

# THE EFFECT OF THE INDOOR RESIDUAL SPRAYING (IRS) PROGRAM ON REDUCING PARASITE INCIDENCE IN THE WORKING AREA OF THE SEA SILAU HEALTH CENTER, ASAHAN DISTRICT

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## ABSTRACT

Malaria is a severe, life-threatening infectious disease transmitted through the bite of infected female *Anopheles* mosquitoes. In Asahan Regency, four areas are endemic for malaria, with Silau Laut District having an API rate of 4.8‰ (Annual Parasite Incidence per 1000 at-risk individuals annually). Indoor residual spraying (IRS) with Lambda Cyhalothrin (Icon 100 CS) is used to eradicate mosquito vectors by applying insecticide to walls and ceilings, interrupting transmission. Research aimed to assess IRS effectiveness in reducing malaria incidence in Silau Laut District found a strong positive correlation (0.826 and 0.912) between RDT and microscopic examination results before and after IRS. However, correlations between education and malaria control using IRS and changes in knowledge and attitudes were weak (0.490 and 0.438). Paired T-tests revealed differences in RDT examination results ( $p = 0.044$ ) and knowledge and attitude levels ( $p = 0.000$ ) before and after IRS education. No significant difference was observed in microscopic examination results ( $p = 0.159$ ). Recommendations include intensified efforts in malaria prevention and control, including active case finding, mosquito nest elimination, continued IRS, mesh installation, insecticide-treated bed net use, health education, and regular bioassay testing every 1-2 months for 3-6 months in Silau Laut District.

**Keywords:** Malaria, RDT, IRS (Indoor Residual Spraying)

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## INTRODUCTION

The government's seriousness in realizing public health has implemented various health programs, including short-, medium-, and long-term programs. Currently, Indonesia is facing three important health problems, namely the eradication of infectious diseases including communicable diseases, increasing cases of non-communicable diseases (non-communicable diseases) and reemerging diseases, and the reappearance of types of diseases that should have been successfully overcome. One infectious disease that is still a problem is Malaria. This disease, which is more widespread in tropical areas, is transmitted through the bite of female *Anopheles* mosquitoes. There are 5 species of plasmodium in humans, namely *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium malariae*, *Plasmodium ovale*, and *Plasmodium knowlesi* (GARINA, 2014; Tondok et al., n.d.; Zein, 2005).

Judging from the determinants of malaria, individual factors and environmental factors play a significant role in the mechanism of transmission. Individual factors include age, gender, genetics, pregnancy, nutritional status, and activities outside the home at night, while environmental factors include home environmental conditions and seasonal conditions which greatly influence the density of malaria vectors, socio-economics, and environmental characteristics around the patient's settlement. The mechanism of malaria transmission is that the parasite enters the human body, then hides and reproduces in the liver and goes through an

incubation period. The parasite will infect red blood cells spread throughout the body and cause clinical symptoms such as fever and headache, in very severe cases it can cause coma. and death (Haqi & Astuti, 2016).

Asahan Regency is one of the malaria-endemic areas, with an area of 3,732.97/km<sup>2</sup>, with a population of 729,795 people. Based on demographic location (regional boundaries), Asahan Regency has territorial boundaries to the north of Karo Regency and the Malacca Strait. To the east, it borders the North Labuhan Batu Regency, the Malacca Strait, and Tanjung Balai City. To the south is Toba Samosir Regency and North Labuhan Batu Regency and to the west is Simalungun Regency and Batubara Regency (BPS Asahan Regency, 2021).

Silau Laut District consists of five villages, namely Silo Baru, Lubuk Palas, Silo Bonto, Silo Lama, and Bangun Sari. The working area of the Silau Laut Community Health Center is on the coast of the Malacca Strait, and most of the population works as fishermen. Silau Laut District, during the dead tide season, cases usually increase, this is because when it is high tide, seawater will rise to land and recede again, the water returns to the sea but still leaves puddles. When it rains, the seawater becomes brackish. Brackish water has the potential to be a breeding place for *Anophels sp* mosquitoes (Asahan District Health Service Profile, 2021).

One of the factors causing the high number of malaria cases in the working area of the Silau Laut Community Health Center is that sufferers generally do not take malaria medication (primakiune) for 14 days. Most of the community's livelihood is fishing. Malaria sufferers usually feel cured after taking OAM (Anti-Malarial Medication) for 3 days, so they don't continue the treatment and go to work at sea again as fishermen, but in the sufferer's body there are still parasites that can recur and the problem is that they can become a source of infection. to other people.

