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IMPLEMENTATION OF SIMPLE FOGGING INNOVATION AS A PREVENTIVE EFFORT FOR DENGUE HEMORRHAGIC FEVER

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ABSTRACT

The rapid spread of dengue fever can cause epidemics and result in deaths within a short period of time. One effort to eradicate this mosquito is fogging. The high incidence of Dengue Hemorrhagic Fever (DHF) in Dungus Village is caused by poor environmental conditions, such as clogged drainage channels, inadequate waste-disposal facilities, and large amounts of garbage thrown onto the streets, which mark the beginning of the high reproduction rate of the Aedes aegypti mosquito. The purpose of this community service activity was to increase community awareness and behavior through the implementation of simple fogging innovation as a preventive measure against dengue fever outbreaks. The method used was Participatory Action Research (PAR), conducted in three stages: planning, implementation, and evaluation. The planning stage consisted of observation and interviews. The implementation stage consisted of counseling and implementation of the simple fogging innovation, and the evaluation stage was carried out to measure the success of the community empowerment program in overcoming DHF. The results of the community service activity after evaluation showed that knowledge was in the good category (74.3%), attitudes were in the good category (77.1%), and actions mostly showed a good category (68%). After the community service activity was implemented, community behavior in preventing DHF using simple fogging innovation showed good behavior.

INTRODUCTION

Geographically, Indonesia is surrounded by the Asian continent, the Australian continent, the Pacific Ocean, and the Indian Ocean. In addition, the country has a tropical climate because it is crossed by the equator. A tropical climate influences temperature, rainfall, sunlight, humidity, and wind, all of which affect the breeding of animals and plants in Indonesia, including disease vectors (Handiny et al., 2020). The ability of disease vectors to develop easily in tropical environments causes Indonesia to become an endemic area for

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infectious diseases (Ulfa & Anwar, 2023). One of these infectious diseases is Dengue Hemorrhagic Fever (DHF). The disease vector is the bite of the Aedes aegypti mosquito, which carries the dengue virus (Sari et al., 2022). This mosquito has a repeated biting behavior pattern, known as multiple biting, which means biting several humans at one time. This allows the dengue virus to move from one person to another and can infect several people with DHF in one household (Ustiawaty et al., 2020).

The transmission of dengue hemorrhagic fever is closely related to environmental conditions. This is because the environment is one of the factors that influences the emergence and distribution of this disease (Wismaridha, 2023). A dirty environment will lead to high breeding of Aedes aegypti mosquitoes because these mosquitoes prefer such environments (Rasidi et al., 2023). Dirty environments favored by these mosquitoes include slightly dark places, hanging objects such as clothes, mosquito nets, shoes, and enclosed places (Baghowi, 2022). The presence of Aedes aegypti mosquitoes is strongly influenced by their environment, both biologically and physically. Biological factors play an important role in shaping the mosquito environment (Upa & Winarti, 2024). If water is stored in containers for a long time, pathogens and parasites are likely to be present and may affect the growth of mosquito larvae (Forsyth et al., 2020). In addition, physical factors may also play a role; during the rainy season, rainfall can increase humidity levels and subsequently increase the number of mosquito larval breeding sites (Soh & Aik, 2021). As a result, the possibility of increased dengue cases with hemorrhagic symptoms becomes higher.

The rapid spread of dengue fever can cause epidemics and result in deaths within a short period of time. Signs and symptoms that appear in DHF patients may include fever for 2-7 days without a clear cause and occurring continuously, hemorrhagic diathesis (positive tourniquet test), decreased platelet count (thrombocytopenia), and plasma leakage due to increased capillary permeability (Kumar et al., 2021). There are four stages of DHF severity: grade I is characterized by fever and nonspecific symptoms with a positive tourniquet test; grade II is grade I accompanied by spontaneous bleeding in the skin or bleeding in other areas such as bleeding gums, nosebleeds, or bloody stools; grade III is characterized by circulatory failure, namely blood pressure reaching hypotension, a rapid and weak pulse accompanied by cyanosis around the mouth, cold extremities, moist skin, and restlessness; and grade IV is characterized by severe shock in the form of an unpalpable pulse and unmeasurable blood pressure (Jannah et al., 2022). However, although a case does not always show symptoms, it is important to remember that individuals infected with this disease may face severe consequences, including death (Ulfa & Anwar, 2023). The prevalence of this disease has caused approximately 390 million people to be infected each year. Dengue fever remains a significant health problem in Indonesia, with cases reported in 472 districts/cities and 34 provinces. According to the Indonesian Ministry of Health, there were 661 deaths due to this disease in 2020 (Kemenkes RI, 2021). The significant impact of Indonesia's rainy climate on the occurrence and severity of dengue outbreaks is clearly seen in East Java Province, which is one of the top 10 regions with the highest number of dengue cases in the country. Specifically, Gresik Regency ranked tenth for the highest number of reported cases in 2024. There were 250 patients or dengue cases from January to the second week of June 2024. Efforts to control this disease include the implementation of mosquito eradication initiatives.

