ABSTRACT

Introduction: Dengue Hemorrhagic Fever (DHF) causes 40% of world population at risk for infection, and 50 million people get infection with as many as 24,000 die every year. Incidence rate in Indonesia, particularly in Maritengngae Subdistrict, Sidenreng Rappang District, is increasing and needed to be controlled. Disease distribution has not been documented regionally. The dynamics of the incidence, that comprises the characteristics of the patient, environmental conditions, susceptibility of mosquitoes resulted from insecticide use, transovarial infectivity, and the incidence pattern were unknown.

Objectives: To identify the dynamics of DHF incidence with spatio-temporal approach, includes gender, age, the habit of cleaning the water containers, house density, the density of water containers within the radius of 100 meters from the house of the patient, resistance of the mosquito, and transovarial transmission of Dengue virus.

Methods: Subjects were DHF patients in Maritengngae Subdistrict. It was an epidemiological observational study with cross-sectional design and spatio-temporal approach to variables of the study, which included the patient characteristics (age, gender, habit of cleaning the water containers), environmental conditions (house density, water container density within 100 meter radius around the patient’s house), and vector conditions (resistance status to organophosphate insecticide, and transovarial transmission of Dengue virus).

Results: Cases of DHF in Maritengngae Sub district, Sidenreng Rappang District, South Sulawesi decreased from 95 cases in 2008 to 38 cases in 2009, except in Kelurahan Majeling. Incidence distribution of DHF in 2008-2009 based on gender were not different (p=1.000), patients with age <15 years old were different from age ≥15 years (P=0.016 and p = 0.013), house density and density of water containers around the patient’s house were not different (p=0.829 and p = 0.538). The habit of cleaning water containers at the house was 43.84%. There were 1.94% of Aedes aegypti samples showed medium resistance (tolerance) status against organophosphat insecticide and 33.33% of samples showed transovarial transmission of Dengue virus. The highest of transovarial transmission occured in Kelurahan Majeling with transovarial transmission index of 100%.

Conclusion: The transmission dynamic of DHF in Maritengngae sub district is not influenced by gender, house densities, water container densities, and the frequency of source reduction, but influenced by ages. Most of Ae. aegypti mosquitoes are still susceptible against organophosphate insecticides. The highest of transovarial transmission of dengue virus in Ae. aegypti in Kelurahan Majeling with Transovarial transmission index of 100% may contribute in the increasing of DHF cases in the Kelurahan Majeling in 2009.

Key words: dynamics, dengue, spatio-temporal, Ae. aegypti, Maritengngae.
INTRODUCTION

Dengue hemorrhagic fever (DHF) is distributed found in 107 countries, and until year 2000 there were 40% of world populations were at risk of DHF. Each year, 50 million people is infected, and 24,000 are died. Indonesia is the second most endemic country in Southeast Asia in morbidity and mortality rate, after Thailand. Incidence rate (IR, cases/10,000 populations) in 2003 was increased until 2007, with case peak in January-February. Control has been conducted with success indicator of maximum IR 2/10,000, case fatality rate (CFR) <1%, and larva-free rate 95%. However, the incidence has been expanded to the areas previously free from DHF. There were 330 cities/districts infected in 2006 and it have been increased to 355 cities/districts in 2007.

All cities/districts in Sulawesi Selatan Province have reported DHF in 2007. Endemic districts were Sidenreng Rappang (Sidrap), which had increased patients in 2006-2007 (IR from 3.6/10,000 to 5/10,000). Each year DHF cases were found in Maritengngae Subdistrict, Sidrap Distric which had the largest population (47,578) and had most density (725/km²) compared with other subdistrict. The strategic location
has facilitated the transmission. DHF patients reported in 2007 were 27 (IR 5.7/10,000), and increased in 2008 to 85 patients (IR 17.9/10,000).

DHF in Maritengngae Subdistrict has been the priority health problem which needs more intensive control. The obstacles in disease control are the susceptibility of population at risk, density and mobility, good transportation, seasonal change influenced by world climate, environmental conditions, viral virulence, health behavior6,9, the unavailability of antiviral agent and vaccine to prevent the disease10, and unintegrated mosquito eradication of mosquito nest. Chemical eradication with insecticide has been conducted, but the result has not been documented and mosquito resistance was unknown. Development and dissemination of the disease has not been documented by regional analysis.

