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The implementation of digital application in reducing Dengue Hemorrhagic Fever (DHF) infection rate from an economic loss perspective as an effort to achieve the Sustainable Development Goals

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Abstract

Background: Dengue Hemorrhagic Fever (DHF) is a disease caused by the dengue virus transmitted through the Aedes aegypti mosquito and is most commonly found in tropical regions. In contemporary society, there is significant emphasis on infectious diseases. DHF is a tropical disease that falls under the third indicator of the Sustainable Development Goals (SDGs). DHF poses a significant global public health problem. Currently, its prevalence is spread across more than 100 countries worldwide. Over three decades, the severity of DHF has shown a significant increase across the Southeast Asian region. In 2021, Indonesia recorded a total of 73,518 DHF cases with 705 fatalities. In 2022, there were 143,266 reported cases resulting in 1,237 deaths. As of March 2023, there have been a total of 17,434 reported cases with 141 fatalities. These DHF case incidence figures indicate a considerable increase.
Purpose: To reduce DHF cases in South Tangerang City by creating an innovative digital application which is called "Pakar" from an economic loss perspective.
Method: This research adopts a mixed-method approach with exploratory research. The research begins with a qualitative phase to design the application, followed by a quantitative phase to assess the effectiveness of the developed application. The study commences with a Focus Group Discussion (FGD) involving various stakeholders, including the South Tangerang City Health Office, public health centers, and community health workers. Subsequently, the application is developed and tested in selected pilot areas as an initial project. Further testing is conducted using a one-group pre-test post-test design. The experimental procedure includes a pre-test as an initial observation, followed by the intervention, and concludes with a post-test as a final observation.
Results: During the pre-test, it was observed that DHF patients had a moderate level of knowledge, with a cumulative percentage of 46%. In contrast, the majority of respondents in the post-test had a high level of knowledge regarding DHF diagnosis, with a percentage of 76%. The paired t-test showed a t-value of -6.306 and the corresponding probability or significance value of 0.000 ($p < 0.005$).
Conclusion: The expert system application, as an innovative approach for DHF mitigation and the experimental assessment of economic impact, is effective as indicated by the pre-post test. Furthermore, it is crucial to consider the economic impact of the costs incurred by DHF patients by placing greater emphasis on improving environmental cleanliness efforts.

Keyword: Dengue Hemorrhagic Fever (DHF); Economic Loss; Implementation of Digital Application-Pakar.

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INTRODUCTION

Dengue Hemorrhagic Fever (DHF) is a disease caused by the dengue virus transmitted through the Aedes aegypti mosquito and is most commonly found in tropical regions. In contemporary society, there is a significant emphasis on infectious diseases. DHF is a tropical disease that falls under the third indicator of the Sustainable Development Goals (SDGs) (Nasution, Sadono, & Wibowo, 2018). DHF poses a significant global public health problem. Currently, its prevalence is spread across more than 100 countries worldwide. Over three decades, the severity of DHF has shown a significant increase across the Southeast Asian region (Yang, Quam, Zhang, & Sang, 2021). In 2021, Indonesia recorded a total of 73,518 DHF cases with 705 fatalities. In 2022, there were 143,266 reported cases resulting in 1,237 deaths. As of March 2023, there have been a total of 17,434 reported cases with 141 fatalities (Ministry of Health of the Republic of Indonesia, 2023). The incidence of DHF cases has shown a considerable increase.

DHF is a significant challenge in urban areas, including South Tangerang, where there is a significant fluctuation in the occurrence of dengue virus infections. In 2021, there were 437 cases, and in 2022, the number of cases increased to a total of 756 cases, with 138 cases specifically reported in the Pamulang District (South Tangerang City Health Office, 2023). In the early part of 2023, a total of 42 cases were reported, with the majority of cases concentrated in the Pamulang District. The annual economic losses experienced by Southeast Asian countries due to DHF amount to 950 million dollars. This disease is associated with significant economic expenditures, and projections indicate that the Asia-Pacific region is responsible for over half of the global economic expenditure (Nadjib, Setiawan, Putri, Nealon, Beucher, Hadinegoro, & Thabrany, 2019).