It is important to note that, to date, there is no known medicine that cures dengue fever. To prevent the spread of the dengue virus, it is essential to implement measures that effectively control disease transmission (Srisawat et al., 2022). One main strategy is to target the infectious vector and disrupt its ability to spread the virus. Various methods can be used to control dengue vectors with the aim of breaking the chain of disease transmission. Control methods in environmental management include physical control, chemical and biological control, and integrated control (Septiani et al., 2022). One effort to eradicate this mosquito is fogging.

Fogging is one chemical prevention method used to eradicate Aedes aegypti mosquitoes (Hustedt et al., 2020). However, fogging cannot be carried out arbitrarily. The fogging method has procedures and must be performed routinely so that prevention of DHF transmission becomes more effective (Auliya et al., 2024). If evidence of transmission is found, such as another DHF patient, three fever patients, or a risk factor such as larvae, then focus fogging is carried out in two cycles accompanied by larviciding and Mosquito Nest Eradication (PSN) activities. Ineffective fogging can cause mosquitoes to become resistant to insecticides. For example, in Bontang City, East Kalimantan, Aedes aegypti mosquitoes were found to be resistant to malathion and lambda-cyhalothrin, with a mortality rate of less than 70% (Daramusseng, 2018). If this problem is not addressed immediately, Aedes aegypti mosquito resistance will continue to increase in the Gresik area, particularly in Dungus Village, Cerme District.

The purpose of fogging in Dungus Village, Cerme District, Gresik, is to reduce dengue fever transmission and eradicate cases of the disease. The high incidence of DHF in Dungus Village is caused by poor environmental conditions, such as clogged drainage channels, inadequate waste-disposal facilities, and large amounts of garbage thrown onto the streets, which mark the beginning of the high reproduction rate of the Aedes aegypti mosquito. In addition, this is also supported by the suboptimal implementation of mosquito nest eradication activities in the community, resulting in DHF cases in several areas of Dungus Village. Therefore, action is needed in Dungus Village, which is a DHF-endemic area, to prevent an outbreak or emergency event. Attention to environmental aspects and community awareness is needed to reduce the incidence of DHF cases. The community still considers dengue fever to be an ordinary fever that is not dangerous and not contagious. Community service through this awareness-raising activity aims to increase community knowledge about the dangers of DHF and its treatment, as well as to increase community awareness of environmental protection and participation in mosquito nest eradication using the 3M method (draining, covering, and burying) so that DHF can be prevented in the environment of Dungus Village, Cerme District, Gresik.

METHODS

Study Design

The method used in this community service activity was Participatory Action Research (PAR), an approach whose process aims at learning to solve problems and meet the practical needs of the community, as well as producing knowledge (Afandi, 2020).

Place and Time

This community service activity was carried out in July 2024. The service location for fogging or smoke application was Dungus Village, Cerme District, Gresik Regency, East Java. The community service activity was carried out over two days and aimed to describe the implementation of simple fogging innovation as a preventive measure against dengue fever outbreaks.

Target Partners

The target of this activity was the entire local community, represented by village officials such as neighborhood unit heads (RT), community unit heads (RW), the Village Secretary, the Village Head, and health cadres of Dungus Village, Cerme District, Gresik, totaling 23 people.

Activity Implementation

Participatory Action Research (PAR) is oriented toward empowerment that fulfills the elements of empowerment, namely collaboratively building knowledge to improve social action and social change. Participatory Action Research involves conducting research to define

a problem and applying information into action as a solution to the identified problem (Rahmat & Mirnawati, 2020). The purpose of this community empowerment activity was to increase community awareness and behavior through the implementation of simple fogging innovation as a preventive measure against dengue fever outbreaks. Basically, the empowerment team and other supporting parties collaborated to manage the empowerment program. The flow of community service activities required several stages, including the preparation stage, implementation stage, and evaluation stage.

