

# Design of Diagnostic Tools for Dengue Fever with Webcam Access Through Handphone Using Wi-Fi Network

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**Abstract.** Dengue Hemorrhagic Fever was a health problem in Indonesia. Dengue Hemorrhagic Fever in West Kalimantan Province in 2017 the death rate was ranked second in Indonesia. The city of Pontianak as the center of West Kalimantan Province plays an important role in the spread of dengue disease, to the surrounding regencies/cities. Objectives: To analyze the sensitivity, specificity, positive predictive value and negative predictive value of the diagnostic tools used, namely; fever/heat, chills, headache, combination of fever and chills, combination of fever and headache, and combination of fever, chills and headache. Methods: The design in this study used an analytical observational design with a cross-sectional design. Results: The validity as measured by clinical symptoms was compared with the standard, namely a complete blood count, the results of clinical symptoms that had high sensitivity were obtained, namely a single clinical symptom of fever/heat, namely Se: 75.00%, Sp: 89.36%, PPV: 17.64% and NPV: 99.15%, while the combination symptoms that have the highest validity are fever/heat, headache, rash on the skin, and bleeding from the nose. and Guzi with the value of Se; 87.78%, Sp:92.96%, PPV: 41.18% and NPV: 99.18%. Develop an application. A simple diagnostic tool, a Wi-fi-based diagnostic tool that can be accessed with a cellphone and has succeeded in making a Flowchart of the Dengue Fever Suggestion: Combination of symptoms of fever, headache, skin rash, and bleeding from the nose and Guzi are typical symptoms found in the study area.

**Keywords:** Diagnostic Tool, DHF, Access HP, based on Wi-Fi

## 1 Introduction

Dengue Hemorrhagic Fever is a health problem in Indonesia. All regions of Indonesia are at risk of contracting dengue disease, because both the virus that causes it and the mosquitoes that transmit it are widespread in residential areas and public facilities throughout Indonesia. Based on existing reports to date, DHF has become an endemic problem in 33 provinces and 436 districts or cities, 605 sub-districts and 1800 villages or urban villages. From 2014 to 2015 it reached 41.25/100,000 population, with a case fatality rate of 0.7% [1]

DHF in West Kalimantan Province in 2009 the CFR DHF mortality rate ranked second in Indonesia, although the number of sufferers was only 979 cases, compared to West Java with 35,453 cases of DHF, and DKI Jakarta with 27,964 cases, but the mortality rate reached CFR: 3.38%, after Jambi with a CFR of 3.67%. An increase in dengue cases occurs every year, in

2017 there were 5,049 cases of dengue fever cases with 68 deaths, five districts/cities including Pontianak City were declared outbreaks. West Kalimantan Province ranks 2nd in the Kalimantan Islands region, after East Kalimantan with 5,762 cases of DHF. [2][3]

Aedes control and prevention programs in various countries including Indonesia generally still rely on fogging to kill adult mosquitoes. This requires large costs, creates vector resistance due to inappropriate doses, and does not have a long impact because the mosquito larvae do not die. Resistance of *Aedes aegypti* to organophosphates in Salatiga ranged from 16.6 - 33.3 percent, while against malathion 0.8% reached 66-82 percent. WHO only recommends the use of fogging not routinely, but only in areas that have been clearly identified.[4][5]. Research in Bandung showed that *Aedes aegypti* was also resistant to Allethrin, Permethrin, and Cypermethrin with a lethal time of 90% (LT90) ranging from between 9-43 hours. [6]

Dengue virus can grow and reproduce without causing death to mosquitoes because it does not form a cytopathic effect and is an obligate intracellular parasite, namely the ability of a virus that can only live in the living cells of certain suitable organisms so that if the living cells it is traveling in die, the virus will die. . Efforts to diagnose DHF in the early stages are difficult to distinguish from other viral infections (infections caused by viruses). A patient may suffer from dengue if the main symptom is fever and is accompanied by other clinical symptoms, namely fever, nausea and vomiting; rash; generalized pain (pain all over); positive tourniquet test results, and cases of dengue fever in an area are increasing. However, the problem is that the habitat of the virus in the host (Human), depends on the accuracy in diagnosing the patient.

