

ANDROID-BASED MOSQUITO LARVA RECORDING SYSTEM DESIGN USING CERTAINTY FACTOR METHOD FOR DBD ENDEMIC CONTROL

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Abstract— Dengue Fever (DHF) or *Demam Berdarah (DBD)* is an endemic disease in Indonesia. In 2015, there were 126,675 dengue cases occurred in Indonesia. This extraordinary event of DHF can be avoided if the early alert system is carried out well, such as counselling about dengue fever, periodic eradication of mosquito nests or *pemberantasan sarang nyamuk (PSN)* by the community, administration of abate drugs in water reservoirs and fogging (Fogging). The success of an early alert system can be measured by the larva free rate (ABJ). The use of the certainty factor method in determining the certainty presentation of ABJ and the endemic DHF early alert system, due to the certainty factor method shows good accuracy results of a certainty level of up to 92%. So that when applied to the larva note system (SICANTIK) mobile application. it is expected to be able to predict accurate and fast ABJ and early alert systems. So that through the larva note system (SICANTIK) mobile application, health workers can quickly find out the value of ABJ in a residential area of citizens. Based on this, health workers can take quick action by fogging in areas with low ABJ values. Where the act of fumigation is an act of controlling dengue outbreaks

Keywords: Larvae Free Numbers, Mobile Applications, Certainty Factors, Dengue Fever

Abstract—*Penyakit Demam Berdarah (DBD) merupakan penyakit endemic di Indonesia. Pada tahun 2015, tercatat 126.675 kasus DBD terjadi di Indonesia. Kejadian Luar Biasa DBD ini dapat dihindari bila sistem kewaspadaan dini dilakukan dengan baik, seperti penyuluhan mengenai demam berdarah, pemberantasan sarang nyamuk (PSN) secara periodik oleh masyarakat, pemberian obat abate pada penampungan air serta pengasapan (Fogging). Keberhasilan sistem kewaspadaan dini dapat diukur dengan Angka Bebas Jentik (ABJ).*

Penggunaan metode certainty factor dalam menentukan presentasi kepastian dari ABJ dan sistem kewaspadaan dini endemic DBD, dikarenakan bahwa metode certainty factor menunjukkan hasil akurasi tingkat kepastian yang baik hingga 92%. Sehingga ketika diterapkan pada aplikasi mobile sistem catatan jentik (SICANTIK), diharapkan dapat memprediksi ABJ dan sistem kewaspadaan dini yang akurat dan cepat. Sehingga melalui aplikasi mobile sistem catatan jentik (SICANTIK), petugas kesehatan dapat mengetahui dengan cepat nilai ABJ pada suatu wilayah perumahan warga. Berdasarkan hal tersebut, petugas kesehatan dapat melakukan tindakan cepat dengan melakukan pengasapan (fogging) pada wilayah yang nilai ABJ rendah. Dimana tindakan pengasapan tersebut sebagai tindakan pengendalian wabah DBD.

Kata Kunci: *Angka Bebas Jentik, Aplikasi mobile, Certainty Factor, Demam Berdarah*

INTRODUCTION

Indonesia as one of the Southeast Asian countries which are an endemic country of Dengue Hemorrhagic Fever (DHF). First discovered in 1968 in the city of Surabaya, as many as 58 were infected and 24 of them died, with a Mortality Rate (AK) reaching 41.3%. Since then, this disease has become one of the biggest outbreaks in Indonesia (Kementerian Kesehatan Indonesia, 2016). Extraordinary Events (KLB) of DHF can be avoided if the Mosquito Nest Eradication System (PSN) is done well, integrated and sustainable. The success of PSN can be measured by the Angka Bebas Jentik (ABJ). If ABJ is more than or equal to 95%, it is expected that dengue transmission can be prevented or reduced (Kementerian Kesehatan RI, 2010).

ABJ control can be done by monitoring larvae by health workers (C. R. L. Putri & Laksono, 2017). But in Susanti's research (Susanti, 2014) explained that not all surveillance officers plan and carry out larvae monitoring. Factors causing the weakness of the DBD surveillance system include surveillance which has not yet received surveillance training, many officers have multiple tasks, not all officers carry out the surveillance system components, and data presentation is still done manually and has not been carried out maximally.