The geographical conditions of an area consisting of swamps, puddles of water, or rivers are good places for the breeding of *Anopheles* mosquitoes, as well as the habit of people gathering with neighbors at night which provides greater opportunities for mosquitoes to come into contact with humans. Apart from that, the average temperature in a region is in the range of 25 - 30 Celsius and air humidity of 80% are optimal conditions for the breeding of *Anopheles* mosquitoes, and these conditions can even speed up the mosquito's life cycle (Sherrard-Smith et al., 2018).

Geographically, Silau Laut District is on the coast of the Malacca Strait, so this area always experiences ups and downs. An increase in malaria cases usually occurs during the high tide season which is accompanied by the rainy season. This is because sea water will rise to land and recede again, but will still leave behind puddles. Pooled sea water will mix with rainwater and become brackish. Brackish water has the potential to be a breeding place for *Anophels sp* mosquitoes. Therefore, it is necessary to study control programs to reduce the increase in malaria cases, in this case, the Indoor Residual Spraying (IRS) program.

Indoor residual spraying (IRS) in residential homes is a method of eradicating vectors by placing a certain amount (dose) of certain insect poison evenly on the surface of the wall being sprayed. Spraying is carried out to break the chain of transmission because the lifespan of mosquitoes is short so they do not have time to produce sporozoites in their body glands. The active ingredient used in IRS is the insecticide Lambda-cyhalothrin (Icon 100 CS) with the consideration that this material is long-lasting in potential places where malaria vectors rest such as on walls, roofs, and ceilings of houses or potential places for mosquitoes to land and

contact with insecticide. The aim of implementing IRS is to reduce the transmission of malaria by spraying insecticide residue to kill mosquitoes/malaria vectors in people's homes (Setiyaningsih et al., 2015).

Over the past few decades, the beneficial effects of IRS in malaria prevention have been reported in both high and low malaria-endemic areas. IRS contributed to the elimination or dramatic reduction of malaria in various parts of Latin America, Asia, and Europe.

According to research by Betty Bawuba et al, 2017 Uganda, has the highest malaria transmission rate recorded in Africa with an average of 1500 infectious bites per person per year in high-intensity areas and one of the highest malaria incidences in the world 478 cases per 1000 people per year. Malaria transmission in Uganda is perennial, with two peaks after the rainy season, in April/May and September/November. In northern Uganda, the rainy season lasts from March/April to October. Malaria is a major cause of morbidity and mortality with an estimated 8–13 million cases per year accounting for 30–50% of outpatient visits, 15–35% of hospitalizations, and 9–14% of inpatient deaths, of which almost half of the deaths occur in children. -children less than 5 years old.

The main malaria control intervention strategies implemented in Uganda include case diagnosis and management with Artemisinin Combination Therapy (ACT)-based combination therapy, integrated vector management (IVM) including the use of long-lasting insecticidal nets LLIN (Long Lasting Insecticidal Net), and intermittent preventive therapy. in pregnancy. In 2006, IRS supported by the United States Agency for International Development (USAID)/President's Malaria Initiative (PMI) was added to the intervention strategy for malaria control that initially focused on malaria-prone areas in the southwest and later concentrated on highly endemic areas. in northern Uganda (Kleinschmidt et al., 2009).

After achieving significant reductions in malaria control, USAID/PMI gradually phased out the spraying program and thereafter conducted continuous entomological monitoring at sentinel sites in the removed districts. The benefits of successful IRS programs in Africa have been documented in several studies. In northern Uganda, selected districts received five rounds of IRS during the study period but there are limited data on the impact of IRS on malaria morbidity in these areas (Teklehaimanot et al., 2009).

Based on research conducted by Soleimani-Ahmadi M et al, 2014, community participation is a key component of malaria elimination programs, and increasing community knowledge about malaria control methods can promote preventive practices against malaria. To achieve efficient IRS coverage, a key factor is identifying and addressing behavioral factors that may lead to IRS denial. Increasing public knowledge about malaria and the IRS will lead to changes in behavior that will help in designing sustainable malaria control programs.

Based on the results of research by Natanael Ritung et al., 2018 at the Mubune Community Health Center, West Likupang District, Manado, it was explained that the diagnostic value of RDT for malaria parasites had a sensitivity of 67% and a specificity of 97%.

Meanwhile, research conducted by Hubullah Fuady et al, 2017 in Pasir Mukti Village, Cineam District, Tasikmalaya Regency, showed that the diagnostic value of RDT for malaria parasites was 94.7% sensitivity and 100% specificity. Based on previous research, this research aims to control malaria in the community and provide information to health workers at community health centers regarding the effectiveness of the IRS program so that it can be used as a consideration for malaria control, especially in endemic areas.

## **METHOD**

The research method applied in this research was carried out starting from a literature study and secondary data collection in the form of characteristics of the research location and Annual Parasite Incidence (API) data, the data obtained was used as a basis for determining the research location. The next step is to identify malaria risk factors through literature studies to develop instruments that will be used in data collection in the field.