Pattern of DHF incidence in 2008 was unknown, and the comparison with that in 2009 was also unknown. The research problems were: what are the dynamics of DHF incidence, which consist of the patient characteristics (gender, age, and habit of cleaning the water containers), specific environmental conditions (house density, density of water containers around the patient’s house), mosquito resistance to insecticide, and transovarial mosquito infectivity. Epidemiological analysis with spatial and temporal approach is needed to be conducted to understand the factors which had role in the transmission of DHF in Maritengngae Subdistrict, and to identify the dynamics of DHF incidence with spatio-temporal approach, includes gender, age, the habit of cleaning the water containers, house density, the density of water containers within the radius of 100 meters from the house of the patient, resistance of the mosquito, and transovarial transmission of Dengue virus.

**MATERIALS AND METHODS**

Subjects were DHF patients in Maritengngae subdistrict, Sidenreng Rappang District, South Sulawesi Province. It was an epidemiological observational study with cross-sectional design and spatio-temporal approach to variables of the study, which included the patient characteristics (age, gender, habit of cleaning the water containers), environmental conditions (house density, water container density within 100 meter radius around the patient’s house), and vector conditions (resistance to organophosphate insecticide, and transovarial transmission of Dengue virus).

Mean and deviation standard of absorbance value (AV) was measured at 450 nm to figure out susceptibility status of *Ae. aegypti* mosquitoes against organophosphate insecticide based on the determination of non-specific esterase activities toward α-naphtyl acetate. The presence of dengue antigen on head squashes of unbloodfed *Ae. aegypti* mosquitoes from ovitrap placed in Maritengngae subdistrict were detected using monoclonal antibody against dengue (DSSC7) based on immunohistochemical assays to measure the transovarial transmission Index (TTI) on the F1 generation of *Ae. aegypti* mosquitoes.

**RESULTS AND DISCUSSIONS**

1. **Location of the study**

Maritengngae Subdistrictis located at 3°56′35.7″-3°57′89.9″SL and 119°47′97.1″-119°49′92.7″EL, in the 50° zone at the South of Equator11, and consists of 7 *Kelurahan* and 5 Village. Total area is 6,590 hectare12 with population of 40,945, and ratio of male and female is 1.05:113. The age compositions are mostly in 15-44 years old (28.81%) and 45-64 years old age group (25.9%).
2. DHF incidence in 2008-2009

Confirmed DHF patients were 127, consisted of 89 patients in 2008 and 38 patients in 2009, scattered in 11 Village/Kelurahan. Most patients in 2008 were found in Kelurahan Pangkajene, Rijang Pittu, and Lautang Benteng, while in 2009 they were found in Kelurahan Majjeliing and Pangkajene.

DHF incidence in 2009 was mostly decreased in each Village/Kelurahan, compared with that in 2008. However, it was increased in Kelurahan Majjelling, Takkalasi Village, and Sereang Village, where there were no previous infections. Thematic visualization of DHF incidence based on Village/Kelurahan in 2008 and 2009 is shown in Figure 2.

Figure 1. Distribution of DHF patients based on Village/Kelurahan in Maritengngae Subdistrict in 2008 and 2009

Figure 2. Thematic DHF incidence based on Village/Kelurahan in Maritengngae Subdistrict in 2008 and 2009
The cause of the decrease in 2009 was unknown, either accidental or resulted from intervention and prevention efforts. In the field study, there were no reports on the control and prevention of DHF in 2008-2009. Reports on focus management activity, fogging focus, and insecticide use in that period could not be obtained. Surveillance staff in local health office informed that insecticide used in that period was organophosphate.

Weekly pattern of DHF incidence was fluctuated, with difference in incidence time. In 2008, incidence was started from week 1-29 with case peak in week 5, 18, and 20. There were no cases in the subsequent weeks. In 2009, there were 3 periods, in week 1-11, 20-30, and 40-52. Each period was interspersed with case-free weeks, and the highest cases were occurred in week 44, 50, and 51.

The dwellings of patients in January-March 2008 were partly grouped to form cluster \((p=0.035)\) based on retrospective space-time analysis with weekly aggregate \((\alpha=0.05)\). Epicentrum cluster was in Pangkajene (radius 330 meter). The presence of cluster showed that the DHF transmission in area it covered was faster, based on weekly duration. Patients in the cluster area were generally ill at the relatively adjacent time and location.