Cost analysis findings conducted at the South Tangerang City Public Hospital in 2022 showed negative financial results for intensive care services with an average loss of Rp 624,723 and for inpatient care with an average loss of Rp 8,848,020 (Riski, Hidayat, Janah, & Putro, 2022). Similar investigations were carried out in Depok City in 2023 and showed a similar picture to what happened in South Tangerang City. In the context of treatment, individuals showing indications or symptoms of DHF must immediately seek professional medical assistance. In the case of South Tangerang City, individuals are required to present their Electronic Identity Card without incurring any costs. However, a significant number of families showing symptoms do not seek immediate medical help. The mentioned impacts may be due to a lack of information and the current economic conditions. This aligns with the theoretical proposition that increased knowledge is accompanied by improved abilities leading to self-awareness development and the ability to behave appropriately (Hodek, Mittendorf, & Von der Schulenburg, 2010).

The proactive use of early detection in DHF is an essential strategy in mitigating the potential severity of this disease. In practical application, this may seem straightforward, but it presents challenges, especially for individuals with a limited understanding of DHF. Family members must take action by seeking medical assistance at health clinics to mitigate the progression of DHF in patients. Therefore, it is important to make new progress in improving the understanding and practices of the community regarding dengue prevention.

Furthermore, it is crucial to emphasize the need for early identification of DHF cases so that patients with symptoms can be promptly referred to healthcare facilities while accurately assessing the economic costs incurred. The propositions presented in this study involve the use of digital applications to provide education and motivation for dengue prevention and rapid patient identification. The use of technology in dengue investigation and early identification has been widely done. However, the integration of technology along with an increased desire to change behavior and accurate assessment of economic losses has not been done before.

The prevention of dengue fever (DHF) depends on the level of knowledge, attitudes, and behaviors of the community. Various studies have shown a significant relationship between knowledge levels and activities aimed at preventing dengue haemorrhagic fever (DHF). The statistical analysis yielded a p-value of 0.0025, indicating a strong level of statistical significance. Furthermore, an odds ratio

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(OR) of 3.4738 indicates a relatively large positive correlation between knowledge and DHF prevention actions. This suggests that having extensive knowledge about DHF incidents is associated with a 3.5-fold increase in the likelihood of preventing DHF incidents (La Tho, & Purnama, 2019). Various research efforts, including technology, are hindered by reliance on manual data entry (Ridwan, Ruliansyah, Yanuar, & Jajang, 2020) and incident location documentation (Sulistyo, & Umar, 2021). However, the use of technology, combined with increased motivation to change behavior and accurately assess economic costs, is an unexplored area.

RESEARCH METHOD

The research study was conducted by using a mixed-method approach with exploratory research. The research began with a qualitative phase to design the system application and then continued with a quantitative phase to assess the effectiveness of the developed application. The study commenced with a Focus Group Discussion (FGD) involving stakeholders, including the South Tangerang City Health Office, public health centers, and community health workers. Subsequently, the application was developed and tested in selected pilot areas as an initial project. Further testing was carried out using the one-group pre-test post-test design technique. The experimental procedure involved conducting a pre-test as an initial observation, followed by the implementation of the intervention, and concluded with a post-test as a final observation.

The pre-test measured the understanding and skills of the respondents in preventing DHF and calculating economic losses before using the Pakar application system. The intervention involved using Pakar application system in reducing the DHF from an economic loss perspective as an effort to achieve universal coverage in the era of SDGs for two months. The post-test measured the respondents' understanding and skills in preventing DHF and calculating economic losses after using the Pakar application system. The research respondents were selected through a random selection process. The research population consisted of residents in the Pamulang District of South Tangerang, Banten. Reliability and validity tests performed on the attributes and skills of the respondents resulted in an alpha value of 0.6, which is below the threshold of 0.7, and a p-value below 0.05 for the validity test.

