THE EFFECTIVENESS OF REACTIVATION OF LONG LASTING INSECTICIDE NETS (LLINS) ON MOSQUITO KILLING POWER *Aedes aegypti*

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Abstract

Vector, especially mosquitoes, is the main cause of vector-borne diseases including malaria, dengue fever and filariasis which are still a public health problem in the world, including Indonesia. Efforts to control vector-borne diseases can be carried out in various ways, including biological, physical, chemical and environmental engineering. Mosquito control in malaria areas is carried out by using various methods of indoor residual spraying (IRS) and use long lasting insecticide nets. Long enough use of long lasting insecticide nets can cause dust and dirt. It is necessary to reactivate the long lasting insecticide nets. The purpose of this study was to determine the reactivity effectiveness of long lasting insecticide nets on the killing power of Aedes aegypti mosquitoes. This research method was pre-experimental the static group comparation with a control group design. The research was carried out by controlling the long lasting insecticide nets without reactivation and treatment with reactivation on the long lasting insecticide nets. Each confinement of 20 Aedes aegypti mosquitoes and the application was carried out for 3 days with 3 replications. The results showed that reactivation of long lasting insecticide nets with clean water had an average death rate of 15 mosquitoes (75%). Reactivation with detergents had an average death rate of 14 mosquitoes (70%), there was no significant difference in the various reactivation methods (p value = 0.209), meaning that various reactivation methods used in the study could be carried out but must pay attention to the detergent dosage used. The conclusion of this study is that there are no differences in the various ways of reactivation with clean water or detergent on the killing power of Aedes aegypti mosquitoes and based on the results of the reactivation effectiveness test of the long lasting insecticide nets used that 45 months of use are no longer effective for controlling vector-borne diseases. For other researchers, reactivation of long lasting insecticide nets for no more than 30 months is used with various reactive methods to determine the effectiveness of the killing power of mosquitoes.

Keywords: *Reactivation; Long Lasting Insecticide Nets; Aedes aegypti*

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A. Preliminary

Vectors and disease-carrying animals in Indonesia have been identified mainly related to tropical infectious diseases both endemic and potential infectious diseases outbreaks. Given the variety of tropical diseases that are vector and zoonotic diseases, the efforts to control vectors and disease-carrying animals become an integral part of efforts to combat vector infectious diseases, including zoonotic diseases that can potentially attack humans, which require standard quality environmental health and health requirements. (Kementrian Kesehatan RI, 2017)

Vectors, especially mosquitoes, are the main causes of vector infectious diseases such as malaria, dengue fever and filariasis are still public health problems in the world including Indonesia. One of the diseases that has been known since before AD is malaria. The disease is caused by the Plasmodium parasite and is transmitted through the bite of an *anopheles* (female) mosquito affected by infection. However, parasites can be spread through blood vessels such as blood transfusions, the use of shared needles, as well as transmission from the mother to the fetus they contain.

Vector disease control efforts can be done in a variety of ways both biologically, physically, chemically and environmentally engineering. The goal is to break the chain of transmission between vectors and humans. One of the chemical vector control that can be done is by killing adult mosquitoes (fogging, indoor residual spraying and insecticidal mosquito nets). The principle is to reduce the density of mosquitoes so that the spread and transmission of diseases can be severed. Various types of mosquitoes are used insecticides that have a board spectrum that can be

used to kill all types of mosquitoes both organophosphat and pyrethroids.

Mosquito control in areas that often occur dengue fever and filariasis is usually done fogging and for endemic areas malaria is done by various means of indoor residual spraying (IRS) and use long lasting insecticide nets. The use of long lasting insecticide nets (LLINs) effectively prevents malaria transmission when supported by good treatment and cleaning (Firmansyah, 2014). This mosquito net is a blend of insecticide mosquito nets mixed, although its main purpose is to control malaria by suppressing the density of mosquitoes *Anopheles spp.* but the insecticidal properties that board spectrum can also be used for other mosquitoes including *Aedes sp* mosquitoes. Another thing is the maintenance of mosquitoes *Anopheles spp*. by laboratory scale not all can and difficulty in rearing it, therefore in this study used mosquitoes *Aedes Sp*.

From the description above, researchers are interested in conducting a study with the title **"The Effectiveness Of Reactivation Of Long Lasting Insecticide Nets (LLINs) On Mosquito Killing Power *Aedes Aegypti*".**

B. Materials and Methods

This type of research is a pre-experimental study of the static group comparation with a control group design. The independent variables in this study were various ways of reactivating long lasting insecticide nets. The dependent variable in this study was the death of the *Aedes aegypti* mosquito. The control variables in this study were the volume of confinement and the size of the mosquito nets.

The research object was the *Aedes aegypti* mosquito that was rearing in the Laboratory for Vector and Nuisance Animal Control (PVBP). Experiments were given treatment A (without reactivation) as a control, treatment B (reactivation of clean water) and treatment C (reactivation of detergents). With each cage containing 20 mosquitoes.