However, accurate larval monitoring results are needed as an effort to prevent and eradicate DHF. To support the Ministry of Health's program, this study proposes to build an android-based larval notes system based on the certainty factor method to determine the accuracy of larval free numbers in endemic DBD control efforts.

This Sicantik application makes it easy for larva monitors that can be done by officers or the public. Smartphones have become an important item for everyone, so recording larvae can be done at any time without waiting for health workers who come to monitor and record larvae.

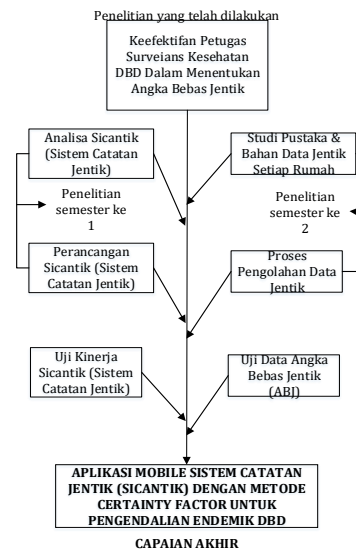
Whereas the certainty factor method has been widely used by previous researchers in various fields and produces accurate accuracy in the process of prediction percentage. As research conducted by Sari (Sari, 2013) that the certainty factor method shows 92% accuracy to detect the risk of DBD.

It is hoped that by using the certainty factor method, the larvae record system (SICANTIK) can determine the areas that must be treated quickly for dengue-endemic fever based on accurate prediction of larval free numbers (ABJ). So that health workers in each region can act quickly to make efforts to control DBD endemic.

MATERIALS AND METHODS

1. Research Phase

A good and directed research flow is needed as a reference to carry out research from the beginning to the end of the study. So that it can produce research outputs that are able as a supporter in solving problems in society. A response to the spread of endemic DBD in the community. The flow of research to be carried out is explained in Figure 1, as follows:



Sources: (Putri & Anggraeni, 2019)

Figure 1 Research Plan

In the research plan, the study was conducted in six stages divided into two semesters in one research year. The first semester consisted of Analysts needing the larval notes system (SICANTIK), building a larva notes mobile application system, testing application performance, implementing the processing and testing of larval free data.

2. Data Collection Method

In building this larvae record system, data can be obtained in three ways. First, conducting library research as an effort to obtain information from books, health service reports and scientific articles relating to previous research; Second, direct observation at the health department of the municipal level of the mayor of Depok; and the third interviewed with health workers from the Puskesmas Cilangkap, Depok.

3. Waterfall Model

In the development of the waterfall model system is widely used by previous researchers. The waterfall model is a classic model that is systematic, sequential in building software. The waterfall model consists of five stages in development. The following is an explanation of the stages diverted in the waterfall model according to Pressman (Pressman, 2010):

a. System/Information Engineering and Modelling

The communication that is formed at the beginning of building the system is initializing the system such as analyzing problems, collecting necessary data, and defining the features and functions of the software. This stage is often referred to as Project Definition.

b. Software Requirements Analysis
 This stage is the design and modelling phase of a system architecture that focuses on designing data structures, software architectures, interface display, and program algorithms.

c. Design
 This process is used for system requirements to be represented in the form of blueprint software before coding begins. The design must be able to implement the requirements.

d. Coding
 This stage is the process of translating a design form into code or can be read by a machine.

e. Testing
 After coding is complete, testing of the negative system is carried out. All functions that are owned by the software must be tested. So that there is no error in the software

f. Deployment (Delivery, Support, Feedback)
 The last stage is the stage of implementing software to the customer, repairing software, evaluating software and developing software.

4. Certainty Factor Method

In this research, in determining the accuracy of predictions of the right handling for the handling of dengue fever, in this study using the certainty factor method. This method is a supporter of the level of confidence in the results of predictions on the choice of handling of DHF response based on the value of ABJ and the number of houses with positive status and negative mosquito larvae. The Certainty Factor (CF) method was introduced by Shortliffe Buchanan in making MYCIN in 1984. CF is a clinical parameter value given by MYCIN to show the amount of trust. Certainty Factor is defined as follows (Mariana, Gernowo, & Noranita, 2012):

$$CF[H, E] = MB[H, E] - MD[H, E] \dots\dots\dots (1)$$

Where:

1. $CF[H, E]$ = certainty factor of hypothesis H which is influenced by the status (evidence) E.
2. $MB[H, E]$ = a measure of the increase in confidence in the Hypothesis that is influenced by symptom E.
3. $MD[H, E]$ = a measure of the increase in distrust of the hypothesis H which is influenced by symptom E.