However, the dwellings of patients in April-June 2008 and October-December 2009 were adjacent, but did not form significant cluster. Most patients in 2008 lived in groups to form cluster in 2 areas \((p=0.01\) and \(p=0.017)\), which different from the incidence in 2009. Epicentrum cluster was in Pangkajene, consistent with epicentrum cluster of patients in January-March 2008 (coordinate 3,92688° SL and 119,79292° EL). Pangkajene is a city area, and the capital of subdistrict and district. There are many housings and gathering places in the urban area, therefore, more people will have contact with mosquitoes, along with the fast development of mosquito population. Cluster in Kelurahan Wala (radius 10 meter) was formed by case of housemates and neighbors. DHF incidence in 2009 did not form any clusters \((p=0.085)\), although the houses were adjacent.
Figure 4. DHF incidence and clusters formed in Maritengngae Subdistrict in 2008 and 2009

Figure 5. Distribution of DHF patients based on gender in Maritengngae Subdistrict in 2008 and 2009
3. DHF incidence based on characteristics of the subjects

a. DHF incidence based on gender

DHF patients consisted of female (53.54%) and males (46.46%). Analysis with chi-square showed no significant difference in patient distribution in 2008 and 2009 based on gender (p=1.000). Retrospective space-time analysis on patient dwellings in 2008 based on gender gave p-value of 0.058 (males) and 0.362 (females). Similar analysis for incidence in 2009 gave p value of 0.720 (males) and 0.121 (females). Analysis showed no significant cluster based on gender, thus, the difference in distribution was not significant.

Proportion of female patients was higher than male patients, but the difference was not significant\(^\text{15}\). However, the total number of male cases was higher than female cases in Singapore, with the ratio of 1.9:1. Particular disease are found more in one gender, but it does not mean that the particular gender has higher risk\(^\text{17}\). Gender was part of epidemiologic triad of disease need to be calculated\(^\text{18}\) and DHF endemicity is affected by its epidemiological component, such as gender\(^\text{19}\). Females mostly stay at home, giving them more exposure and more infection while stay inside the house\(^\text{20}\), parallel with behavior of \textit{Ae. Aegypti} who has activities inside the house. On the other hand, immune responses of females increased faster compared with males\(^\text{20}\), so that they develop immunity faster, but this is needed to be studied further.

b. DHF incidence based on age

Most patients were distributed in \(<15\) years old age group (88.19%) compared with \(\geq15\) years old age group (11.81%). Analysis with chi-square showed a significant difference in distribution between patients in 2008 and 2009 based on age group (p=0.016).

### Table 1. Distribution of DHF patients based on gender and incidence year in Maritengngae Subdistrict in 2008 and 2009

<table>
<thead>
<tr>
<th>Gender</th>
<th>2008</th>
<th>2009</th>
<th>Total</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Male</td>
<td>41</td>
<td>32.29</td>
<td>18</td>
<td>14.17</td>
</tr>
<tr>
<td>Female</td>
<td>48</td>
<td>37.79</td>
<td>20</td>
<td>15.75</td>
</tr>
<tr>
<td>Total</td>
<td>89</td>
<td>70.08</td>
<td>38</td>
<td>29.92</td>
</tr>
</tbody>
</table>

### Table 2. Distribution of DHF patients based on age group in Maritengngae Subdistrict in 2008 and 2009

<table>
<thead>
<tr>
<th>Age group</th>
<th>2008</th>
<th>2009</th>
<th>Total</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>&lt;15 years old</td>
<td>83</td>
<td>65.35</td>
<td>29</td>
<td>22.83</td>
</tr>
<tr>
<td>(\geq15) years old</td>
<td>6</td>
<td>4.72</td>
<td>9</td>
<td>7.09</td>
</tr>
<tr>
<td>Total</td>
<td>89</td>
<td>70.08</td>
<td>38</td>
<td>29.92</td>
</tr>
</tbody>
</table>
Most patients <15 years old in 2008 lived closely, gave a cluster (p=0.013) with 10 meter radius in Wala and 530 meter in Pangkajene, but there were no clusters for patients ≥15 years old (p=0.85). Dwellings of patients in 2009 did not form any significant clusters for <15 years old (p=0.184) and ≥15 years old (p=0.722). Cluster in Wala was formed by patient group with adjacent houses, with patients in the age between 3-8 years old, and mostly ill in February. Age affects susceptibility. Children are commonly susceptible to DHF. Under-five-years-olds mostly stay at home, sleep in the morning and afternoon, which is the optimum activity time of Aedes\textsuperscript{10,21}. Mosquito activity is increased around two hours after the sun rises and several hours before the sun sets\textsuperscript{22}. School children (5-14 years old) are commonly susceptible to DHF\textsuperscript{23,13}. However, the proportion of patient ≥15 years old in 2009 was higher than in 2008, which showed a shift of proportion to adults. The highest proportion of patients in 1994-1995 was in school children, but in 1996-1998 it was shifted to ≥15 years old\textsuperscript{24}, which may be associated with the interaction of various serotypes of Dengue virus, particularly in the endemic area.