1. The first stage was the planning stage, which included direct observation and interviews to identify the situation and problems that emerged in order to seek and find appropriate solutions. The identified location was based on various problems occurring in the area. In addition, the area is classified as prone to flooding. Direct observations were conducted at the research location, and direct interviews were conducted with informants. These activities related to the implementation of DHF management policies were used to collect primary data to obtain the real situation and needs in the field. In addition, documentation activities and information gathering from various sources were carried out to refine the method of utilizing simple fogging innovation as a preventive effort against dengue fever outbreaks. After that, a pre-test was given to several health cadres and officials of Dungus Village, Cerme District, Gresik.
2. The second stage was the implementation of activities, which included counseling and simulation of the simple fogging innovation program procedures, as well as evaluation of program success through observation of the community's knowledge, attitudes, and actions during the simple fogging innovation simulation. The activity consisted of counseling and simulation on the use of simple fogging innovation as a preventive effort against DHF outbreaks. Counseling was conducted to improve community knowledge, attitudes, and actions regarding the control of Aedes aegypti mosquitoes, so that the community is expected to prevent DHF; in other words, the community can control larvae as the cause of dengue hemorrhagic fever. A simulation of the implementation procedure for simple fogging innovation was then carried out through intensive assistance and guidance.
3. The third stage was the evaluation of community empowerment activities. This stage was necessary to measure the success of the implemented program and determine improvements in community knowledge, attitudes, and actions by distributing post-test questionnaires. The level of achievement of the activities carried out could be determined through questionnaire-based evaluation. The data obtained were analyzed descriptively to further assess the value of the entire process and the benefits of the activity.

RESULTS AND DISCUSSION

Observation and Interviews

The first activity was field observation and interviews with the government of Dungus Village, Cerme District, Gresik. Field observation was carried out through community service activities to clean the village environment. This involved several community members and youth organization members of Dungus Village, Cerme District, Gresik. Structured interviews were conducted with several cadres and village officials to determine the preventive efforts that had been used to control DHF so far.

The results of field observations showed that many places could become breeding sites for Aedes aegypti mosquitoes. Poor geographical and environmental conditions, such as the presence of reservoirs as rainwater collection sites and ground holes containing stagnant water, clogged drainage channels, inadequate waste-disposal facilities, large amounts of garbage dumped on the roads that become the starting point for the high breeding rate of Aedes aegypti mosquitoes, and the lack of awareness among village communities in maintaining

environmental cleanliness were identified. DHF vector control activities were constrained by limited available logistics. Insecticide materials were limited, and only six fogging devices were available to cover all villages in Cerme District. According to village residents, the Cerme Health Center once ran out of insecticide supplies when there was a DHF case that needed to be handled immediately. Structured interviews with several village officials and health cadres found that DHF control had so far been conducted through fogging by the Cerme Health Center and mosquito nest eradication. Requests for fogging implementation in Dungus Village had to be submitted to the Cerme Health Center and required procedures as well as a relatively expensive village budget for fogging operations. A pre-test was given to several cadres and village officials who participated in this simple fogging innovation implementation activity.

Figure 1. Field observation and interviews as part of community service activities in Dungus Village

Mosquito Nest Eradication (PSN) is carried out in part by increasing community knowledge, attitudes, and actions in DHF management (Hakim et al., 2020). Through the Sustainable Development Goals (SDGs), the 2030 target is to end epidemics of infectious diseases and neglected tropical diseases such as DHF. The main priority of DHF control is standardized in the Decree of the Minister of Health Number 581/MENKES/SK/VII/1992, which emphasizes that DHF eradication focuses on prevention efforts by improving community attitudes and actions through the implementation of simple fogging innovation. These prevention and control measures are included in breaking the DHF transmission cycle from Aedes aegypti mosquito bites through PSN activities (Kurniawati et al., 2020). This community service activity with the implementation of simple fogging innovation was based on the findings and problems faced by Dungus Village, Cerme District, Gresik, every year.