The MYCIN method for combining the antecedents of a rule is shown in the table below (Mariana et al., 2012):

Tabel 1 Aturan MYCIN untuk mengkombinasikan evidence antecedent

Evidence, E	Antecedent Ketidapastian
E1 DAN E2	Min[CF(H,E1), CF(H,E2)]
E1 OR E2	Max[CF(H, E1), CF (H,E2)]
TIDAK E	- CF(H,E)

Sources: (Mariana et al., 2012)

RESULTS AND DISCUSSION

A. System Analyst

At the system analysis stage, the data obtained in this study through field studies on health workers (PUSKESMAS) who understand the identification of environmental health, especially regarding dengue fever. In addition, it is supported by a literature study on larval free numbers and the handling of low larval free numbers as an effort to control endemic dengue fever. Where in this study, the reasoning process used by using the forward chaining process. The system will make the reasoning to determine dengue fever countermeasures based on larval free numbers, as well as the negative and positive status of the number of larvae in each house. The system has provided knowledge-based rules for the investigation of the type of handling of dengue fever. Data output from research conducted is the result of the prediction of countermeasures and the value of trust based on the certainty factor method. In this design, the production rules are written in the form of a statement IF [permis] THEN [conclusions]. Whereas the symptom is connected by using the AND logical operator. So that the following statement is formed:

IF [AB]1 Value] AND [Status1] THEN [Handling]

From the form of production rules above, can be applied as an example of the following rules:

Rule 1:

If the larval free value is less than 50%
And the number of larva positives is more than 13,
then Fogging

Converters of production rules to dengue handling tables can be seen in Table 3. The rows show the value of larva free numbers and status.

Table 2 Handling

Kode	Handling
P001	Counseling
P002	Mosquito Nest Cleaning
P003	Giving Abate
P004	Fogging

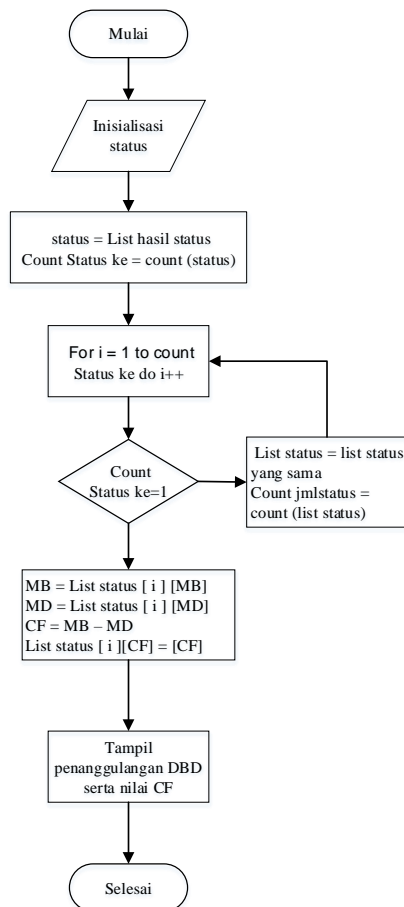
Sources: (S. A. Putri & Anggraeni, 2019)

Tabel 3 Relation

No	Status	P001	P002	P003	P004
S001	ABJ 10% - 50%				X
S002	ABJ 51% - 75%			X	
S003	ABJ 76% - 85%		X		
S004	ABJ 86% - 100%	X			
S005	Positive larval 0 - 3	X			
S006	Positive larval 4 - 8		X		
S007	Positive larval 8 - 12			X	
S008	Positive larval 13 and above				X

Sources: (S. A. Putri & Anggraeni, 2019)

Knowledgebase that is dynamic, so that health workers can add or change the knowledge base according to new data. In designing this mobile-based larva note system using forward chaining reasoning method that starts from the number of positive or negative larvae numbers in each home given by the user as a system input, then tracking is calculated until the final goal in the form of prediction of the possibility of handling control endemic dengue fever and the value of trust. In the process of drawing, conclusions can be seen in the picture which is an expert system solution using a flowchart or flow diagrams.