Reactivation of the long lasting insecticide nets is done by soaking the long lasting insecticide nets in clean water and detergent for 1 hour. Dip and lift repeatedly. Dry the mosquito net by hanging it in the shade. The treatment of each sample was carried out 3 times, by preparing 20 *Aedes aegypti* for each experiment so that the total sample needed was 180 mosquitoes.



Researchers used a mosquito cage with a cage area specification of 50 x 50 cm^2. Researchers made observations every 6 hours to see mortality in mosquitoes. In addition, researchers also took measurements of temperature, humidity and in the research room. The study was conducted for 3 days, each replication the researcher counted the number of deaths of mosquitoes that died.

The research data is normally distributed so that no further tests are carried out.

Analysis of the data used in this study using One-Way Anova. The hypothesis used in this study is that there is no difference between reactivation of insecticide-treated bed nets and the number of deaths of *Aedes aegypti* mosquitoes.

C. Result and Discussion

1. The number of deaths of *Aedes aegypti* mosquitoes

The control with the 1st replication had the number of deaths of 8 mosquitoes, the 2nd replication had the number of deaths of 8 mosquitoes, the 3rd replication had the number of deaths of 8 mosquitoes with an average of 8.

In clean water reactivation as treatment 1 with the 1st replication having the number of deaths of 18 individuals, the 2nd replication had the number of deaths of 14 heads, the 3rd replication had the number of deaths 13 individuals with an average of 15.

In reactivation with detergent as treatment 2 with the 1st replication had 16 deaths, the 2nd replication had 15 deaths, the 3rd replication had 11 deaths with an average of 14.

The overall average result was 12.3. The results of the average number of *Aedes aegypti* mosquitoes that died after contact with reactivated insecticide-treated mosquito nets with clean water were 1.8 times more effective than controls and detergents were 1.7 times more effective than controls.

Research (Firmansyah, 2014) conducted a preliminary test to determine the test mosquitoes to be used in the bioassay test, by comparing the *Aedes aegypti* mosquito with *Anopheles subpictus* mosquitoes. From the preliminary test, it is known that of the 63 *Aedes aegypti* mosquitoes tested, 59 (93.7%) experienced knockdown within 60 minutes and 63 (100%) after 24 hours were declared dead. While the *Anopheles subpictus* mosquitoes from 31 tested mosquitoes were 31 (100%) who experienced knockdown within 60 minutes and 31 (100%) after 24 hours were declared dead. From the results of the preliminary test, it was decided that the *Aedes aegypti* mosquito

could be used in this study.

The data states that the number of *Aedes aegypti* mosquitoes that died based on replication shows that the reactivation of insecticide-treated mosquito nets with clean water is 15 (75%) on average. Reactivation with detergent mortality rate of mosquitoes was 14 (70%). The results of the average mosquito mortality based on various reactivation methods, getting an average value of mosquito mortality between 70% -75% means that various reactivation methods used in research can be carried out but must pay attention to the detergent dosage used.

The research conducted by (Barodji & Damar Tri Boewono, 2003) at Menoreh Hill with the PermaNet netting bioassay test, the result was the percentage of *An. aconitus* <70% after the mosquito net is used for approximately one year, and the new PermaNet insecticide-treated mosquito net can kill *An. aconitus* 90.00%. Meanwhile (Parkash et al., 2009) re-washing reduced the efficacy of mosquito nets with an average mortality rate of 72.5% of tested mosquitoes.

According to WHOPES, this insecticide-treated mosquito net can at least cause ≥ 95% of mosquito knockdown and or ≥ 80% of mosquitoes to die when exposed to it. The average results carried out on insecticide-treated bed nets show that the mosquito mortality rate after 6 hours does not exceed 80%, so it can be said that all insecticide-treated bed nets are no longer effective in killing mosquitoes. Insecticide-treated mosquito nets are no longer effective because they have been used for more than 3 years and were washed less than 4 times (Nurmaliani et al., 2016).

2. Total Percentage Increase in dead *Aedes aegypti* mosquitoes

The results of the observation and calculation of the increase in the percentage of *Aedes aegypti* mosquitoes that died with the number of tested mosquitoes in each cage as many as 20 were that reactivation with clean water had an increase in the ability to kill by 34.1% of the mosquito nets without treatment or as control, while reactivation with detergent has a 34.0% increase in killing power. Reactivation with clean water tends to be more effective in killing power against *Aedes aegypti* mosquitoes than reactivation using detergents. This can occur because the dosage of detergent usage is not appropriate and the surfactant content in the detergent as a foam producer and water wetting power removes fat impurities so that the effect of the active ingredients contained in the mosquito net fiber decreases and its effectiveness will be reduced.

The way of reactivating the mosquito nets can also affect the effectiveness of the insecticide-treated bed nets. Insecticidal mosquito nets should be washed with clean water or using appropriate detergent and not washed with bar soap because they contain high levels of soda (Nurmaliani et al., 2016).

