CONTROL OF ENVIRONMENTAL RISK FACTORS IN THE CASE OF DENGUE FEVER AT THE COVID-19 PANDEMIC

(Literature Review)

Abstract

Vector control efforts that have been carried out so far have been used to massively suppress mosquito density by using insecticides and mosquito genetic modification techniques. Analysis of environmental risk factors for dengue fever is one of the alternative solutions for better dengue control. The method used is a literature review by comparing research journals on risk factor analysis and mathematical models that affect cases of dengue fever. Results and discussion: the results of a literature review of three main risk factors, namely mosquito density RR 26.43, existence of breeding OR = 6.75; Habit of hanging used clothes OR = 5.12; while the variables that reduce cases of dengue fever are PHBS measures and 4 M efforts. This is because disease transmission is always through Aedes Sp. As a medium of transmission. Conclusion: mosquito density is the main determinant of increasing cases of dengue fever, while reducing cases is an effort to maintain environmental cleanliness.

Keywords: Risk Factors, Mathematical Models, Cases of Dengue Fever

A. Introduction

This disease is caused by the dengue virus through the bite of the Aedes sp mosquito, both A. aegypti as the primary vector and A. albopictus as the secondary vector. The mode of transmission can be horizontally from the patient to the susceptible person or vertically from the vector to the eggs it contains and in the end when it becomes an adult mosquito, the mosquito has become a vector and is ready to infect susceptible humans. [1]

This disease was first discovered in Surabaya in 1968 and until now the Indonesian Ministry of Health has complete surveillance of the disease[2], so that the seasonal cycle can be known at any desired period. Even though the disease has been carefully monitored through routine surveillance mechanisms ina tiered and very neat system, as well as control efforts, the facts show an extraordinary spread and on an increasingly wide scale, even WHO states that this vector-borne disease is the fastest disease in the world. 100 tropical and sub-tropical countries[3].

The system mechanism is so systematic starting from surveillance and control efforts and has been going on for more than 50 years, of course we need to re-question the efforts that have been carried out, especially now that the covid period has become a pandemic and the graphics are not so stable, it is necessary re-evaluation of what has been done. This mosquito control effort can actually control other diseases carried by the same vector [4,5], although the dominance is very dependent on the location. Control efforts that are one package with a surveillance system carried out using fogging and PSN efforts after going through an epidemiological investigation.

The use of insecticides through the fogging program on dengue fever that has been going on for a long time, do the mosquitoes disappear... no, but the mosquitoes still survive and give birth to a new generation that is superior to the previous generation through the ability of adaptation and genetic switching, giving rise to mechanisms resistance, as it is known today.

Resistance has occurred in all areas, even locations that have never been exposed to dengue fever, due to the use of household insecticides. As a consequence, the type of insecticide was replaced with a pyrethroid type and now it is also resistant.

The question is whether then we will chase between changing insecticides and resistance, for how long?... Repressive treatment of mosquitoes actually changes the normal habitat of the agents in them, whether these changes have consequences for humans in the form of increasing the degree of virulence insome vector-borne diseases.

The last human action against mosquitoes, especially Aedes Sp. Modification of transgenic mosquitoes known as Genetically Modified Mosquito's (GMM's) was used. This effort was carried out in two ways, namely spaying male mosquitoes with radiation and depositing Wolbachia bacteria to attack viruses in the body of Aedes Sp. Maybe this is the last strike of humans against mosquitoes, if this still fails... what else should humans do to overcome vector-borne diseases. The Zika disease, which was a pandemic during the Rio Olympics, is thought to be due to the effects of this technique6, although this is still a hypothesis and still requires more in-depth research, it is possible that one day this will also happen in Indonesia. What next steps should be taken... can environmental management (modification or manipulation) contribute to

controlling this disease in a more mosquito-friendly manner?