Therefore, in this study, we will design a diagnostic tool for DHF patients using a webcam equipped with a heat sensor that changes to color, which is a combination of DHF case management technology with Information technology (IT). Cameras with heat sensors will perform image processing to change the heat temperature to a certain color. The detection system is then connected using a webcam and to sound an alarm on a computer/HP device that has been programmed with a detection system as a sign of danger and alertness. So that in addition to being able to immediately handle the patient, it is also connected to the dengue surveillance system which allows an epidemiological investigation (PE) to be carried out immediately in preventing transmission by the *Aedes aegypti* vector.

## 2 Method

This type of research is descriptive observational, with a cross-sectional study design, which aims to analyze the sensitivity, specificity, positive predictive value and negative predictive value of the diagnostic tool used, namely single symptom; fever/heat, chills, headache, and a combination of symptoms Symptoms Fever/heat, headache, skin rash, and bleeding from the nose and gut. The population in this study were all suspected DHF patients who checked themselves at 23 Puskesmas in Pontianak City, with a large sample calculation of the Cochran, W. G. (1977) formula at a 95% confidence level, on prevalence, and a margin of error of 0.05, so a sample is needed. of 136 respondents.[7]

As for Data Collection Techniques, the data collected includes data on the identity of people, clinical symptoms and results of microscopic blood examinations. Identity and clinical symptoms were carried out by structured interviews using a questionnaire. Interviews are addressed to the subject unless the interview children are represented by their parents.

Meanwhile, the results of the blood examination were carried out by the Officer. Data was analyzed descriptively and presented in the form of tables and narratives. To determine the prevalence of suspected DHF, the number of positive slide results was then compared with the total number of respondents. In addition, the sensitivity and specificity of each of these clinical symptoms were also calculated.

### 3 Results

Overview Pontianak City is the capital city of West Kalimantan Province, with an area of 107.82 km<sup>2</sup> consisting of 6 (six) sub-districts and 29 urban villages (see table 1 attachment profile). Pontianak City is crossed by the Equator at 0° 02' 24" north latitude to 0° 01' 37" south latitude and 109° 16' 25" east longitude to 109° 23' 04" east longitude. The height of Pontianak City ranges from 0.10 m to 1.50 m above sea level. The Pontianak City area as a whole is bordered by the Pontianak Regency and Pontianak City areas, namely:[8].

The largest area of Pontianak City is North Pontianak District which is 37.22 km<sup>2</sup> (34.52 %), followed by West Pontianak District 16.47 km<sup>2</sup>, Pontianak City District 15.98 km<sup>2</sup>, South Pontianak District 15.14 km<sup>2</sup>, Southeast Pontianak District 14 , 22 km<sup>2</sup>, while the smallest area is Kec. East Pontianak is 8.78 km<sup>2</sup> (8.14 %).

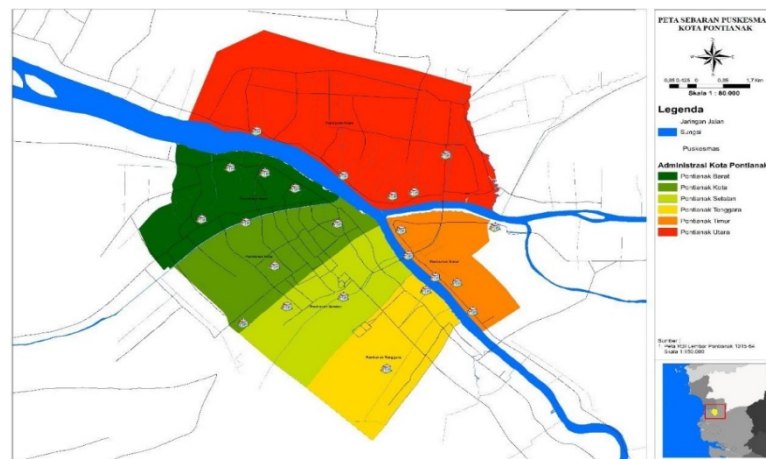


Fig. 1. Map of Administration and Distribution of Pontianak City Health Center

Situation of Dengue Hemorrhagic Fever (DHF). Dengue Hemorrhagic Fever is an acute infectious disease caused by the dengue virus. Dengue Hemorrhagic Fever is a dangerous infectious disease that can cause death in a short time if not treated immediately. Generally, dengue fever outbreaks increase again towards the beginning of the dry season in urban areas [9].

