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REVIEW OF THE EXISTING POLICIES PERTAINING TO DENGUE IN CONSTRUCTION PROJECTS AND IDENTIFICATION OF GAP IN RESEARCH

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Abstract

World Health Organization (WHO) identifies that more than half of the world's population are at risk for vector-borne diseases. Vectors are living organisms that transmit infectious diseases and mosquitoes are the best-known carrier of vector-borne diseases. Among the vector-borne diseases, dengue has become a widespread health problem faced by Malaysians. There has been various research studies in curbing dengue issues; however, the Malaysian government is still having a hard time in reducing the number of dengue issues. Existing guidelines and legislation seem insufficient in controlling and reducing the number of dengue cases. It has been reported from January 2015 to October 2015, that there were 96,222 of dengue cases and 263 deaths cases in Malaysia. Construction projects have been identified as one of the reasons for the high incidences of dengue menace. The construction activities and uncleanliness of the construction sites have caused a spate of dengue cases. This paper seeks to review the existing policies pertaining to dengue in construction projects and to identify the gap in vector-borne disease research. The findings may act as a catalyst for conducting further researches in this field of study.

Keywords: Vector-borne diseases, dengue, construction projects

Abstrak

Pertubuhan Kesihatan Sedunia (WHO) mengenal pasti bahawa lebih daripada separuh penduduk dunia berisiko untuk menghidap penyakit bawaan vektor. Vektor merujuk kepada organisma-organisma hidup yang menghantar penyakit-penyakit berjangkit, manakala nyamuk aedes pula merupakan antara penyumbang kepada penyakit bawaan vektor yang paling terkenal. Antara contoh penyakit bawaan vector ialah, denggi yang telah menimbulkan masalah kesihatan yang semakin meluas yang dihadapi oleh penduduk Malaysia. Terdapat pelbagai kajian yang telah dilakukan dalam usaha untuk membendung isu denggi ini. Walau bagaimanapun, kerajaan Malaysia masih menghadapi kesukaran untuk mengurangkan bilangan kes denggi itu sendiri. Garis panduan dan undang-undang seolah-olah tidak memadai dalam membantu mengawal dan mengurangkan bilangan kes denggi. Dilaporkan bahawa sejak Januari 2015 hingga Oktober 2015, terdapat sebanyak 96,222 kes denggi dan sebanyak 263 kes kematian di Malaysia. Projek-projek pembinaan telah dikenal pasti sebagai salah satu punca yang menyebabkan kes denggi kerap berlaku. Aktiviti-aktiviti pembinaan dan keadaan di kawasan tapak pembinaan yang kotor telah mengakibatkan kes denggi berlaku. Kajian ini dilakukan bertujuan untuk mengkaji semula polisi-polisi sedia ada yang berkaitan dengan denggi di kawasan projek pembinaan dan seterusnya mengenal pasti jurang dalam bidang kajian penyakit bawaan vektor. Dapatan daripada kajian ini boleh bertindak sebagai pemangkin kepada kajian lanjutan dalam bidang ini.

Kata kunci: Penyakit bawaan vektor, denggi, projek pembinaan

1.0 INTRODUCTION

Vector-borne disease (VBD) is a growing problem worldwide. Vector-borne diseases are illnesses caused by an infectious microbe that is transmitted by a blood-sucking arthropod from an infected vertebrate to a susceptible person [1]. Humans can be affected from the arthropod diseases either directly by bites or stings and may also be affected indirectly through disease transmission. Arthropod diseases can be spread from insects such as mosquitoes, sand flies, fleas, and ticks. However, mosquitoes are the best-known disease vectors among the other types of insects that spread VBD. Figure 1 shows the types of vector-borne diseases in Malaysia.