Figure 6. DHF patients based on age group and clusters formed in Maritengngae Subdistrict in 2008 and 2009
c. Habit of cleaning the water containers

Water containers in 127 patient’s houses consisted of closed water tanks in 10 houses, water buckets in 114 houses, and bak mandi (cuboid/rectangular water container in the bath room) water tubs in 73 houses. The habit of cleaning the water buckets was found in almost all houses (110 houses, 96.49%). Most people even clean them every day (87.77%), therefore, possibility of Ae. Aegypti hatching eggs in the water containers were decreased. However, the habit of cleaning the bak mandi for a minimum of once a week was only occurred in 32 houses (43.84%).

The availability of water containers in the patient’s house showed the habit to save the water. This is similar with the result of the study in Sangata Utara (Kutai Timur) which indicated that the people had habit of saving water for household. The more the water containers represent the more available locations for the breeding of mosquitoes. There was a significant association between the activity of draining the water containers and population of Aedes mosquitoes. Risk of DHF transmission will still exist when the transmission vector is still breeding. Irregular cleaning of the bak mandi provides a place for Ae. Aegypti to breed. Cleaning the water container in household for a minimum of once a week may break the mosquito life cycle, which corresponds with the duration of egg, larva, and pupa growth. Generally, the growth from Ae. Aegypti egg to adult mosquito needs 9-10 days. Most houses with frequency of cleaning the bak mandi minimum once a week formed cluster with radius of 540 meter (p = 0.026). The breeding of mosquitoes in that cluster area was supposed to be low.

Figure 7. Cluster of DHF patients’ houses with the habit of cleaning the bak mandi
4. DHF incidence based on environmental conditions

Environmental conditions around the DHF patient’s houses consist of house density, and the density of water containers within the radius of 100 meter, which is the flying distance of Aedes mosquito\textsuperscript{27,36}, as the buffer area of Dengue virus transmission. Buffer area is also determined internationally to prevent the transmission of Yellow Fever (radius 400 meter) from airports and harbors\textsuperscript{31}.

Epidemiological investigation, focus management, and focus fogging use 200 meter radius from patient’s house\textsuperscript{32}. House density and density of water containers around the patient’s house is part of potential environmental conditions in DHF transmission. Each house forms buffer area which coincident and intersects with each other, so that the flying distance and transmission area of the mosquito are wider. Most houses of patients in 2009 were in the same location with those in 2008, so that the transmission buffer area formed was overlapped. It showed the similarity of pattern of DHF incidence which concentrated in similar places, although the total number of patients in 2009 was smaller. Based on the pattern, DHF incidence in previous and subsequent years would probably concentrated in the similar locations.

a. DHF incidence based on house density

Each transmission buffer area was situated between 5-93 houses. The similarity of house density around the houses of DHF patients in 2008 and 2009 was that the distribution was bigger in the interval of 30-39 houses than in the other intervals, although the proportion in 2008 was bigger (23.6%) than in 2009 (18.42%). Total number of houses in each

Figure 8. DHF patients and transmission buffer area formed in MaritengngaeSubdistrictin 2008 and 2009
transmission buffer area gave different risk in DHF transmission by Aedes aegypti. Analysis with independent t-test showed no difference in average houses in transmission buffer area in 2008 and 2009 (p = 0.829), therefore, the house density 100 meter from patient’s house was not significantly different. The recurrent DHF incidence in the same area caused no significant difference in house density in transmission buffer area in 2008 and 2009.