In line with previous research, positive effects have been found from draining water reservoirs, covering water reservoirs, recycling used items that can hold water, reducing the habit of hanging clothes, and implementing fogging in relation to DHF incidence (Hambur et al., 2023). Based on this, it is necessary to improve community knowledge and skills in DHF prevention by using simple fogging innovation to activate the community's active participation in PSN. Community service was carried out in the form of socialization and counseling on the importance of Mosquito Nest Eradication or PSN (draining, covering, and recycling used items) and simulation of simple fogging innovation (fogging using a simple device with water-based agent liquid).

Implementation of Simple Fogging Innovation

Simple fogging innovation was carried out as a form of prevention against Dengue Hemorrhagic Fever (DHF), which is caused by dengue virus infection from the bite of the Aedes aegypti mosquito. Simple fogging innovation was designed using simple materials and

tools that are easy to purchase at building-supply stores. The tools and materials needed to make the simple fogging innovation were: 1) a 1/4-inch copper pipe with a length of 45 cm; 2) a gas torch flame gun or portable gas torch; 3) a portable canned gas cylinder; 4) a 5/16-inch transparent water hose with a length of 30 cm; 5) a coil protector or cover; 6) a sprayer pump with a capacity of 2 liters; 7) an aluminum/stainless pipe with a length of 20 cm and a diameter of 12 mm; 8) steel wool dish scrubber; 9) a 0.5-thick iron plate measuring 20 x 30; 10) four M4 x 10 nuts and bolts; and 11) Water Fogging Agent (WFA), a water-based material for the fogging mixture as a substitute for diesel fuel or white oil.

Figure 2. Components of the Simple Fogging Innovation

The strategy for eradicating Dengue Hemorrhagic Fever places greater emphasis on preventive efforts, namely spraying before the disease transmission season in DHF-endemic areas such as Dungus Village, Cerme District, Gresik. In addition, PSN (Mosquito Nest Eradication) activities and counseling for the community through various media were also conducted. In reality, eradicating DHF is not easy because there are various obstacles in its implementation. DHF is transmitted through the bite of Aedes aegypti mosquitoes, most dominantly females (Owa, 2024). Fogging that is usually carried out by smoking with the insecticide malathion mixed with diesel fuel may endanger community health (Frida, 2020). In addition, fogging using this method requires a large budget for implementation. Therefore, this simple fogging innovation device using a water-based agent (WFA) is one safe and more economical method for DHF control in Dungus Village, Cerme District, Gresik. Eradication and control of larvae, egg density, and pupae of Aedes aegypti mosquitoes can be carried out using simple fogging innovation in their breeding sites, most of which are stagnant, humid, dark, and enclosed areas resulting from annual flooding in Dungus Village, Cerme District, Gresik. Fogging is one preventive measure against DHF. However, in reality, this preventive measure is not optimally carried out by heads of households in Indonesia. This is consistent with the study by Rahman et al. (2024), which stated that only 15% of heads of households realize the importance of fogging when DHF cases are found, although its function is to eradicate adult mosquitoes so that the number of vectors causing DHF transmission can be reduced (Oroh et al., 2020). The increase in DHF cases is predicted to be caused by the transition season and the lack of community understanding of Clean and Healthy Living Behavior (PHBS), especially low concern for environmental cleanliness (Sawaluddin & Lidayanti, 2024). In addition, community habits that pay insufficient attention to environmental cleanliness, such as hanging clothes, cleaning garbage, and low community participation in preventive actions when DHF cases occur, will increase the risk of dengue transmission (Susilowati & Cahyati, 2021).

Simple fogging innovation is an important intervention in preventing dengue transmission, especially by eradicating the vector mosquito, Aedes aegypti. Research shows

that fogging can significantly reduce mosquito populations when applied effectively (Ulfa & Anwar, 2023). For example, optimal fogging time, particularly before or during peak transmission periods, improves effectiveness in minimizing dengue cases. However, the effectiveness of simple fogging innovation depends on its strategic application. Studies indicate that without proper observation of mosquito breeding sites in dengue-prone areas, fogging may not have a significant impact on case reduction. In addition, integrating simple fogging innovation with other control measures, such as vaccination, can further reduce the number of infected individuals and vectors. Despite its potential for DHF control, the use of simple fogging innovation faces challenges, including the need for timely execution and consideration of mosquito breeding sites, which can influence the overall success of DHF control. Thus, simple fogging innovation is a valuable tool in dengue prevention, and its effectiveness can have positive effects when combined with strategic planning and complementary interventions.