The study combined sample criteria that included both inclusion and exclusion criteria to determine the eligibility of the researched sample. Inclusion criteria for this research included individuals residing in the Pamulang District, aged over 17 years, owning a smartphone, capable of reading, having the ability to access health information systems (following the socialization process), expressing a willingness to participate as respondents, and committing to using the health information system for two months. Exclusion criteria included participants who did not comply with the complete intervention protocol and those who did not use the health information system for a period of up to two months.

The development of the smartphone-based information system includes information about the definition, prevention methods, and information related to economic loss calculations. Additionally, it contains motivation to improve understanding and attitudes regarding DHF prevention. The application not only contains text but also includes posters, animated videos, and rhymes that encourage users to continually prevent DHF. Regarding respondent characteristics, education levels are categorized as low (below high school) and high (high school and above). Respondent income is considered low if it is below the regional minimum wage for Tangerang Selatan and high if it is above the regional minimum wage.

This research has obtained ethical approval from the Ethics Research Commission of STIKes Widya Dharma Husada Tangerang with the number: 15/RT-MONO/K-STIKES-WDH/VII/2023.

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RESEARCH RESULT

Table 1. Respondents' Characteristics (N= 100)

Variable	Result
Age (n/%)	
(Mean±SD)(Range)(Year)	(25.65±12.13)(17-65)
< 20	67/67
21 – 35	16/16
36 – 50	9/9
51 – 65	8/8
Sex (n/%)	
Male	57/57
Female	43/43
Education (n/%)	
Low	61/61
High	39/39
Occupation (n/%)	
Not employed	67/67
Employed	33/33
Income (n/%)	
Low	73/73
High	27/27
Insurance Ownership (n/%)	
Non SSAH	0/0
SSAH Health Insurance	100/100
Commercial Insurance	0/0
Payment Method (n/%)	
General/public	0/0
SSAH Health Insurance	100/100
Commercial Insurance	0/0
Health Care Class (n/%)	
Primary	27/27
Second	12/12
Third	61/61
Duration of Treatment (n/%)	
<6 days	80/80
6 – 12 days	20/20

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Knowledge Pre-Test (n/%)	
Low	29/29
Medium	46/46
High	25/25
Knowledge Post-Test (n/%)	
Low	14/14
Medium	10/10
High	76/76

*Social Security Administrator for Health (SSAH)

Based on the data presented in Table 1, it is evident that male respondents have a higher prevalence, with 57 (57%) cases of DHF, compared to females, who have only 43 (43%) cases. Most of the respondents diagnosed with DHF are in the age group under 20 years, accounting for 67 (67%) cases. On the other hand, the age group of 51-65 years has the lowest percentage, at 8%. The majority of respondents have low educational attainment (< high school), with a total of 61 (61%), and most of the respondents are not employed, totaling 67 (67%). Respondent income is also at a low level (<IDR 4,230,792), with a percentage of 73 (73%). All respondents have insurance, with 100% of them using SSAH, and the majority opt for SSAH Class 3, with a percentage of 61 (61%). The duration of respondent treatment is less than 6 days, accounting for 80 (80%). Regarding knowledge at the pre-test stage, it is observed that both families and DHF patients have a moderate level of knowledge, with a cumulative percentage of 46%. Conversely, the number of individuals demonstrating high knowledge is the lowest, at only 25%. The relationship observed between the post-test results and the intervention provided through the application shows an inverse proportionality. The majority of respondents in the post-test have a high level of knowledge regarding the diagnosis of DHF, with a percentage of 76%..