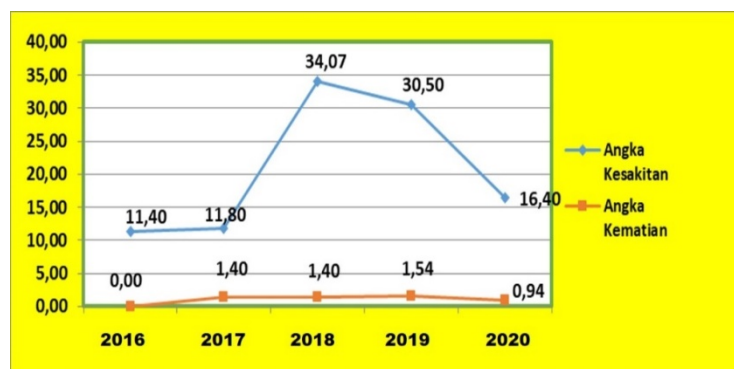


Fig. 2 Dengue Disease and Death Rate Pontianak City in 2016 to 2020

Figure 2 above illustrates the morbidity and mortality of dengue hemorrhagic fever in 2016-2020 in the city of Pontianak. Dengue hemorrhagic fever is a disease that always exists every year (endemic) and always has the potential to cause outbreaks.

Many factors have contributed to the increasing number of DHF sufferers, including: population density, clean and healthy living behavior of the people in Pontianak City which has not been optimal in eradicating mosquito nests, lack of availability of adequate resources both in terms of facilities and infrastructure, personnel and operational financing. activities, the higher the case of DHF in the district bordering the city of Pontianak and the higher the mobilization of the population from the district to the city which can increase the transmission of DHF. Thus, it is necessary to cooperate between various elements, both the community, the government and the private sector to make efforts so that the number of dengue cases in Pontianak City can be suppressed.

In Figure 3 above, we can see that the highest number of dengue cases in 2020 was in the Pontianak City sub-district with 31 cases, followed by South Pontianak sub-district with 28 cases and West Pontianak with 20 cases. While the fewest cases of DHF in North Pontianak sub-district were 6 cases.

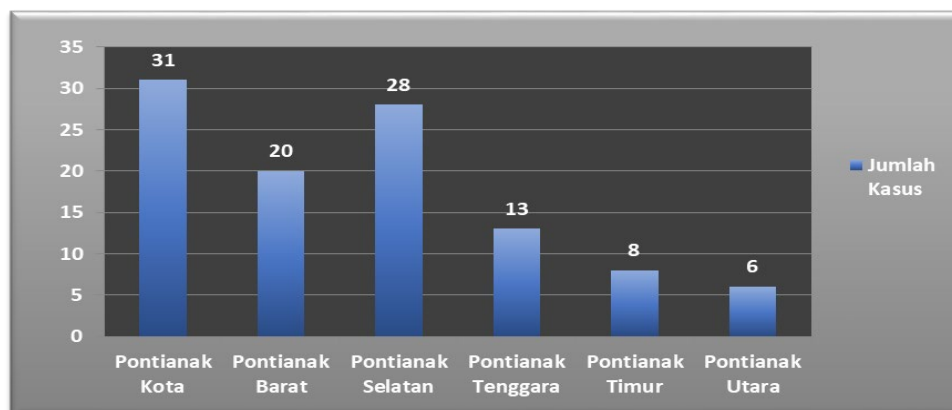


Fig. 3. Distribution of DHF Cases by District of Pontianak City in 2020

When viewed by gender, the highest number of dengue cases in 2020 was male, 76 cases, compared to 30 cases for women. There are 4 types of dengue virus (DENV), namely DENV-1, DENV-2, DENV-3, and DENV-4 viruses. Among these 4 viruses, the DENV-3 virus most often attacks the Indonesian population. Please note that someone who has been infected with 1 type of dengue virus, that person can be infected with another type of dengue virus. This means that a person can suffer from dengue fever more than once.[3]