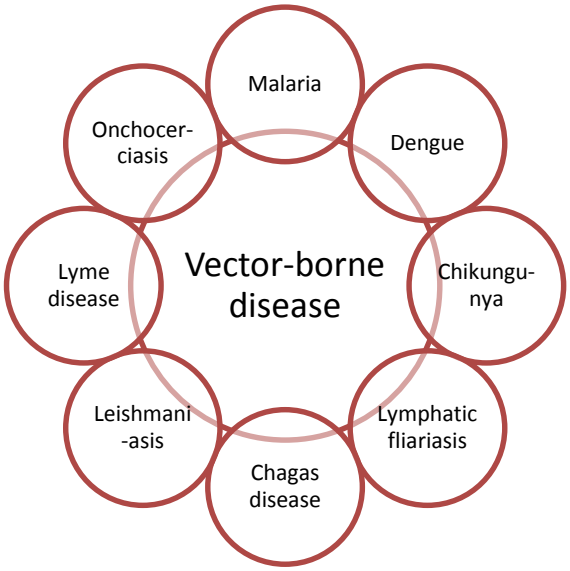

Figure 1 Types of Vector-borne diseases in Malaysia (Sources: World Health Organization)

According to World Health Organization (WHO), VBD accounts for 17% of the estimated global burden of all infectious diseases, and the world's fastest growing vector-borne disease is dengue, with a 30-fold increase in disease incidents over the last 50 years [2]. Thus, dengue is categorised in the group of vector-borne diseases and it is well known to be a high-burden disease in Malaysia.

Dengue is caused from mosquitoes which breed successfully in permanent bodies of water, generally in shallow water, debris, emergent grass, or in any location that gives aquatic vegetation shelters to mosquito larvae. From mosquitoes, dengue is transmitted to humans by Aedes (Aegypti). Dengue has become a serious public health problem in Malaysia. One of the main reasons for the increase in the number of dengue cases is contributed by construction projects.

Construction projects have been identified to be one of the hotspot locations for mosquito breeding [14]. Various types of research studies have been conducted to finds ways and means to control and prevent the dengue epidemic, especially in the risk assessment, control methods, human behaviour, vaccine development and treatment of dengue [3-6]. However, a few studies have focused on dengue issues in construction projects as it is known to be the highest factor in contributing the increase of dengue cases in Malaysia [7].

The increase in dengue cases in Malaysia may cause death and indirect loss such as loss in productivity from illnesses and premature deaths. Even though researches have been conducted to identify ways of controlling dengue, it seems to be inadequate [8]. It has been found that the personnel of most construction projects have been neglecting the duty to ensure construction activities are well managed to prevent mosquito breeding in an unclean environment.

By virtue of the Destruction of Disease Bearing Insect Act 1975 (Act 154), any person guilty of an offence under this Act or any regulation made thereunder for which no specific penalty is provided shall be liable on conviction in respect of a continuing offence to a further fine not exceeding of RM500 for every day that the offence is continued to breed mosquitoes by the local government and will face court action or a stop of work order (Section 23)[9]. Howbeit, the existing legislation does not seem to compel towards the developers and contractors of construction projects as the amount of the penalty is relatively low.

There is still a lack of consideration in implementing prevention measures and control towards construction projects since it is known to be one of the main reasons for the serious dengue epidemic in Malaysia. Thus, the existing prevention measures are unable to prevent the increase in the number of dengue cases, and dengue has become a major health concern in recent years. The purpose of this paper is to review the existing policies pertaining to dengue in construction projects and to identify the gap in vector-borne disease research. The scope will be on dengue-related researches in construction projects.

2.0 CONTROLLING VECTOR-BORNE DISEASE AND DENGUE ISSUES

Tropical Disease Research (TDR) [10] confirms that the vector-borne diseases, whose agents are transmitted by insect vectors such as mosquitoes, flies, and triatomine bugs, occur in more than 100 countries worldwide and affect about half of the world's population including Malaysia. The key aspects affecting this disease to be a widespread problem are from social and environmental factors including climate change.

It is estimated that 2.5 million people in more than 100 countries are at risk and it is estimated that 50 million dengue infections occur annually worldwide.