Sources: (S. A. Putri & Anggraeni, 2019)

Figure 2. Reasoning Flowchart

To find out the prediction results of dengue endemic prevention, the prediction process is tested. In testing, based on the results of status 1). ABJ <50%, 2). Number of positive larvae > 13. From the status obtained certainty weights on each status produced, thus producing the amount of MB and MD based on the results of the status. After the MB and MD values are obtained, then the process of calculating the value of certainty factor is certain, as follows:

Jika the rate of larval free ABJ 10% - 50%
 DAN Positive larval 13 and above,
 Maka MB [ABJ < 50%, Positive larval > 13] = 0.95,
 MD [ABJ < 50%, Positive larval > 13] = 0.05

$$CF [ABJ < 50\%, \text{Positive larval} > 13] = 0.95 - 0.05 = 0.90$$

After the testing process is successfully carried out, the calculation result from the system of possible countermeasures is fogging with a certainty factor value of 90%.

A. Application of the Waterfall Model

1. System/Information Engineering and Modeling

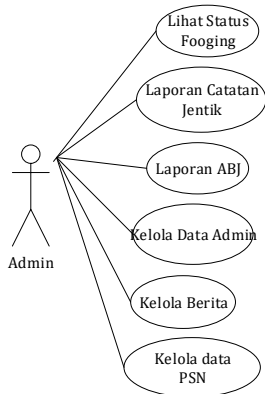
The needs analysis process identifies the importance of recording larvae in surveillance activities for public environmental health in a variety of situations and conditions. In addition, how the attitude of public acceptance of applications made so that the purpose of making applications that have been described previously can be achieved.

2. Design

This planning process is an effort to provide convenience for the public in using this application. So that the purpose and objectives of making this application can be fulfilled. In making the design using UML tools.

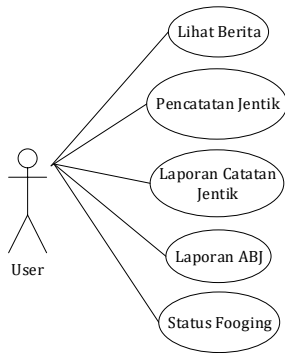
a. Use case Application Menu Diagram

Figure 3 is a use case diagram of the system that has been created. The figure shows that in the system that was designed there were eleven use cases. In the use case diagram described in the Figure there are things that can be done by administrators including (1) Manage news data, (2) Manage PSN data, (3) See Fogging Status, (4) Flick Notes Report, (5) Report ABJ, (6) Manage admin data.



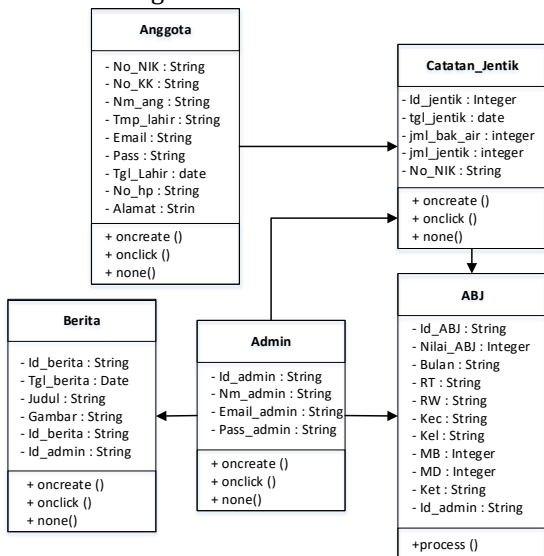
Sources: (S. A. Putri & Anggraeni, 2019)
Figure 3. Admin Usecase Diagram

As for users (members), use case diagrams can be explained in Figure 4. Users can do the following things, namely: (1) See News, (2) Record of larvae, (3) Report of larvae notes, (4) Report of ABJ and (5) Fogging Status.