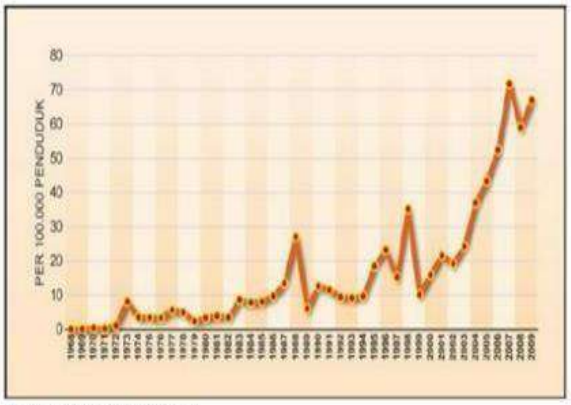
B. Epidemiology of dengue fever

The description of dengue fever according to time and place can provide many meanings for the developer of the disease control program, whether the program that has been implemented so far has been in accordance with the rules or needs to be evaluated both in terms of concept and operation, there are several descriptions based on:

1. Annually distribution

The graph of the distribution of dengue fever since it was first discovered until 2009, can be described as follows:

Gambar Angka Insiden DBD per 100 000 Penduduk di Indonesia Tahun 1968 – 2009



Sumber : Ditjen PP & PL Depkes RI, 2009

The first case in 1968 there were 58 cases, in mid-1988 there had been an increase of 821 times and after 20 yearsthe increase was 3.34 times greater. Thehighest phase after 2000 cases always increased and in 2004 Indonesia was declared an outbreak of dengue fever bythe Minister of Health, Suyudi, after previously in 1999 and 2016[7] there werealso outbreaks and in 2020[8] cases were also high.

2. Distribution by place

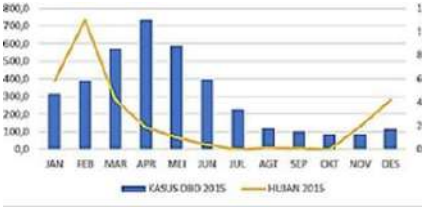
The national distribution of the latest case descriptions up to 2020 can be seen:

Distribution by province is dominated by densely populatedprovinces, especially in Java, Bali, NTB, NTT, parts of Sumatra and South Sulawesi; when compared to the distribution chart of previous years, almost all provinces have experienced outbreaks, except for Papua, where cases are relatively small. The distribution and increase in cases that occur is due to high population mobility, urban area development, climate change, changes in population density and distribution,[7] The important point is not just those mentioned above, but the outbreaks simultaneously provide other indications, namely the occurrence of transovaries, the transmission model is cluster, which also means the abundance of environmental carrying capacity, thereby strengthening the environmental contribution as the main determinant for the existence of mosquitoes so that they become vectors. the question is whether the DB can be "stopped".

3. Seaseonal distribution

It is important to understand this distribution well, by combining surveillance data and prevention efforts that must be carried out by the control program manager in stages, as for some examples of distribution in various regions as follows:

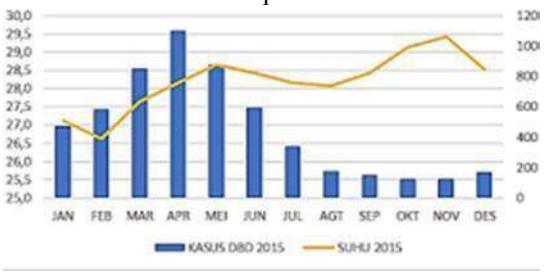
a. Jakarta city



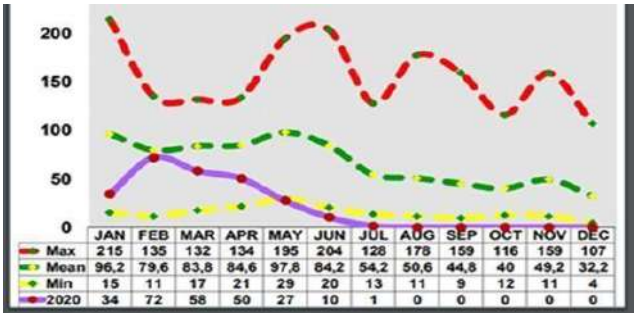
The figure shows the same trend between rainfall and DB cases, pay attention to the tendency of cases starting in March and peaking in May, tending to fall in June. This graph provides two analyzes, namely one that strengthens after the peak of the rainy season, it will be followed byan increase in DB cases one to two months afterward; This is due to the presence of abundant breeding and the frequency of mosquito bites more often as a form of adaptation to the transition of seasons. The graph of the DB case with temperature, further emphasizes two important things how the environment influences the age of the mosquito and the two weaknesses of the mosquito itself to environmental changes, especially humidity which is strongly influenced by temperature and temperature is influenced by light intensity, besides