According to World Health Organization [2], Asia is one of the regions that bear a high burden of dengue cases because most of the countries are in the region of tropical and sub-tropical countries. The rapid increase in the number of dengue cases has become a great public health concern as the severity and frequency of the dengue epidemic may be influenced by many factors such as human ecology, demography, and globalisation, as well as climate change. Tomasheck, Sharo, and Margolis [11] confirmed that there is no specific antiviral agent that exists for dengue and there is still no vaccine available to cure dengue patients. Therefore, prevention measures are the best practice to combat dengue issues in our country. The lack of concern by people towards dengue issues and the lack of sense of responsibility have led to major changes toward the environment, which eventually affect the increase in dengue menace. Thus, knowledge on dengue prevention measures and behaviour plays an important role in the transmission of dengue.

The recent climate change patterns, poor planned urbanisation and control programmes are believed to be the main factors for the high number of dengue cases [8]. The following factors remain debatable and the issues have been identified to link towards the increase in dengue issues. Climate change is seen as a factor that contributes to the increase of the dengue epidemic since rainfall and temperature both affect the spread of mosquito vectors. Poor planned urbanisation results in an abundance of potential breeding sites such as poor street drainage, which are most likely to contribute to dengue infection towards the environment. It has been confirmed that the breeding areas at construction sites are usually located at water tanks, shallow grounds, drums, styrofoam containers, cement mixers, and water bottles [12]. Poor planning may increase the number of dengue cases and action should be taken in order to eradicate breeding areas. As for curbing dengue issues, there are various developments of technologies used to overcome the obstacles in terms of clinical trials, establishing field sites, and working with developing countries to create a vaccine; however, there are still complications and failures from the development of dengue vaccines. The global trend of dengue fever is identified to further continue for several decades and the prevention controls may not affect the incidence and spread in the short term [13]. Thus, it is a need to identify the gap in this research in the matter of combating the vector-borne disease problem faced in Malaysia.

Table 1 indicates the existing guidelines and legislation on dengue prevention and control that have been implemented in Malaysia.

Table 1 Existing Guidelines and Legislations on Dengue Prevention and Control in Malaysia

Title	Framework	Summary
International Health Regulation (2005)	Guideline	International Health Regulation (2005) is published in consideration of the growth in international travel and trade, and the emergence or re-emergence of international disease threats and other public health risks in order to prevent, protect against, control, and provide a public health response to the international spread of diseases in ways that are commensurate with and restricted to public health risks, and which avoid unnecessary interference with international traffic and trade.
Global Strategy for Dengue Prevention and Control (2012 – 2020)	Guideline	The Global Strategy for Dengue Prevention and Control (2012 – 2020) aims to correct situations in the sense that the tropical disease has taken the world by surprise. The Global Strategy emphasises on new opportunities, opened by experience from countries and resent researches, and also on vaccine, that can be seized to reduce morbidity and mortality, rationalise the disease response, and build capabilities that increase the resilience to future outbreaks. Besides, the Global Strategy promotes an integrated approach to vector management, and sustained control measures at all levels. Its guiding principle is to harmonise prevention, entomological and epidemiological surveillance, and case management with the existing health systems, ensuring that the efforts are coherent, sustainable, cost-