Sources: (S. A. Putri & Anggraeni, 2019)
Figure 4. Use Case Diagram of Users (Members)

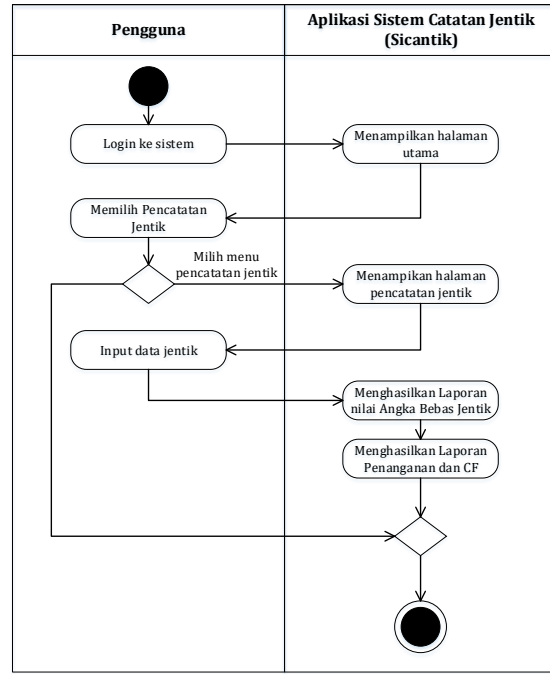
b. Class Diagram



Sources: (S. A. Putri & Anggraeni, 2019)
Figure 5 Class Diagram

Figure 5 illustrates the structure and description of classes, packages, and objects and their relationships with each other.

c. Activity Diagram



Sources: (S. A. Putri & Anggraeni, 2019)
Gambar 6 Activity Diagram Pencatatan Jentik

Figure 6 Typical larva recording activity

3. Coding

At this stage is the making of program code that is used to produce a percentage of confidence prediction of the type of endemic DHF countermeasures based on the value of larvae free numbers derived from the data on mosquito larvae recording.

Source Code Looks for ABJ Value and Certainty Factor

```

Widget formcatatanjentik() {
    return Container(
        padding: EdgeInsets.only(left: 30.0,
            right: 30.0, top: 25.0),
        child: Column(
            crossAxisAlignment:
                CrossAxisAlignment.stretch,
            children: <Widget>[
                new TextFormField(
                    decoration: new
                    InputDecoration(hintText: 'Tahun'),
                    keyboardType: TextInputType.number,
                    maxLength: 20,)),
                new TextFormField(
                    decoration: new
                    InputDecoration(hintText: 'Bulan'),
                    keyboardType: TextInputType.text,

```



```

        maxLength: 45,)),
        new TextFormField(
            decoration: new
InputDecoration(hintText: 'Minggu'),
            keyboardType: TextInputType.text,
            maxLength: 30,)),
        new TextFormField(
            decoration: new
InputDecoration(hintText: 'baikair'),
            keyboardType:
TextInputType.datetime,
            maxLength: 100,
            maxLines: 5,)),
        new TextFormField(
            decoration: new
InputDecoration(hintText: 'Jentik'),
            keyboardType: TextInputType.number,
            maxLength: 15,)),

Button
btnTX=(Button);
}}};
    
```

4. Implementation

The research conducted resulted in a mobile-based larva note system.

1) Login Display



Sources: (S. A. Putri & Anggraeni, 2019)
Figure 7 Login page

Before using the Sicantik application, users are required to log in according to the user and password that has been registered previously.

2) Display the main Menu



Sources: (S. A. Putri & Anggraeni, 2019)
Figure 8 User Main Menu Page

After logging in, the user's main page will appear. On this page the user can choose the larvae recording, larvae report, larvae number report.

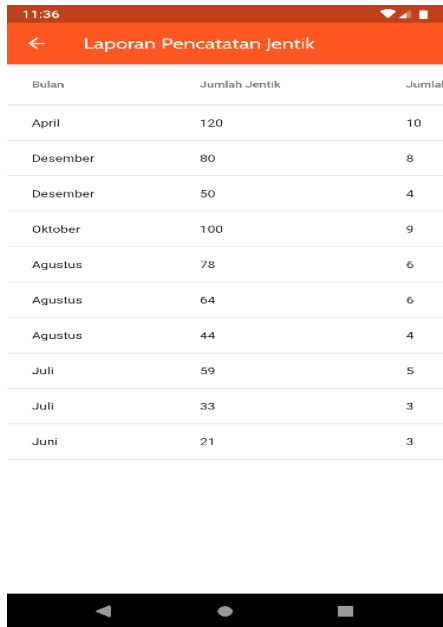
3) Display of Mosquito larvae recording



Sources: (Putri & Anggraeni, 2019)
Figure 9 Menu Page

After selecting the larva recording menu, a larva recording page will appear. The data included consisted of, the number of water tanks owned and the number of mosquito larvae in the water tank.

