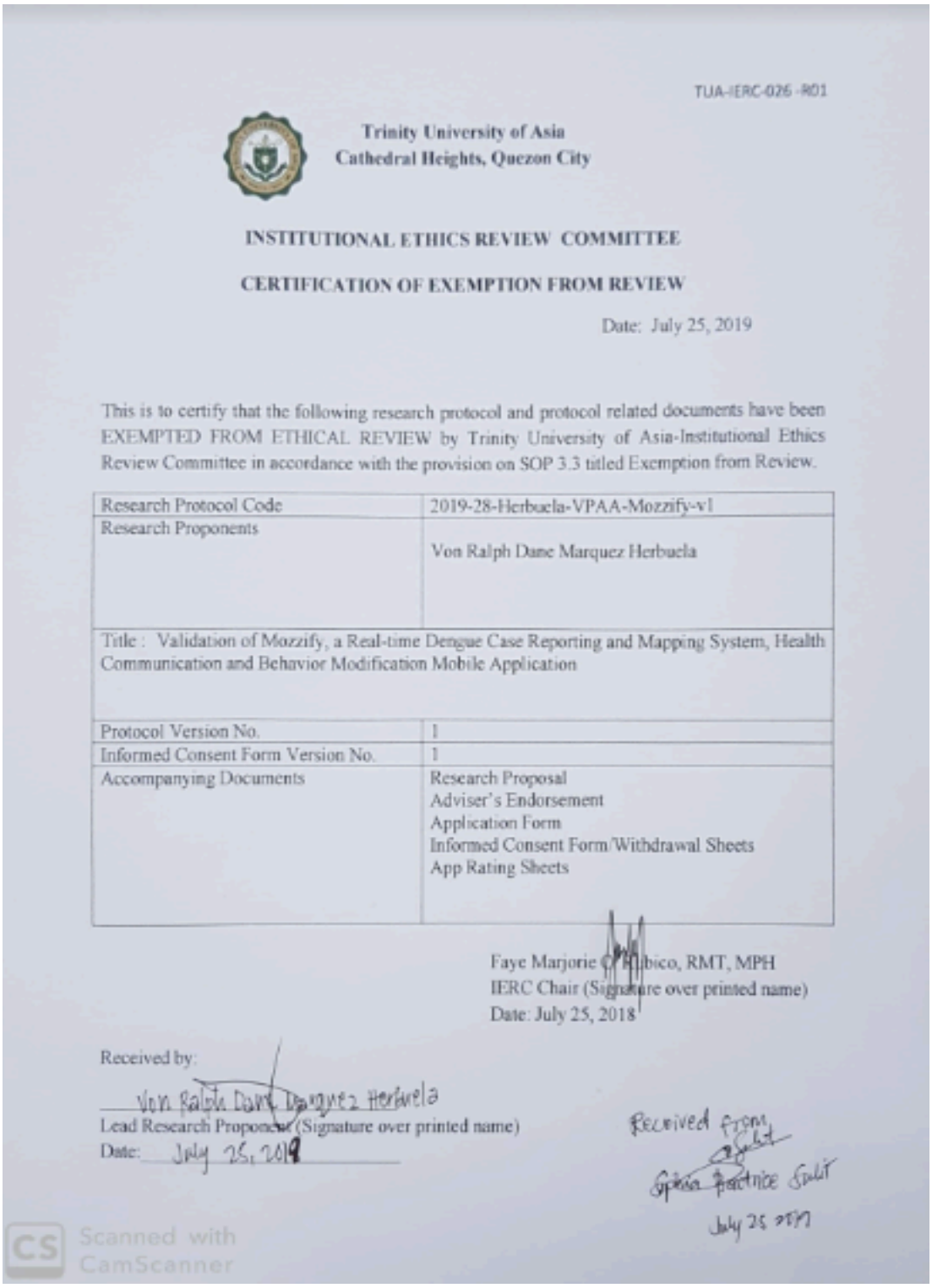
Strongly disagree				Strongly Agree
1	2	3	4	5

Further comments about the app?

THANK YOU!

Supplementary File S7. Mozzify Advertisement Poster

Supplementary File S8. Ethics approval certificate from Trinity University of Asia (TUA)



TUA-IERC-026 -R01

Trinity University of Asia
Cathedral Heights, Quezon City

INSTITUTIONAL ETHICS REVIEW COMMITTEE

CERTIFICATION OF EXEMPTION FROM REVIEW

Date: July 25, 2019

This is to certify that the following research protocol and protocol related documents have been EXEMPTED FROM ETHICAL REVIEW by Trinity University of Asia-Institutional Ethics Review Committee in accordance with the provision on SOP 3.3 titled Exemption from Review.

Research Protocol Code	2019-28-Herbuela-VPAA-Mozzify-v1
Research Proponents	Von Ralph Dane Marquez Herbuela
Title : Validation of Mozzify, a Real-time Dengue Case Reporting and Mapping System, Health Communication and Behavior Modification Mobile Application	
Protocol Version No.	1
Informed Consent Form Version No.	1
Accompanying Documents	Research Proposal Adviser's Endorsement Application Form Informed Consent Form/Withdrawal Sheets App Rating Sheets

Faye Marjorie C. Rubico, RMT, MPH
IERC Chair (Signature over printed name)
Date: July 25, 2018