3. Number of *Aedes aegypti* Mosquitoes That Die After Contact with Beinsecticide Nets Based on Time and Washing Technique

The death of the *Aedes aegypti* mosquito was caused by the insecticide residue that was still contained in the mosquito net after reactivation. Reactivation using clean water and detergent statistically the results are the same or there is no difference. Meanwhile, descriptively, reactivation using clean water tends to be more effective than detergents. This is because the mosquito nets used are only dirty with dust and grease so that reactivation with clean water without detergent can increase the effectiveness of the mosquito nets. Reactivity with detergents tends to be lower, because the surfactant content in the detergent can dissolve the insecticide in the bed net if the dosage is not appropriate.

The number of *Aedes aegypti* mosquitoes that died of reactivation with clean water was effectively used for reactivation of the mosquito net, which was able to kill mosquitoes for 6 hours, which was able to kill 9 mosquitoes at the 1st hour, 8 mosquitoes at the 2nd hour and at the 3rd to 3rd hour. the 6 killing power is still stable. Reactivation with detergent is effective for reactivating bed nets, which is able to kill 6 mosquitoes at the 1st hour, 5 mosquitoes at the 2nd hour and at the 3rd to 6th hour the killing power is still stable.

The decrease in reactivation of the mosquito net to the killing power of mosquitoes can be influenced by several factors such as not reactivation during use or the frequency of washing the mosquito net.

Research (Yahya & Endang Puji Astuti, 2013) shows that there is no significant difference between the average mosquito mortality based on the year the mosquito nets are distributed, but there is a significant difference between the average mosquito mortality based on the frequency of washing. Effectiveness decreases with time of use and frequency of washing.

The decrease in reactivity, it is known that the average decrease in the killing power of mosquitoes at the 2nd, 3rd, 5th hour and the increase in the killing power of the mosquitoes again at the 4th and 6th hours. The condition of the mosquitoes when the research was carried out at the 2nd and 3rd hour was the mosquitoes resting or resting so that there was a decrease in the number of mosquitoes that died. Although the research room has been in conditions conducive to mosquitoes. This may be due to the natural instincts of mosquitoes that are supposed to rest at that hour.

Mosquitoes have antennae and palps that

function as chemical sense organs that are very sensitive and can be stimulated by chemical odors. When the mosquito is released inside the cage, the smell of the active ingredients in the mosquito net will be detected by the chemoreceptors that the mosquito senses, after which it is continued to nerve impulses. This smell is not liked by mosquitoes because it can provide nerve stimulation to the effect of death on mosquitoes.

4. Analysis of Statistical Test Results

The independent variables tested were the various ways of reactivating the insecticide-treated bed nets. From the table of significance of the variables, various reactivation of the mosquito nets got a significant value> 0.05, namely p value = 0.144.

The One-Way Anova test results showed a significant value of 0.209. These results indicate that Ho is accepted, meaning that there is no difference in the various ways of reactivating the mosquito net against the death of the *Aedes aegypti* mosquito. This is because the insecticide content in the mosquito net fibers is only covered by dust so that washing with plain water or with detergent is still able to kill the *Aedes aegypti* mosquito.

Various ways of reactivating the mosquito nets used in this study are reactivation with clean water and detergent, the more reactivation is carried out the lower the active ingredients contained in the mosquito net. The various ways of reactivation are also intended to determine whether the active ingredient in the net is reduced or not.

The significant value shows 0.144 which means the p value> 0.03. These results indicate that Ho is accepted, meaning that there is no difference in the various ways of reactivating the mosquito nets against the death of the *Aedes aegypti* mosquito, this is because the mosquito nets used are only dirty with dust and grease so that reactivation with clean water or detergent can increase the effectiveness of bed nets with the conditions of using detergents in accordance with dose. So it can be concluded that all reactivation methods have the same killing power against *Aedes aegypti* mosquitoes.

Research conducted by Rizki Nurmaliani et al showed that reactivation of insecticidal mosquito nets using clean water to 100% of Aedes aegypti mosquito deaths, while with detergent 66.66% of the mosquito deaths. This shows that reactivation of insecticide-treated mosquito nets using clean water is 34% more effective than reactivation with detergents (Nurmaliani et al., 2016).

How the reactivated insecticide-treated mosquito net works is to remove dust that sticks to the surface of the mosquito net so that there will be a migration of the active ingredients from the netting fibers to the surface, so that the surface of the mosquito net will be coated with active ingredients again. The active ingredients contained in the mosquito net will enter the body of the mosquito which lands on the insecticide-treated mosquito net and disrupt the nervous system such as pyrethroids. Pyerethroid is an axonic poison, which is poisonous to nerve fibers. Binds to nerve fiber proteins known as voltage-gated sodium channels. Normally, this protein opens to stimulate the nerves and closes to stop nerve signals. Pyrethroids bind to voltage-gated sodium channels and prevent normal closure resulting in sustained nerve stimulation. This causes tremors and incoordinated movements in mosquitoes that are poisoned and undergo paralysis and die.

D. Conclusions and suggestions

1. Conclussions

There is no difference in the different ways of reacting mosquito nets with clean water or detergents on the killing power of the *Aedes aegypti* mosquito.

2. Suggestion

In further research, reactivation of insecticide-treated mosquito nets with no more than 30 months of use with various reactive methods to determine the effectiveness of the killing power of mosquitoes.

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