The activities that have been carried out by the Pontianak City Health Office in an effort to prevent and eradicate Dengue Hemorrhagic Fever (DHF) in 2020 include: Implementation of Fogging / Fumigation of DHF vectors, Procurement of Logistics for Prevention and Control of DHF, Fogging Cadre Training, conducting Surveillance of DHF to Health Service Facilities., Printing of Fogging Report Forms, Cross-Programme and Related Cross-Sectoral Cooperation. Implementation of Larva Control Cards for households, Implementing Mosquito Nest Eradication (PSN), Periodic Lartic Monitoring (PJB) by Public Health Center officers and the Health Service, Periodic larva monitoring by cadres, Triggering DHF PSN in RW/RT that are endemic for DHF, and monitoring the use of larva identification cards in the community, as well as recording and reporting

The results of screening and diagnostic tools, the subjects who were examined were 136 people who were at 23 health centers in Pontianak City. The data obtained were as follows:

**Table 1.** Distribution of DHF screening targets by age group and gender in Pontianak City in 2021

| Age Group<br>(years old) | Jenis Kelamin |           | Total      | proportion<br>(%) |
|--------------------------|---------------|-----------|------------|-------------------|
|                          | Man           | Woman     |            |                   |
| < 14                     | 24            | 21        | 45         | 33,1              |
| 15 - 24                  | 19            | 14        | 33         | 24,3              |
| 25 - 44                  | 19            | 16        | 35         | 25,7              |
| 45 - 64                  | 10            | 9         | 19         | 14,0              |
| > 65                     | 3             | 1         | 4          | 2,9               |
| <b>Total</b>             | <b>75</b>     | <b>61</b> | <b>136</b> | <b>100</b>        |

From table 1 above, it can be seen that the group of subjects examined were 31.1% were children and 68.9% were adults. If we look at the research subjects according to gender, the male subject group is 55.15% and the female subject is 44.85%.

Incidence of DHF. In this screening study, all research subjects were taken peripheral blood preparations. Of the 136 complete blood preparations of the subjects of this study there were 17 subjects with positive results (Incidence Rate = 12.5%). This is when compared with the total population in November in Pontianak City is 2.63/100,000 population. Table 2 below is the distribution of subjects with positive DHF blood by age group. Table 2 below is the distribution of subjects with positive DHF by age group.

**Table 2.** Distribution of Subjects With Positive DHF by Age Group and in Pontianak City in 2021

| Age Group<br>(years old) | Number of blood<br>samples | Positive | incident<br>rate-<br>IR (%) |
|--------------------------|----------------------------|----------|-----------------------------|
| <14                      | 45                         | 8        | 18                          |
| 15 - 24                  | 33                         | 5        | 15,15                       |

|              |            |           |             |
|--------------|------------|-----------|-------------|
| 25 - 44      | 35         | 1         | 2,85        |
| 45 - 64      | 19         | 3         | 15,78       |
| > 65         | 4          | 0         | 0           |
| <b>Total</b> | <b>136</b> | <b>17</b> | <b>12,5</b> |

From table 2 below, it can be seen that positive blood preparations were found in 4 groups <14 years old, 15-24 years old, 25-44 years old and 45-64 years old, of the four groups, the highest IR was in the <14 year age group and lowest in the 25-44 year age group. To determine the sensitivity and specificity of clinical symptoms of DHF for screening tools compared to the results of microscopic examination of the examination of DHF blood preparations, the results can be seen in.