Table 2. Test-T Analysis

	Paired Differences					t	df	Sig (2 tailed)
	Mean	Std. Deviations	Std. Mean Error	95% Confidence Interval of The Difference Lower	Upper			
Pre – Post Test	-.660	1.047	.105	-.868	-.452	-6.306	99	.000

The paired t-test results, as seen in Table 2, indicate a t-value of -6.306 and a corresponding probability or significance value of 0.000, making the p-value less than 0.005. Based on the analysis conducted, it can be concluded that the average of the two populations shows dissimilarity, as evidenced by a significant difference in the average scores between the pre-test and post-test.

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Table 3. Treatment Cost

Variable	Average (Rp)	Minimum (Rp)	Maximum (Rp)
Direct Treatment Cost			
Doctor services	1.550.000	40.000	1.590.000
Laboratory	3.136.000	28.000	3.164.000
Medical support	753.000	108.000	861.000
Room	8.018.000	115.000	8.133.000
Treatment	8.621.000	183.000	8.804.000
Direct Non-Treatment Cost			
Transportation	140.000	10.000	150.000
Meal/day	195.000	15.000	210.000
Indirect Cost			
Miscellaneous	1.995.000	105.000	2.100.000

Table 3 provides an overview of the medical expenses incurred by respondents diagnosed with DHF, including direct treatment costs, direct non-treatment costs, and indirect costs. Direct treatment costs include doctor's fees, laboratory tests, medical support services, hospital room accommodation, and treatment expenses. Among the various financial aspects, treatment expenses are the largest costs borne by DHF patients, with an average cost of Rp8,621,000, with a minimum cost of Rp183,000 and a maximum cost of Rp8,804,000. On the other hand, the component with the lowest cost is medical support costs, with an average cost of Rp753,000, a minimum cost of Rp108,000, and a maximum cost of Rp861,000. Furthermore, for direct non-treatment costs, it is observed that the largest expenditure is allocated to daily patient meal expenses, with an average cost of Rp195,000, a minimum cost of Rp15,000, and a maximum cost of Rp210,000. As for indirect costs, which include other miscellaneous expenses, it is evident that the average cost borne by the respondents is Rp1,995,000, with a minimum cost of Rp105,000 and a maximum cost of Rp2,100,000.

DISCUSSION

The age of respondents refers to the chronological age of an individual, starting from birth and continuing through the following years. Increasing age is associated with increased maturity, both in terms of cognitive development and professional behavior. Individuals are more likely to place their trust in those who display a higher level of maturity compared to those who lack such qualities (Baitanu, Masihin, Rustan, Siregar, & Aiba, 2022). Age is a significant determinant of vulnerability to dengue virus infection in the context of DHF. However, individuals of all age groups are vulnerable to dengue virus infection (Kolondam, Nelwan, & Kandou, 2020).

Based on the research results in different age groups, it is evident that the majority of respondents diagnosed with DHF are those under 20 years of age, accounting for 67% of the total sample. This finding is consistent with surveys conducted in Indonesia, indicating that the age group under 15 years has the largest cumulative DHF cases, representing 49% of the total cases (Ministry of Health of the Republic of Indonesia, 2023). Conversely, the age group between 51 and 65 years has the lowest proportion, at 8%. This result aligns with surveys in Indonesia, showing that individuals aged 44 years and older have the lowest incidence of DHF, accounting for only 12% of reported cases (Ministry of Health of the Republic of Indonesia, 2023).

Regarding gender disparities among patients, the research results show that there is a disparity in the gender of respondents, with a higher proportion of male respondents, totalling 57 (57%) individuals,

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compared to female respondents, numbering 43 (43%) individuals. In the context of reported DHF cases in Indonesia in 2022, the analysis indicates that 51% of the total reported cases are male, while 49% are female (Ministry of Health of the Republic of Indonesia, 2023). Some countries in the Southeast Asian region have also found similar findings, showing a higher male-to-female ratio (Bhatia, Dash, & Sunyoto, 2013). Males exhibit higher vulnerability to dengue virus transmission due to their activities, such as traveling or working outdoors, primarily during the daytime. This temporal pattern aligns with periods of increased exposure to the dengue virus vector (Zhu, Liu, Tan, & Shi, 2016). The immune response to the dengue virus in males is diminished due to lower cytokine production compared to females (Takahashi, & Iwasaki, 2021).