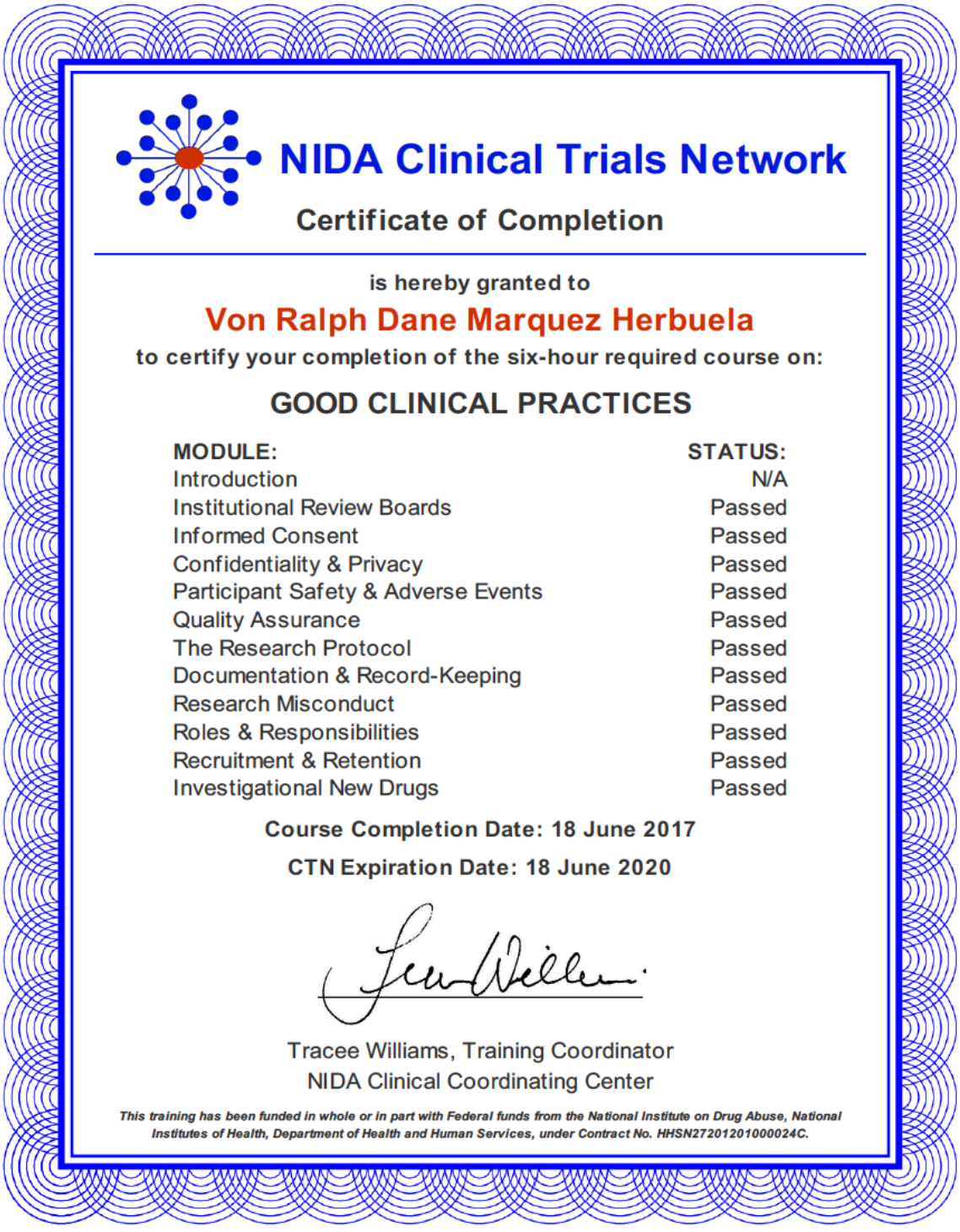
Received by:

Von Ralph Dane Marquez Herbuela
Lead Research Proponent (Signature over printed name)
Date: July 25, 2019

Received from
Sophia Beatrice Sulit
July 25 2019

Scanned with CamScanner

Supplementary File S9. Good Clinical Practice Certificate (NIDA, 2017)



NIDA Clinical Trials Network

Certificate of Completion

is hereby granted to

Von Ralph Dane Marquez Herbuela

to certify your completion of the six-hour required course on:

GOOD CLINICAL PRACTICES

MODULE:	STATUS:
Introduction	N/A
Institutional Review Boards	Passed
Informed Consent	Passed
Confidentiality & Privacy	Passed
Participant Safety & Adverse Events	Passed
Quality Assurance	Passed
The Research Protocol	Passed
Documentation & Record-Keeping	Passed
Research Misconduct	Passed
Roles & Responsibilities	Passed
Recruitment & Retention	Passed
Investigational New Drugs	Passed

Course Completion Date: 18 June 2017

CTN Expiration Date: 18 June 2020

Tracee Williams, Training Coordinator
NIDA Clinical Coordinating Center

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Supplementary File S10. Good Clinical Practice, University of the Philippines Manila-National Institutes of Health (UPM-NIH)

University of the Philippines Manila - National Institutes of Health (UPM - NIH)
Training Center for Health Research Ethics and Good Clinical Practice

in collaboration with the

Forum for Ethical Review Committees in Asia and the Western Pacific (FERCAP)

awards this

CERTIFICATE OF ATTENDANCE

to

Von Ralph Dane Herbuela

for having completed the

Training Workshop on Health Research Ethics and Good Clinical Practice

held at

Sophia 1 & 2 Function Room, Hotel Kimberly, Malate, Manila
on the 22nd to 24th of August 2017

CRISTINA TORRES, PhD
Coordinator
Forum for Ethical Review Committees
in Asia & Western Pacific Region

EVA MARIA CUTIONGCO-DE LA PAZ, MD, FPPS
Vice Chancellor for Research, University of the Philippines Manila and
Executive Director, National Institutes of Health

PMA CME UNITS: 100