Next, a preliminary survey was carried out to build communication with parties who would collaborate in research activities, such as the Silau Laut Community Health Center, the Silau Laut District Head, and the Asahan District Health Service with the aim of researchers receiving support and facilitation when conducting research.

The type of research used is interventional research which is applied research with a pretest and posttest design on the results of microscopic examination using the RDT method before and after treatment, in this case, the implementation of the IRS program in each house is the target of the research. The sampling method used was purposive sampling with inclusion criteria:

1. Residents who are registered as residents of Silau Laut District
2. Lived more than 1 year in the Silau Laut District Area
3. Willing to take a microscopic test to check for positive malaria (RDT)

The sample size is determined using the Lemeshow formula as follows:

$$n = \frac{4pq}{d^2}$$

With the estimated p and q values of 0.5 (50%) and the limit error (d) of 10% (0.1), the sample size is 100. The research sample is housed so that for the RDT examination the number of family members in each house is followed. However, in this study, an estimate was made of 4 family members in one house so that the participants who took part in the RDT were allocated a total of 400 people. Based on the funds submitted at the time of submitting the proposal, after the proposal passed the selection and the approved research funds were reduced, the number of samples was reduced to 50 samples and IRS was carried out in 100 residents' homes.

Furthermore, to analyze malaria risk factors, the chi-square test was used at a 95% confidence level and the odds ratio for each risk factor was also looked at to determine the most dominant risk factor while analyzing the influence of the IRS program on reducing parasite incidence, the paired T-test was used at the level of malaria. 95% confidence. The next step is to identify the weaknesses and strengths of the IRS program which will be used as a basis for modifying the IRS program.

## **RESULTS AND DISCUSSION**

Based on the results of RDT and microscopic malaria examinations, the majority of positive malaria sufferers in the Silau Laut Community Health Center working area are vivax malaria sufferers. Transmission of malaria in the working area of the Silau Laut Community Health Center in the five villages is from the village itself. This is possible because this area has Anopheles Sp mosquito transmission and the source of transmission is vivax malaria sufferers.

Specifically for *P. vivax* in its parasitic cycle in part of the liver tissue (tissue sizon). Parasites in liver cells do not continue their cycle to erythrocyte cells, however embedded in liver tissue - called hypnocytes -. This form of hypnosis is what causes malaria relapse. In patients who contain hypnosis, if at any time in a state of decreased endurance, for example, due to being too tired, busy, stressed, or changing climate (rainy season), the hypnozoites in the body will be stimulated to continue the cycle parasites from liver cells to erythrocytes. After the parasitic erythrocytes are broken, they will reappear as symptoms of the disease. For example, 1 – 2 years previously had suffered from *P. vivax* and recovered after treatment, if you then experience fatigue or stress, the symptoms of malaria will reappear even if the person concerned is not bitten by the *Anopheles* mosquito. When an examination is carried out, a blood smear (SD) examination will be positive for *P. vivax*. Indoor Residual Spraying (IRS) is a large-scale insecticide application to spray the inside of the house to kill mosquitoes. It remains one of the main components of malaria control strategies, which aim to prevent transmission of the parasite through interventions targeting the *Anopheles* vector (Santjaka, 2019; Siregar & Ginting, 2023).

IRS has been used to eliminate malaria from different malaria-endemic regions including Europe, Asia, Latin America, and Africa. National malaria control programs in 91 endemic countries reported that 106 million people worldwide were protected by the IRS in 2015. Some factors that influence the effectiveness of IRS interventions include spray coverage, type of insecticide, type, and situation of housing, community awareness and cooperation, household acceptance, and informing households about program benefits and spraying times during the spraying campaign (Lengeler & Sharp, 2003; Marsum et al., 2015).

The Lambda Sihalotrin formulation has remaining efficacy for 12 weeks. WHO classifies this insecticide in the class II category in the moderately dangerous insecticide group. The lambda-cyhalothrin formulation used for evaluation was 'capsule suspension'. In this case, the active ingredient is hidden in a polymer capsule. The water suspension of this formulation after spraying releases the insecticide slowly, thereby extending the residual life of the compound. This formulation is not adsorbed or absorbed by porous spray surfaces and easily adheres to insects thereby increasing insect-insecticide contact. In WHOPES-supervised trials, this formulation demonstrated equal or better efficacy than the WP formulation, and trials conducted elsewhere also reported good efficacy of ICON 10 CS IRS in controlling mosquito densities. Field trials with IRS lambda-cyhalothrin in Brazil showed higher efficacy in controlling malaria-infectious *Plasmodium*. Several other studies also reported the effectiveness of IRS lambda-cyhalothrin in controlling sand flies and other insects (Raghavendra et al., 2011).