In terms of the educational characteristics of the respondents, the majority of those diagnosed with DHF are reported to have lower educational levels. In contrast to respondents with higher education, 61% of the respondents have lower educational backgrounds, while the remaining 39% have higher education. A study conducted in Mojokerto revealed a significant correlation between education levels and the prevalence of DHF cases (Laily, & Rossyanti, 2020). Similar findings were also found in a separate study conducted in Padang, which showed a significant relationship between education and the occurrence of DHF, as indicated by a p-value of 0.001 (< 0.005) (Manulang, Amirus, & Sari, 2023). The incidence of DHF is influenced by the level of education, as it is assumed that higher levels of education are associated with a lifestyle characterized by cleanliness and health-conscious behavior. Therefore, it is expected that higher levels of education will lead to a decrease in the incidence of DHF.

Furthermore, the majority of respondents fall into the low-income category, earning less than the regional minimum wage (IDR 4,230,792) in South Tangerang City. The percentage of respondents with low income is 73%. According to other research findings, there is a significant statistical relationship between individuals with low incomes and the occurrence of DHF, as indicated by a p-value of 0.024 (α=0.05) (Damayanti, & Mega, 2022). The prevalence of dengue fever (DHF) is most likely to occur in participants with low income, suggesting a correlation between low income and a lower level of cleanliness awareness.

In this study, the percentage of respondents with employment is smaller than those without employment. The proportion of respondents without employment is 67%, while the proportion of respondents with employment is 33%. This research is consistent with previous studies, which show that unemployed individuals are more likely to contract DHF (Damayanti, & Mega, 2022). In contrast, a study conducted in East Nusa Tenggara, observing all respondents who contracted DHF, found that they were employed (Mbani, Limbu, & Landi, 2021).

Based on the research findings, it is known that all participants already have SSAH Health Insurance. All research participants have ownership status, and SSAH is used as a payment method for dengue fever (DHF) treatment. Another study examined the ownership status of SSAH and its utilization as a financing mechanism for respondents diagnosed with DHF from 2014 to 2018. The findings indicate that almost all DHF respondents during that period had SSAH coverage and used it for healthcare financing (Saputra, & Yudhastuti, 2022). A similar study was conducted in Japan, resulting in findings that all participants had health insurance and used it as a financial support means to address dengue fever (Kajimoto, & Kitajima, 2020).

National Health Insurance is a comprehensive health insurance program provided to individuals who have met their financial obligations, with the premiums covered by the government (Ministry of Health of the Republic of Indonesia, 2016). In another study, it was found that around 25% of the dengue fever disease burden is covered by the National Health Insurance, while approximately 20% is covered by various additional subsidies, primarily from government sources (Wilastonegoro, Kharisma, Laksono, Halasa-Rappel, Brady, & Shepard, 2020). Further studies have established that the overall economic impact due to dengue fever is USD 681.26 million with a 95% uncertainty interval ranging from USD 232.28 million to USD 2,371.56 million. All participants in this study were found to have exclusively utilized government health insurance in the form of SSAH, with a utilization rate of 100%. This finding aligns with earlier research indicating

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that DHF patients prefer to use SSAH as a payment mechanism rather than relying on direct payments. A study conducted at Tangerang Selatan General Hospital showed that the average expenditure related to dengue fever was IDR 6,116,590 (Riski et al., 2022). The utilization of SSAH Health Insurance by the general public suffering from dengue fever has the potential to impact the government's healthcare economy.