Houses around the patient’s house were mostly grouped in Kelurahan Pangkajene, Majjelling, Lautang Benteng, and Rijiang Pittu. The area was the center of the city and the center of government in Sidrap District. Therefore, the population was heavier and become the gathering place for people from other Village and Subdistrict. The growth of Ae. aegypti population is faster in the urban area, results in more contact with human, particularly in areas close to household water containers\(^1\). One of the causes of the increased DHF cases are the population density, house density, and other complex causes\(^9\).

b. DHF incidence based on the density of water containers

Total number of water containers in each transmission buffer area was 12-267, with the highest distribution in the interval of 90-199 (28.35%). The more the water containers, the faster the mosquito population increased\(^2\). The similarity of distribution of water containers in each transmission buffer area for DHF incidence in 2008 and 2009 was that the highest number was found in the interval of 90-119, although each proportion was different (28.09% and 28.95%). Analysis with independent t-test showed insignificant difference (p=0.538) in the average of total number of water containers in transmission buffer area in 2008 (125.79) and 2009 (118.39). It meant that the density of water containers in the radius of 100 meter from patient’s house in 2008 and 2009 was not different.

<table>
<thead>
<tr>
<th>Year incidence</th>
<th>Min</th>
<th>Max</th>
<th>Average</th>
<th>SD</th>
<th>SE</th>
<th>p-value</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>8</td>
<td>93</td>
<td>43.99</td>
<td>18.873</td>
<td>2.001</td>
<td>0.829</td>
<td>89</td>
</tr>
<tr>
<td>2009</td>
<td>5</td>
<td>91</td>
<td>44.82</td>
<td>21.747</td>
<td>3.528</td>
<td></td>
<td>38</td>
</tr>
</tbody>
</table>

Note: Min=minimum; Max=maximum; SD=standard deviation; SE=standard error; N= total subject

<table>
<thead>
<tr>
<th>Incidence year</th>
<th>Min</th>
<th>Max</th>
<th>Average</th>
<th>SD</th>
<th>SE</th>
<th>p-value</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>19</td>
<td>267</td>
<td>125.79</td>
<td>59.357</td>
<td>6.292</td>
<td>0.538</td>
<td>89</td>
</tr>
<tr>
<td>2009</td>
<td>2</td>
<td>255</td>
<td>118.39</td>
<td>66.984</td>
<td>10.866</td>
<td></td>
<td>38</td>
</tr>
</tbody>
</table>

Note: Min=minimum; Max=maximum; SD=standard deviation; SE=standard error; N= total subject
Aedes mosquito hatches eggs in clean water containers, such as (bak mandi), buckets, and others. They only put their eggs in clean water. Eggs are hatched in the house and around it, or in public places and particular locations which drowned by water, until radius of 500 meter from surrounding buildings.

5. Resistance to insecticide and transovarial transmission

*Ae. Aegypti* mosquitoes for dengue virus examination were obtained from 6 Villages/ Kelurahan, and those for resistance examination were obtained from 4 Villages/Kelurahan.

### Table 5. Distribution of susceptibility status of *Ae. aegypti* based on Village/Kelurahan in 2010

<table>
<thead>
<tr>
<th>Kelurahan</th>
<th>Susceptibility status</th>
<th>Total</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sensitive (AV&lt;0.753)</td>
<td></td>
<td>Moderately resistant (0.753 ≤ AV&lt;1.236)</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Majjeling</td>
<td>86</td>
<td>95.56</td>
<td>4</td>
<td>4.44</td>
</tr>
<tr>
<td>L. Benteng</td>
<td>89</td>
<td>98.89</td>
<td>1</td>
<td>1.11</td>
</tr>
<tr>
<td>Rijang Pittu</td>
<td>89</td>
<td>98.89</td>
<td>1</td>
<td>1.11</td>
</tr>
<tr>
<td>Takalasi</td>
<td>89</td>
<td>98.89</td>
<td>1</td>
<td>1.11</td>
</tr>
<tr>
<td>Total</td>
<td>353</td>
<td>98.06</td>
<td>7</td>
<td>1.94</td>
</tr>
</tbody>
</table>

### Table 6. Distribution of result examination of transovarial transmission in *Aedes aegypti* based on the origin of mosquito in 2010