that, anatomically and physiologically, especially the presence and the function of the spiracle and hemolymp which is very vital for the life

of the mosquito.[9]



b. Yogjakarta



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Max	215	135	132	134	195	204	128	178	159	116	159	107
Mean	96,2	79,6	83,8	84,6	97,8	84,2	54,2	50,6	44,8	40	49,2	32,2
Min	15	11	17	21	29	20	13	11	9	12	11	4
2020	34	72	58	50	27	10	1	0	0	0	0	0

The condition of Jogjakarta is relativelythe same as Jakartaeven though the year isdifferent, this shows"there is a similar rhythm of DBfluctuation"; maybe this conclusion is a bit rash, but due to the limitations of the pages that must be presented, it is possible that this analysis is only a hypothesis; if someone corrects it with national data itwill be much better. However, the same thing can be drawn from the initial conclusion that DB is closely related to the carrying capacity of the environment and the control that has been carried out so far is a non-anticipatory routine, because it does not utilize surveillance data for preventive measures, so that outbreaks locally, regionally and nationally always occur.

C. Theory recontruction.

The theory of the incidence of dengue fever can be understood by rearranging the theory of transmission so that causality between variables can be explained in a coherent manner. the order is as follows:

The formulation of this theory is simple, taking the basic principles in the interactional pattern between the outbreak cases and the closest stochastic determinant, namely mosquitoes. it is very dependenton his development on breeding and comfortable resting; while the determinant is actually deterministic, how many vectors, but this is very rarely used except for research with a specific purpose; While mosquitoes are very dependent on the determinants of the physical environment, especially on humidity.

This humidity depends on the presence of water and the intensity of sunlight in the environment, this indicator of humidity is very important for mosquitoes because it is related to the age of the mosquito which greatly affects the extrinsic cycle of agents in the mosquito's body. Another condition that also affects the development of mosquitoes is the social environment, this environment is related to the density of occupancy per area (dense slum area), the residential environment that is not inhabited

This condition triggers the absence of sunlight which is blocked by residential density, the subsequent impact of low temperatures and high humidity. This condition is very favored by mosquitoes so that the chances of becoming a vector are high. Thus, if viewed from the distribution of areas, densely populated and housing estates will turn into "permanent" dengue endemic areas.

D. Risk factor analysis.

Stochastic symptoms are used to find the cause of dengue cases. This analysis is based on probabilities called risk factors. The advantage of this analysis is that researchers can make causality models between direct variables in the form of mosquito indicators and indirect variables in the form of the environment. Although in the end the explanation was carried out in stages, according to the existing causal path.

1. Risk factor analysis

The discussion is divided into two, namely risk factors and mathematical models, starting from direct and indirect variables. The search for existing journals is as follows[20,21,22,23,24,25]:

Table 1. Environmental Risk Factor Analysis

INDEPENDENT VAR.	RISK FACTORS	STTISTIC ANALYSIS
Presence of mosquito larvae, maya index status, 4M Plus action	4M Plus action OR= 0,105	REG. LOG
The density of houses, the habit of draining the water reservoirs, CI, MI, the pattern of collecting waste, the existence of a public water reservoirs	The density of houses (OR=3,322), the habit of draining the water reservoir (OR=3,322), the existence of a public water reservoirs (OR =3,297)	REG. LOG
The existence of breeding, Habit of hanging used clothes, Habit of using repellent	The existence of breeding (OR=4,87); Habit of hanging used clothese (OR = 5.12)	REG. LOG
Use of Mosquito Repellent, Trash Processing, Water Reservoirs, Lighting, Ventilation	*Use of Mosquito Repellent (OR=3,870), Trash Processing (OR=2,895), Water Reservoirs (OR=2,005), Lighting (OR=3,018), Ventilation(OR=2,292)*	REG. LOG

Next Table 2 .