Lambda Sihalotrin is a synthetic pyrethroid insecticide from the alpha-cyano group. Lambda Sihalothrin has a low vapor pressure and evaporates easily. The formulation has residual effectiveness after only 12 weeks. Continuous use of the Lambda Cyhalothrin insecticide can increase resistance to insecticides. The most frequently used insecticides are Lambda Sihalothrin and Cypermethrin. The advantages of Lambda Sihalotrin are that it saves handling costs, has no odor, does not leave marks on the sprayed surface, and is easy to use. Meanwhile, the advantages of Cypermethrin are that it is cheap, effective in controlling adult *Aedes aegypti* mosquitoes, low application dose, has low toxicity to mammals, and is easy to apply by fogging and fumigation (Setiyaningsih et al., 2018).

Factors supporting the occurrence of resistance are the continuous use of the same or similar insecticides, the use of active ingredients or formulations that have the same activity, long residual effects, and the biology of the vector species. Residual spraying provides a greater chance of creating a resistant generation compared to other application methods because the chance of contact between the vector and the active ingredient is greater. Another supporting factor is the use of the same insecticide against all vector growth stages (eggs, larvae, pupae, and adults). Therefore, to prevent and reduce the occurrence of accelerated resistance, it is best not to use insecticides from types and/or classes of insecticides that work the same way to control pre-adult and adult stages (Debora et al., 2018; Gusra et al., 2014).

Resistant mosquito populations in the field almost always contain some heterogeneity and are susceptible to continued infiltration from surrounding areas that are not exposed to insecticides. In mosquitoes, resistance is mainly associated with target site modification and metabolic resistance. In areas that are not exposed to insecticides, this is most likely due to their proximity to areas that are exposed to insecticides. This proximity creates a high potential for the movement and crossing of resistant mosquitoes between the two locations, resulting in the production of resistant offspring. To ensure effective control measures, it is necessary to monitor the status of resistance to insecticides in areas with active malaria transmission at an early stage (Miller et al., 2013; Setiyaningsih et al., 2018).

This is in line with research conducted in Senegal by A. Kan Dio et al. In 2019, the use of the Lamda Sihalotrin insecticide for five years in Senegal targeted vector populations at high insecticide pressure, which resulted in an increase in insecticide resistance, observed in six districts in the Senegal region. Therefore, the Lamda Sihalotrin formulation was replaced by the insecticide Bediocarb (Ficam WP 80). The insecticide Bediocarb (Ficam 80 WP) is much more effective than the Lamda Sihalotrin insecticide. Bediocarb is an irreversible inhibitor of Acetylcholinesterase (A type of enzyme) and acts on the central nervous system of insects. It is one of the insecticides recommended by WHO, especially against malaria vectors (Wassmer et al., 2015).

Based on the results of field trials by K.Raghavendra, et al., in 2011 at three locations it was determined that the ICON 10 CS formulation was found to be comparable or relatively more effective than malathion 25% WP, deltamethrin 2.5% WP and lambda Sihalotrin 10 WP in several evaluation parameters such as mosquitoes resting indoors. Mosquito vector parity levels, increased persistence, etc., and in reducing malaria cases. It can be used as an IRS to control malaria vectors with two rounds of spraying with an interval of 3 months to limit malaria transmission and one additional round is recommended in areas of perennial malaria transmission (Raghavendra et al., 2011).

By implementing a rotation strategy, the development of resistance can be slowed, because different insecticides with varying killing power will be used. This approach helps maintain the effectiveness of insecticides in controlling malaria vectors and reduces the risk of further development of resistance. To provide confidence regarding the high effectiveness of insecticide spraying within the framework of IRS, especially in the case of the use of Icon 100 CS, it is recommended that a bioassay test be carried out by the Asahan District Health Service every month or at least every

two months over a 3-6 month time period. The Malaria Inspection Program and IRS have been hampered in recent years by the COVID-19 pandemic, malaria treatment has stopped and supplies of malaria drugs are inadequate so the malaria program is not running well.

## CONCLUSION

The results of the RDT examination and microscopic examination before and after showed a correlation value of 0.826 and 0.912, this means that the relationship with the results of the plasmodium examination, both RDT and microscopic, is very strong and positive. Meanwhile, for knowledge and attitudes, correlation values of 0.490 and 0.438 or smaller than 0.50 mean that the relationship between education and malaria control using IRS and changes in levels of knowledge and attitudes tends to be weak.

The probability value/p value of the Paired T-test on the RDT examination shows a result of = 0.044, this means that there is a difference between the results of the RDT examination before and after being given education and controlling malaria using IRS, while the results of the microscopic examination show a result of = 0.159, which means that there is no difference between the results of microscopic examination before and after education and malaria control using IRS because the p-value is > 0.05 (95% confidence level).

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