The class of care refers to the level of inpatient facilities chosen by respondents based on the costs they are willing to bear. Respondents allocate higher nominal values to access better facilities. In this study, the most commonly used service category was Class III, accounting for 61%. In contrast, Class II service was the least utilized, with only 12% of the total percentage. Class III service is the most economical option with affordable prices that cater to the socioeconomic lower class, making it the preferred choice of the public (Utari, Lidiawati, & Elmiyati, 2021).

Lower-class care, which is Class III, tends to accommodate a larger number of patients compared to higher-class care, especially Class I and Class II. This indicates that Class III has the highest patient volume compared to Class I and Class II (Ripha, & Wujoso, 2018). A study conducted at the South Tangerang City General Hospital revealed that patients diagnosed with dengue fever receiving Class II treatment had an average inpatient cost of IDR 975,125, while patients treated in Class III had an average inpatient cost of IDR 5,289,305 (Riski et al., 2022).

Length of Stay (LOS) refers to the average duration a patient remains hospitalized as an inpatient. Typically, the treatment duration is determined by measuring the interval between the patient's admission to the hospital and their subsequent discharge. The duration of inpatient care directly affects the financial implications and the level of care provided (Maghfiroh, Yusrani, Aini, & Iswanto, 2023). The research findings show that a total of 80 people diagnosed with dengue fever received medical intervention in less than 6 days. This finding aligns with research conducted at UKI General Hospital, which revealed that the duration of inpatient care for individuals diagnosed with dengue fever was less than six days. Specifically, this study involved a sample of 67 respondents, representing approximately 71% of the total population investigated (Rumana, Indawati, & Dewi, 2022). Previous research stated that there is a significant relationship between the length of hospital stay and the immunological status of each individual (Supadmi, Izzah, Suwantika, Perwitasari, & Abdulah, 2019). It can be concluded that individuals with a strong immune system exhibit faster recovery, making it easier for them to be discharged from medical facilities.

Furthermore, some respondents underwent treatment for more than six days, representing 20% of the entire population. The prolonged length of hospitalization for dengue patients can be influenced by comorbidities (Mallhi, Khan, Sarriff, Adnan, & Khan, 2017). Extended hospitalization can be caused by various factors, such as diarrhea, abdominal pain, ascites, and low hemoglobin levels upon admission (Tantawichien, 2015). This finding aligns with previous research indicating a significant relationship ($r = 0.359$, $\rho = 0.003$) between platelet count and the length of hospital stay in children with dengue hemorrhagic fever (DHF) (Alfiana, & Mahmuda, 2019).

Based on the prevalence of patient knowledge and attitudes, they can be considered as risk factors in relation to the occurrence of dengue fever because they play a crucial role in shaping individual behaviors and actions aimed at preventing the development of DHF (Palar, Engkeng, & Munayang, 2019). Consistent with other studies, it is shown that the utilization of video media is effective in improving knowledge both before and during the implementation of interventions (Aeni, & Yuhandini, 2018). This aligns with the efforts of researchers in developing new applications that encompass comprehensive information about DHF.

In this study, knowledge was categorized into three categories: low, moderate, and high levels. The research findings show that the pre-test results indicate that families and individuals suffering from dengue fever have a moderate level of knowledge, which accounts for 46% of the sample. On the other hand, individuals with a high level of knowledge represent the smallest proportion, at 25%. This occurrence may be due to a lack of education exposure about dengue hemorrhagic fever (DHF) in

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the community. However, the post-test results show an inverse relationship between the intervention provided through the Dengue Look application and the observed results. The highest proportion of patient awareness is found in family members and individuals diagnosed with DHF, with a combined percentage of 76%. This is supported by other research indicating an information acquisition gap between the pre-knowledge socialization phase and the post-knowledge socialization phase regarding knowledge improvement (Herawati, & Hakim, 2023).