Table 3. Calculation of the Validity of Clinical Symptoms Against Microscopic Examination of Dhf Blood Samples in Pontianak City in 2021

| No       | Clinical Symptoms   | Se (%) | Sp (%) | PPV (%) | NPV (%) |
|----------|---|--------|--------|---------|---------|
| <b>A</b> | Single Symptoms   |        |        |         |         |
| 1        | Fever   | 75,00  | 89,36  | 17,64   | 99,15   |
| 2        | Reddish Rash  | 16,66  | 87,69  | 5,88    | 95,79   |
| 3        | Severe Headache   | 10,00  | 87,30  | 5,88    | 95,79   |
| <b>B</b> | Combination Symptoms  |        |        |         |         |
| 1        | Fever / fever, headache, and bleeding from the nose and Guzi, Swollen lymph nodes   | 15,38  | 87,78  | 11,76   | 90,75   |
| 2        | Fever / fever, headache, Pain in joints, muscles, and bones, and bleeding from the nose and Guzi, Swollen lymph nodes; Decreased appetite | 4,54   | 87,28  | 11,76   | 86,55   |
| 3        | Fever / fever, headache, Red rash on the skin, and bleeding from the nose and Guzi  | 87,50  | 92,96  | 41,18   | 99,18   |
| 4        | Decreased appetite Fever / fever, headache, and bleeding from the nose and Guzi, Swollen lymph nodes                                      | 3,22   | 84,76  | 5,88    | 74,78   |
| 5        | Swollen lymph nodes; Decreased appetite   | 2,30   | 82,97  | 5,88    | 82,00   |

From table 3 above, it can be seen that the symptoms of a combination of fever/heat, headache, red rash on the skin, and bleeding from the nose and Guzi, have high specificity. Clinical symptoms of fever/heat and headache have low sensitivity but high specificity.

## 4 Discussion

From the results of the screening conducted in Pontianak City, complete blood tests were carried out on 136 patients from 7 health centers in the research location. The distribution of research subjects whose blood samples were taken was known that the proportion of the age group <14 years was 18%, in the adult group > 15 years was 82%. Of the 136 subjects whose

blood samples were taken, 17 were positive for DHF (IR = 12.5%), with the highest SPR in the <14 years age group, with IR = 18%.

In 2020 there was 1 death from 106 cases of DHF. All cases of DHF as many as 106 cases in 2020 have been treated medically in hospitals with 1 death / CFR (Case Fatality Rate) 0.94%. This happened because the implementation of the DHF Prevention and Control Program was carried out in an intensive way by involving cross-programs and related sectors as well as empowering Cadres and the Community, although we know that the cases in the districts around Pontianak City are still quite high.

The validity as measured by clinical symptoms compared with the standard standard, namely complete blood examination, obtained the results of clinical symptoms that have high sensitivity, namely a single clinical symptom of fever/heat, namely Se; 75.00%, Sp: 89.36%, PPV: 17.64% and NPV: 99.15%, while the combination symptoms that have the highest validity are fever/heat, headache, skin rash, and bleeding from the nose. and Guzi with the value of Se; 87.78%, Sp:92.96%, PPV: 41.18% and NPV: 99.18%. This is in line with

The criteria for the diagnosis of dengue hemorrhagic fever (DHF) were established by the diagnostic criteria published by WHO in 2014. These criteria consist of clinical and laboratory criteria. Clinical criteria are: High fever, lasting for 2-7 days, for no apparent reason, Microbleeding is indicated by: Tourniquet test (+), Ecchymosis, petechiae, and purpura, Epistaxis, mucosal bleeding, bleeding gums, and hematemesis melena, enlarged liver, rapid pulse (tachycardia), poor tissue perfusion coupled with a weak pulse, decreased pulse pressure (< 20 mmHg), hypotension with cold and/or restless akral (finger tips or soles of the feet), and Laboratory Criteria: a). Thrombocytopenia (100,000/ $\mu$ l or less). b) Hemoconcentration, (as seen from the increase in hematocrit > 20%). The Rumpel Leede test, or sometimes called the tourniquet test, is a simple clinical examination recommended by WHO in the initial screening of patients with probable dengue. This test can be used as a predictor of platelet hemostatic activity, measure the degree of capillary fragility, and evaluate the presence of a decrease in platelet count and function. The Rumpel Leede test is also sometimes referred to as the Hess test or the containment test. In 2009, WHO included the results of this test as one of the criteria for diagnosing dengue infection and determining the degree of dengue hemorrhagic fever. In addition to dengue infection, this test can also be positive for immune thrombocytopenic purpura, thrombocytopenia, and Cushing's syndrome.[4][7]