INDEPENDENT VAR.	FAKTOR RISIKO	JENIS ANALISIS
The existence of water reservoirs, Maya index, Larval density, Pupa density, Habits of not eradicating mosquito, Habits of hanging clothes, Habits of not using mosquito repellent	**Maya index** (OR=3,25), Habits of not eradicating mosquito (OR=4,01), Habits of hanging clothes (OR=3,31) Habits of not using mosquito repellent (OR=3,33)	REG. LOG
Presence of rainwater ways, Presence of containers, Mobility of population, Habit of staying at home	Presence of containers (OR=6,75)	REG. LOG

The results of the analysis of 28 independent variables analyzed there were 16 significant variables or 57.14% and only one that was directly related to the presence of larvae, namely the maya index. While further variables related to the presence of larvae and reducing mosquitoes such as the presence of potential breeding, use of repellents and mosquito behavior. Physical environmental conditions such as lighting and ventilation. The extent of these variables must be analyzed in the construction of the existing theory, which is fixed through the existence of mosquitoes.

2. Mathematic models

This analysis is intended to predict the presence of dengue cases based on variables known aspredictors. Some of the research results can be described as follows[15,16,17,18,19,20]:

Table 3. Mathematics Models Analysis

INDEPENDENT VAR.	Risk factor	Statistics analysis
X1:Population density, X2 : households that have implemented clean and healthy living behaviors, X3 : Percentage of healthy houses, X4: Ratio of health facilities X5: Ratio of health workers	All independent variable as positive determinant, exceptly PHBS	*Multiple regression*
(X1):Population density, (X2):Area large, (X3):free larva, (X4):The role of jumantik	Area large dan the role jumantik with contribution 54,9%	*Spatial Auto Regressive* (SAR)
(x1):Humidity; *(x2):Rainfall;* *(x3)Temperature*	*Humidity (p=0.000),* *Rainfall (p= 0.002),*	*Multiple regression*

Tabel 4. Lanjutan Mathematics Models Analysis

INDEPENDENT VAR.	Risk factor	Statistics analysis
Imported Cases, Meteorological, Mosquito Density	*mosquito density RR 26,43*	*The regression tree model*
Intention, Attitude, Education, Dengue Fever Prevention, Family Income, and Sanitation	*Sanitation* (b=-1.32) *and good prevention behavior* (b=-2.61).	*Multiple regression*

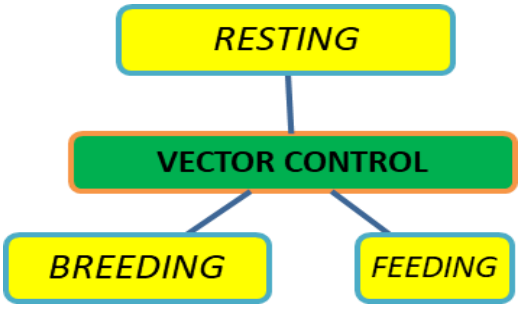
The results of the analysis are making a mathematical model as a predictive model, if you pay attention to almost all of the independent variables, remote variables are used, namely the environment, both physical and social, there is behavior in the form of PHBS and prevention of contact with mosquitoes. There are 21 variables analyzed, 12 of which are significant or 57.14%

The analysis of this significant distant variable still in interpreting the results of the analysis still refers to the theoretical construction used, namely the mosquito indicator (both larvae and mosquito resting density), the presence of this mosquito is associated with bionomics which includes mosquito habitat and behavior. In this position, the remote variable can only give meaning to the existence of causality.

E. What is to be done

Paradigm is used to start a more friendly mosquito control with the slogan "mosquitoes are creatures of God who also have the right to live, so how do we live with mosquitoes without causing disease to humans", the author developed a simple theory known as vector control triage. (Aris Santjaka 2016), The theory developed is known as the vector-borne disease control triangle.