Figure 3. Simulation of the procedure and handover of the simple fogging innovation to Dungus Village, Cerme District, Gresik

Evaluation

Evaluation was conducted after the implementation of the simple fogging innovation activity. The evaluation was carried out by distributing post-test questionnaires to cadres and officials of Dungus Village who participated in this community service activity.

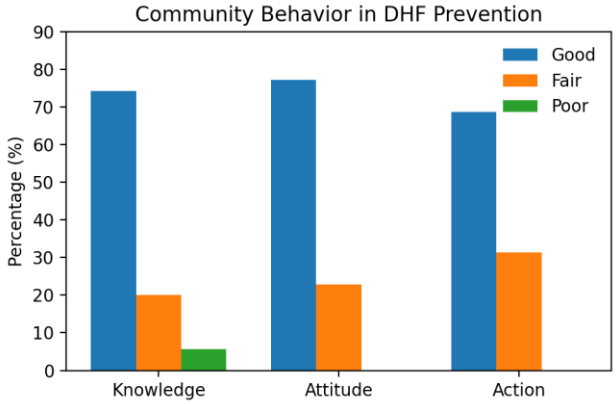

Figure 4. Evaluation results of community behavior in DHF prevention in Dungus Village

The evaluation results after the implementation of simple fogging innovation showed that, among the 23 respondents who participated in the community empowerment activity in Dungus Village, Cerme District, Gresik, most had knowledge in the good category (74.3%).

The attitude indicator was mostly in the good category, with a percentage of 77.1%. Actions were mostly in the good category, at 68.6%. Thus, it can be concluded that community behavior in preventing DHF using simple fogging innovation showed good behavior.

Effective DHF preventive practices by the community require good knowledge, attitudes, and actions (Marpaung et al., 2024). Knowledge is a factor that influences a person's behavior toward an object; therefore, discussion of knowledge in the context of DHF control ability cannot be separated from the process of behavior formation (Mungall-Baldwin, 2022). Knowledge about DHF includes its definition, signs and symptoms, modes of transmission, methods of eradication, preventive actions, and so forth. Knowledge about DHF, its vectors, and its spread influences community health behavior in DHF control and prevention activities (Espiana et al., 2022). The level of community knowledge and behavior is known to play an important role in DHF transmission. A person's behavior in preventing DHF transmission is strongly influenced by that person's level of knowledge. Good knowledge of the symptoms and signs of dengue fever is important for managing the disease and seeking health services promptly (Saputra Munthe et al., 2024). In addition, community attitudes and actions are factors in the formation of dengue hemorrhagic fever prevention behavior (Manulang et al., 2023). Community awareness of cleanliness is needed as a main factor in the development of Aedes aegypti mosquitoes that cause DHF, so that DHF case management is not delayed and DHF cases in Dungus Village, Cerme District, Gresik, do not increase. Opinions about DHF state that the eggs, larvae, and pupae of Aedes aegypti mosquitoes grow and develop in water.

CONCLUSION

Based on the implementation of simple fogging innovation as a DHF preventive measure in Dungus Village, Cerme District, Gresik, this community service activity was carried out by KKN students of the University of Gresik. This activity focused on improving the knowledge, attitudes, and actions of the Dungus Village community, Cerme District, regarding DHF prevention management using simple fogging innovation and its implementation. This activity was intended for the entire Dungus Village community, represented by Dungus Village officials, Cerme District. This community service activity ran according to the plan and achieved the established targets.

Residents of Dungus Village showed a positive response and enthusiasm during the counseling conducted by the community service team. Based on the evaluation results regarding knowledge of DHF and fogging, the Dungus Village community showed increased knowledge after counseling. This was identified through an evaluation method using questionnaire sheets provided by the community service team. With this increase in knowledge, residents are expected to be more active in preventing DHF by eradicating Aedes aegypti mosquito breeding sites at home. However, in the future, it is recommended that counseling participants include one representative from each household so that the information provided can reach the Dungus Village community more broadly. The fogging implementation proceeded very well, even though it used simple fogging innovation. This activity was very effective in fumigating all areas of Dungus Village. However, it would be better if fogging used insecticides and analyzed the appropriate time for fogging, namely when transmission is at its peak.

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