4) Display detailed report of larvae

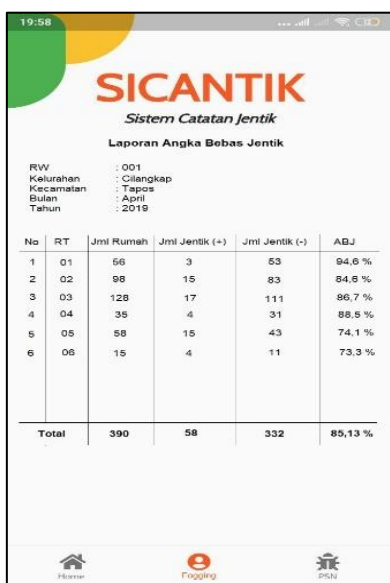


Bulan	Jumlah Jentik	Jumlah
April	120	10
Desember	80	8
Desember	50	4
Oktober	100	9
Agustus	78	6
Agustus	64	6
Agustus	44	4
Juli	59	5
Juli	33	3
Juni	21	3

Sources: (S. A. Putri & Anggraeni, 2019)
Figure 10 Flick Notes Report

After recording the larvae data will produce several reports, first, the larvae notes report. This report has information such as larva data recapitulation from each resident's house.

5) Display of the Free Quartal Report (Details)

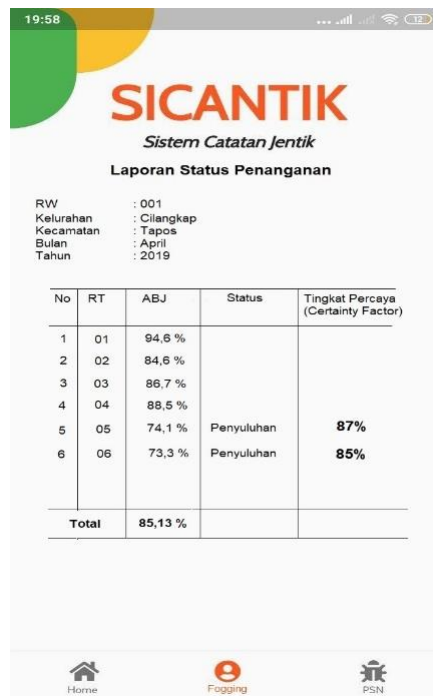


No	RT	Jml Rumah	Jml Jentik (+)	Jml Jentik (-)	ABJ
1	01	56	3	53	94,6 %
2	02	98	15	83	84,6 %
3	03	128	17	111	86,7 %
4	04	38	4	31	88,5 %
5	05	58	15	43	74,1 %
6	06	15	4	11	73,3 %
Total		390	58	332	85,13 %

Sources: (Putri & Anggraeni, 2019)
Figure 11 Free larval rate report

Next, the larvae free report is obtained from the larvae data recapitulation. This report has a recapitulation of data on the number of larva positive, negative numbers of larvae, and the value of larvae free numbers in each region.

6) Display of Fogging Status Report (Details)



No	RT	ABJ	Status	Tingkat Percaya (Certainty Factor)
1	01	94,6 %		
2	02	84,6 %		
3	03	86,7 %		
4	04	88,5 %		
5	05	74,1 %	Penyuluhan	87%
6	06	73,3 %	Penyuluhan	85%
Total		85,13 %		

Sources: (Putri & Anggraeni, 2019)
Figure 12 Fogging Status Report

Furthermore, the latest report produced is the Status Fog Report and the level of prediction confidence using the certainty factor method.

5. Testing

The testing phase is the final stage in software development which is done to detect errors (error) and ensure the output produced in accordance with what is desired. The testing phase uses black-box testing.

CONCLUSION

Android-based larva note system (sicantik) that has been designed is expected to provide convenience or help users in recording larvae data routinely. In addition, the larva data recorded are neatly stored and quickly accessed when needed in a database. With this result, it is expected that the application of the larvae record system can help provide decision support quickly for health workers to determine the treatment chosen in accordance with the prediction of larval free values (ABJ) produced so that endemic DHF control efforts can be carried out quickly. It is expected

that further research in the future, the application of the larva note system (sicantik) can provide notifications automatically if the larval free rate (ABJ) is below 80% in each region. So that health workers can find ABJ under 80% in real-time.

BERDARAH DENGUE DI PUSKESMAS KOTA SEMARANG. In *Skripsi*. Semarang.

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