Symptoms Fever/heat, headache, red rash on the skin, and bleeding from the nose and Guzi are typical symptoms found in the study area. In accordance with the results of the conference in London in 2015, it was stated that the symptoms of DHF were specific local symptoms[10][11][12] Thus the combination of fever/heat, headache, skin rash, and bleeding from the nose and guzi can be relied upon as a malaria screening tool in Pontianak City compared to other symptoms.

Flowchart of the Dengue Fever Examination System, starting from 1) The user opens/starts the Dengue Fever Examination System, 2) The user inputs the symptoms that are being experienced in the system, 3) The system processes the symptoms experienced by the user, 4) The system decides the user is sick with Dengue Fever or not and 5) Done. The use of this simple diagnostic tool is expected to assist the DHF initial examination officer as a screening tool in helping medical personnel determine the accuracy of diagnosis and immediate treatment. In addition, in the case of an out break emergency conditions can be utilized by Surveillance personnel to carry out proper mitigation. This simple diagnostic tool can also be used by DHF cadres, especially Jumantik, in conducting early detection.[13]

Obstacles and obstacles in this study were the difficulty of following up on the results of the examination of respondents both Suspec and cases of DHF in the medical records of

hospitals throughout Pontianak City. 30% of patients are referred to the hospital because they are suspected of being a Covid-19 suspect. This is in accordance with the Circular of the Ministry of Health No. HK.02.02/IV/2360/2020, dated April 6, 2020, prevention of dengue fever in the Covid-19 pandemic situation. That in establishing an early diagnosis of DHF, a Cross Reaction is carried out with other viruses (covid-19) at the Hospital, so that every serological examination of Dengue LgM is Positive in the Covid-19 Pandemic, it must be estimated that Covid-19 infection is a differential diagnosis, especially if the clinical symptoms are getting worse. Therefore, another method for early detection that is more precise is needed, namely the Learning Vector Quantization (LVQ) method, which is to diagnose Dengue Hemorrhagic Fever using input parameters, namely hemoglobin, leukocytes, platelets, and herithrocytes. results Based on the results obtained, the best accuracy value is 97.14% as research conducted by Firman Tawakal and Ahmedika Azkiya[14][15]

## **5 Conclusion**

Based on the sum of sensitivity and specivity and PPV, it can be concluded that the symptoms of a combination of fever/heat, headache, skin rash, and bleeding from the nose and guzi can be used as an early screening tool for DHF in Pontianak City. Based on the determination of the diagnostic test from clinical symptoms that have the highest validity, it is possible to design a Wi-Fi-based diagnostic test tool that can be accessed by HP.

## **6 Suggestion**

Combination of symptoms Symptoms of fever/heat, headache, rash on the skin, and bleeding from the nose and Guzi are typical symptoms found in the study area as a Wi-fi-based diagnostic tool and can be accessed with cellphones in diagnosing DHF patients in Pontianak City and possibly in other endemic areas.

Follow-up aspect: socializing and educating the use of Alta Dianosik to health workers and Jumantik Cadre before implementation. It is necessary to continue with the reliability test / kaffa coefficient test of the device, namely by microscopic examination of the blood of DHF patients in one or more different laboratories, then compared with the gold standard (West Kalimantan Health Laboratory), if the results are between 0.75-1, then the reliability of the device The diagnostics are very good. Can be used to conduct entomological surveys in the context of early vigilance before an outbreak occurs.

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