Based on the research results, it is known that the treatment cost component is the largest expense incurred by dengue fever patients. The highest cost incurred is represented by an average value of IDR 8,621,000, with a maximum price of IDR 22,004,000 and a minimum cost of IDR 183,000. It is also important to note that healthcare support costs are the most economical component, with an average cost of IDR 753,000, a maximum cost of IDR 861,000, and a minimum cost of IDR 108,000. The total direct expenses for DHF patients range from a minimum of IDR 3,016,300 to a maximum of IDR 27,883,128, with an average cost of IDR 7,492,499.

According to previous research, it is known that the primary cost associated with treatment is the direct cost of treatment, which amounts to USD 329.74 for one disease episode. It often lasts for an average duration of 4 to 5 days per episode (Faridah, Syahfitri, Nugroho, Supadmi, Dania, & Perwitasari, 2022). Furthermore, a study conducted in Yogyakarta revealed that treatment costs account for the largest proportion of the overall financial burden. The treatment costs vary, depending on the utilization of the SSAH program. In 2015, the therapy cost for individuals utilizing the service was USD 243.6, whereas those not utilizing the service incurred a treatment cost of USD 363.41. In 2016, the treatment cost for individuals using the service was USD 368.13, while non-users were charged a higher cost of USD 427.03 (Supadmi et al., 2019). It can be concluded that failure to manage dengue fever cases in a timely manner will result in a financial burden in terms of economic losses.

This study includes an examination of non-treatment direct costs, which encompass expenses related to transportation and food. It is clear that the main financial allocation is directed towards daily food expenses, with an expenditure of IDR 195,000. If a patient's length of stay is 6 days, the total cost incurred during that period is IDR 1,170,000. In the context of transportation costs, the average expenses incurred by the patient's family during the hospitalization period do not exceed IDR 140,000. According to previous research, non-medical direct costs include several elements, such as transportation costs and food-related expenses. During a specific illness period, transportation costs were reported as USD 11.03 or IDR 167,653. Furthermore, these categories were further segmented based on food expenses, taking into account various age groups responsible for patient care. In terms of food expenses, the average expenditure for adults was USD 9.44 or the equivalent of IDR 143,568 per day. While the costs for children's food were USD 9.56 or IDR 145,393 per day (Weerasinghe, Bodinayake, Wijayaratne, Devasiri, Dahanayake, Kurukulasooriya, & Nagahawatte, 2022). It can be concluded that there is no significant statistical disparity between transportation expenses and food expenses. Although daily food expenses are relatively low at IDR 1,170,000 compared to the minimum wage in Tangerang Selatan, this expenditure places a significant burden on the economic well-being of the patient's family.

This study considers indirect costs as expenses related to reduced production. It is known that the highest indirect expenses incurred by individuals or families in cases of dengue fever amount to IDR 2,100,000, with the lowest expense recorded at IDR 105,000. The average indirect expense is IDR 1,995,000. Research findings reveal that the indirect costs associated with lost productivity amount to USD 303.99 or IDR 4,623,231. The quantity of lost productivity is determined by calculating the average treatment duration, which is five days. Loss of productivity refers to the economic loss resulting from reduced output indirectly experienced by the immediate family of the sick individual. This phenomenon occurs because productive time and resources are allocated to caring for dengue fever patients, hindering their ability to work and earn income. Another factor to consider is that if there is a loss of productivity, the entire burden is borne by the patient's family as it is not subsidized by the

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government or SSAH. The maximum loss of productivity reaches IDR 2,100,000 per illness period and, compared to the minimum wage in Tangerang Selatan, it leads to a disease burden.

CONCLUSION AND SUGGESTION

The use of Paka applications system as an innovative approach to reduce the occurrence of dengue fever and assess the economic impact is effective in decreasing cases of DHF. Additionally, it crucial to consider the economic impact related to direct treatment costs, non-treatment direct costs, and indirect costs when prioritizing efforts to prevent the spread of dengue fever. This can be achieved by placing greater emphasis on improving environmental hygiene efforts.

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