<table>
<thead>
<tr>
<th>No</th>
<th>Origin of mosquito</th>
<th>Result</th>
<th>TTI (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>Positive</td>
</tr>
<tr>
<td>1</td>
<td>Majjeling</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>Lautang Benteng</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Rijang Pittu</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Lakessi</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Tanete</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Takalasi</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>32</td>
<td>16</td>
</tr>
</tbody>
</table>
Most *A. aegypti* mosquitoes examined were sensitive to organophosphate insecticide. The presence of moderately resistant mosquitoes prompts a consideration of changing the type of insecticide used. *Ae. Aegypti* studied in Cimahi District also showed a decrease in susceptibility to organophosphate insecticide, while in Yogyakarta they tended to be resistant to similar insecticide. Active substance of insecticide is related to resistance of mosquitoes, which effect still present in the environment after being used for more than 6 years, and the resistance process may occurred between one to several decades. Each year, DHF incidence is followed by continued insecticide use. Mosquito coil (*obat nyamuk bakar*) has been used daily in more than 85% of patient’s houses. Mosquito repellent used continuously in the household may affect the susceptibility of the mosquitoes. The susceptibility of Aedes mosquito to organophosphate and pyrethroid insecticides in Cimahi city was decrease. In Takalasi, Majjelling, and Lautang Benteng Village, most area is used for agriculture and cattle centre. Continuous pesticide use for agriculture and livestock may affect susceptibility status of Aedes mosquito in the area. However, various types of insecticides used is not documented, so that it is difficult to predict the exposure to *A. aegypti* based on area and time. The District of Health Office have to conduct diversification of insecticides in managing DHF focus to decrease the resistance of the mosquitoes. Observation and prevention is needed to be increased, particularly more accurate patient recording, counselling on mosquito repellent use to school children, and controlling the habit of population in cleaning their water containers by periodic larva survey. Local government (District, Subdistrict, Village/Kelurahan), The District of Health Office, and Public Healt Center (Puskesmas) have to cooperate in increasing the community participation to be more active in source reduction by conducting 3M+ (*menguras* draining, *menutup* covering, *mengubur* burying, and *memberi* applying larvicide). Enhancing role of cadres in each Village/Kelurahan to monitor the area to prevent the transmission of DHF.

b. Transovarial transmission of Dengue virus

Dengue virus was examined with immunohistochemistry-immuperoxidase streptavidin biotin complex (IISBC), which showed the transovarial Dengue virus transmission, which proportion is determined by transovarial transmission index (TTI).

Dengue virus-positive mosquitoes were obtained from *Kelurahan* Majeling (TTI=100%) and Tanete Village (TTI=50%), while the others (TTI=12.5%) came from Lautang Benteng, Takalasi, Lakesssi, and Rijang Pittu. A study in Pontianak also found transovarial viral transmission in *A. aegypti*. The viral transmission is probably occurred through DHF transmission process every year. The decrease in Dengue virus in *A. aegypti* in Selangor (Malaysia) was occurred for the subsequent five generations. It was suggested that there was a double shift of virus from mosquitoes who were anthropophilic and multiple bities, that is, firstly, from mosquito to its offspring, and secondly, new mosquito
obtain Dengue virus from patients with viremia. However, transovarial Dengue virus transmission in Maritengngae Subdistrict is still needed to be studied further. Visualization of resistance and transovarial transmission of Dengue virus in *A. aegypti* is shown in Figure 9. Other researchers is suggested to study further about spatio-temporal approach on the resistance of *A. aegypti* to insecticide and transovarial viral transmission in endemic and sporadic areas of DHF.

**CONCLUSION**

Cases of DHF in Maritengngae Sub district, Sidenreng Rappang District, South Sulawesi decreased from 95 cases in 2008 to 38 cases in 2009, except in *Kelurahan* Majelling increased from 5 cases in 2008 to 13 cases in 2009. Most patients in 2008 lived in groups to form cluster with epicentrum cluster of patients on January-March at coordinate of 3.92688° SL (P=0.01), and epicentrum cluster on April-June at coordinate of 119.79292°EL (P=0.017). The epicentrum is in *Kelurahan* Pangkajene, a city area, and the capital.
of sub district and district. However, the dwellings of patients in April-June 2008 and October-December 2009 were adjacent, but did not form significant cluster. DHF incidence in 2009 did not form any clusters (p=0.085), although the houses were adjacent. This transmission dynamic is not influenced by gender, house densities, water container densities, and the frequency of source reduction, but influenced by ages. Most of Ae. aegypti mosquitoes are still susceptible against organophosphate insecticide. The highest of transovarial transmission of dengue virus in Ae.aegypti in Kelurahan Majelling with TII of 100% may contribute in the increasing of DHF cases in the Kelurahan Majeling in 2009.

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