This teory cam explain various risk factors and predictions that have been described previously. The efforts that can be made are in the form of a table as follows as shown in the table 5:



The analysis above, if simplified, there are only two, namely shortening the age of mosquitoes which aims to prevent extrinsic cycles from occurring and suppressing mosquito density with the aim of reducingthe risk of mosquito bites.

Table 5. what is to be done

Komponen Pengendalian	Upaya Teknik	Dasar teoritis	Faktor risiko
Resting	Increase sunlight in the house Keep the distance between plants 2 canopy, Don't hang clothes in the room, Using surfactants	Fisiology theory[20,21] Particle theory[21,22] Bionomic mosquitoes[24]	*Sanitation humidity, rainfall, Area large, % healthy home, Habits of hanging used clothes, Trash Processing Ventilation*
Breeding	*Artificial breeding (ovi & larvitrap), Dry bathroom system, Eradication breeding[1], flushing and drying waste water disposal*	Done two months before the peak of cases Bionomic mosquitoes [24]	*The role jumantik Persentase PHBS 4 M action, Drain the water reservoir Breeding existence Water Reservoirs Maya index Eradication breeding*
Feeding	*Repellent, a blast of air behind the door Mosquitoes trapping*	Bionomic Theory[24,25] mosquitoes attraction to the host theory [26,27]	*good prevention behavior, mosquito density, Use of Mosquito Repellent*

F. Conclusion

Human efforts to control mosquitoes on a massive scale have entered a very worrying phase in the form of resistance which will continue in the next chain effect, the process of sterilization even though humans also don't want to be sterilized, giving wolbachia bacteria is also an effort to control mosquitoes until they are destroyed, we are not aware that control by destroying one living thing will break the food chain that naturally already exists. We humans today do not know the chain effects that will occur in the future.

This empirical fact should make us aware as decision makers to review all programs that have been implemented so far and switch or at least combine control models more naturally where the

environment has become one of the determinants of vector control.

Professor James Collins of Arizona State University "Such technologies (TSM and fogging) can have unintended damaging consequences" such as unwanted disruption of non-target species or the emergence of a second, more aggressive and resilient species. The same thing was stated by Prof. Upik from IPB who actually suggested control with a classical (natural) system.

"The solution offered today, may be a problem in the future". (Aris Santjaka, 2016)

Reference:

1. Aris Santjaka, 2016, Zika dalam Perspektif Vektor dan Upaya Pengendaliannya, *disajikan dalam seminar nasional di Poltekkes Kemenkes Semarang*, Purwokerto.
2. Pusat data dan Surveilans Epidemiologi Kemenkes RI, 2010, *Buletin Jendela Epidemiologi* Topik Utama Demam Berdarah Dengue, Jakarta.
3. WHO, Better environmental management for control of dengue, *Health and Environment Linkages Policy Series*, akses 25 Mei 2021.
4. Webber R, 2005, Communicable disease epidemiology and control. A global perspective. London school of hygiene and tropical medicine, London
5. Manson's 2009, Tropical diseases Twenty second edition, Sounders, London.
6. Mlakar J, et al, 2016, Zika virus Associated with microcephaly, The New England Journal of Medicine, downloaded 19 sepetember 2016
7. Pusdatin Kemenkes, 2016, Situasi Demam Berdarah Dengue 2016, Jakarta. https://pusdatin.kemkes.go.id/ , akses 27 Mei 2021.
8. Kemenkes RI, 2020, *Hingga Juli 2020 Kasus DBD di Indonesia Capai 71 Ribu*, https://www.kemkes.go.id/ , akses 27 Mei 2021.
9. Ericha FW, 2018, Faktor Risiko yang Berpengaruh terhadap Kejadian Demam Berdarah Dengue di Wilayah Kerja Puskesmas Pare, Surabaya. https://e-journal.unair.ac.id.
10. Lia Ristiyanti, 2016, Analisis Faktor Risiko Lingkungan Rumah dan Praktik Manajemen Lingkungan Keluarga terhadap Kejadian Demam Berdarah Dengue, Semarang. https://lib.unnes.ac.id/28156/1/6411412184.pdf
11. Litbangkes RI,2019, Risk Factors of Dengue Fever Outbreak in Karo District, North Sumatera, Indonesia; Frans Yosep Sitepu1*, Elpiani Depari2, Saban Kemit, *JHECDs, Journal of Health Epidemiology an CommunicableDiseases*.Jakarta. https://ejournal2.litbang.kemkes.go.id/index.php/jhecds/article/view/1545/1238
12. Muh. Jusman Rau, Adhar Arifuddin, Sylvia Afrianti, Pitriani, 2019, The Analysis of Environmental Risk and the Use of Repellent on Dengue Hemorrhagic Fever in Kamonji Public Health Center, *Journal of Current Medical Research and Opinion*, Amsterdam. http://cmro.in/index.php/jcmro/article/view/156
13. Novia WP, Sitti RU, Susi I, 2015, Analisis Faktor Risiko Lingkungan yang Mempengaruhi Kejadian Demam Berdarah Dengue dan Status Kerentanan Larva Nyamuk Aedes spp di Kecamatan Lubuk Basung Kabupaten Agam, Jogjakarta. http://etd.repository.ugm.ac.id/penelitian/detail/88684
14. Azizah GT, Faizah BR, Analisis Faktor Risiko Kejadian Demam Berdarah Dengue di Desa Mojosongo Kabupaten Boyolali, https://journal.kopertis6.or.id/index.php/eks/article/view/12
15. Nendi Septi Arniva, 2019, Pemodelan Dan Pemetaan Kasus Demam Berdarah *Dengue* Di Provinsi Jawa Timur Tahun 2014 Dengan *Generalized Poisson Regression, Regresi Binomial Negatif* Dan *Flexibly Shaped Spatial Scan Statistic*, ITS, Surabaya .
16. Ni Made Surya Jayanti, Wayan Sumarjaya, Made Susilawati, 2017, Pemodelan Penyebaran Kasus Demam Berdarah Dengue (DBD) di Kota Denpasar dengan Metode Spatial Autoregressive (SAR), *e- Jurnal Matematika*,Denpasar. https://ojs.unud.ac.id/index.php/mtk/article/view/27173/0
17. Tri WK, Sri A, Sudarto, Henny, 2018, Determination of Environmental Factors Affecting Dengue Incidence in Sleman District, Yogyakarta, Indonesia, *African Journal Infectious Diseases*, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5876768/

18. K-K Liu, T Wang, X-D Huang, G-L Wang, Y Xia, Y-T Zhang, 2016, Risk Assessment of Dengue Fever in Zhongshan, China: a Time-Series Regression Tree Analysis, *Epidemiology & Infection*, Cambridge University Press.
19. Kanthi Devi Ayuningtyas, Setyo Sri Rahardjo, Bhisma Murti, 2019, Risk Factors of Dengue Fever: Application of PRECEDE – PROCEED Model *Journal of Epidemiology and Public Health*, Solo.
20. Edbras, 2010. Fisiologi serangga (artikel elektronik)., Akses 24 maret 2011. *Universitas Soedirman*. Purwokerto.
21. Gabriel JF, 2010. Fisika Kedokteran. Penerbit buku Kedokteran EGC. Jakarta.
22. Koestoer RA, 2002, Perpindahan kalor. Salemba teknika, Jakarta.
23. Departemen Kesehatan Republik Indonesia, 2007, Survey Entomologi Malaria, Direktorat Jendral Pemberantasan Penyakit Menular dan Penyehatan Lingkungan Pemukiman. Jakarta.
24. Ebed de Rosary, 2020, Perubahan Perilaku Nyamuk Demam Berdarah Terkait Iklim dan Lingkungan Picu Peningkatan Kasus, *Mongabay situs berita lingkungan*, Kupang.
25. NN, NY, Tinjauan Pustaka, Universitas Udayana, Denpasar. https://sinta.unud.ac.id/uploads/wisuda/1391261008-3-BAB%20II.pdf.
26. Manson's 2009, Tropical diseases Twenty second edition, Sounders, London.
27. Marcus B, 2008, Deadly diseases and epidemic, Malaria second edition, Chelsea house publishers, NewYork.