Title	Framework	Summary
		effective, and ecologically sound.
Asia Pacific Strategy for Emerging Disease (ASPED) (2010)	Guideline	The Asia Pacific Strategy for Emerging Disease (ASPED) provides a framework in strengthening national and regional capacities to manage the emerging disease, improve pandemic preparedness, and comply with the core capacity requirements of the International Health Regulation (2005).
Asia-Pacific Dengue Strategic Plan (2008 – 2015)	Guideline	The Asia Pacific Dengue Strategic Plan (2008 – 2015) is a preparation in response to the increase in the threats from dengue, which is spreading to new geographical areas and causing high morality during the early phase of the outbreaks. The Asia Pacific Dengue Strategic Plan is developed to reverse the rising trend of dengue in countries of the Asia-Pacific region. The guideline is an adaptation of a region approach through a collaboration between countries and sustained partnership to enable countries to implement evidence-based interventions and the use of best practices. Moreover, the strategic plan is to promptly detect, characterise, contain, and limit the outbreaks and epidemic of dengue with effective prevention and control.
Destruction of Disease-Bearing Insects Act 1975 (Act 154), Section 14; Section 18 (d); Section 19	Legislation	The legislation by virtue of Section 14 is a provision towards the prohibition on breeding disease-bearing insects without permission; Section 18 (b) is a provision for the closure of premises that are found harbouring disease-bearing insects; and Section 19 is a provision on the duty of the owner and occupier to protect works for preventing the breeding of disease-bearing insects.
Prevention and Control of Infectious Diseases Act 1988 (Act 342)	Legislation	An act to amend and consolidate the law in relation to the prevention and control of infectious diseases. The legislation states the provision of control of the spread of infectious diseases and its offences and penalties.

For the enforcement of legislation, Malaysia has been using the Destruction of Disease- Bearing Insects Act 1975 (Act 154), and Prevention and Control of Infectious Diseases Act 1988 (Act 342) towards controlling dengue issues. Even so, there is still a rise in the number of dengue cases in Malaysia. In this case, it can be seen that the existing prevention measures used in Malaysia may not be sufficient and effective in reducing the number of dengue issues.

2.1 Dengue

Dengue is a flavivirus with four types of serotypes that spread primarily by the Aedes aegypti and the Aedes albopictus mosquitoes [3]. According to World Health Organization (WHO) [2], dengue is transmitted by the bite of a mosquito infected with one of the four dengue viruses. It occurs in tropical and sub-tropical areas of the world. A person infected with dengue will normally have symptoms ranging from mild fever to incapacitating high fever with severe headache, pain behind the eyes, muscle and joint pain, and rash.

Dengue could not be spread directly from person to person; it spreads through the bite of a mosquito, which becomes infected when it takes the blood of another person who is infected with the virus. This is how dengue is transmitted from one country to another as humans are known to carry the infection from one area to the other during the stage when the virus circulates and reproduces in the blood system. Meanwhile, the Aedes aegypti mosquito is a daytime feeder; the peak biting periods are early in the morning and in the evening before dusk.

This paper emphasises on the increase in dengue issues in Malaysia in 2015, which is considered to be one of the viral infectious diseases among the other types of vector-borne diseases that has taken a number of lives. (Figure 2: Number of dengue cases per week 2014 – 2015). According to the Department of Health Malaysia, as of 12 September 2015, there were 85,4888 cases of dengue with 234 deaths reported from 2015. This is 21.5% higher compared to the same reporting period of 2014. From 6 – 12

September 2015, there were 2,604 cases of dengue reported, which is 17% higher than the number of cases reported in the previous week. In August 2015, DENV-1 has been the dominant serotype with a percentage of 60% [26].

Despite the conduct of previous researches and the availability of the relevant legislation in controlling and preventing dengue, the above statistic shows that the number of dengue cases are still hard to tone down.

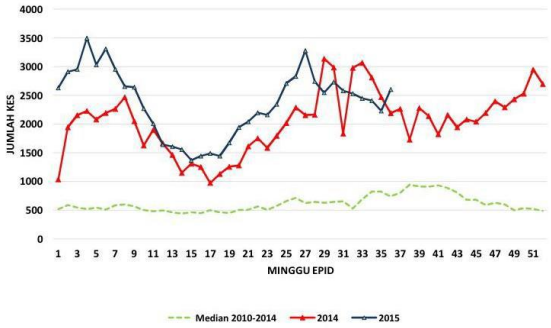

Figure 2 Number of dengue cases per week 2014-2015, (Department of Health, Malaysia)

The increase in the number of dengue cases week by week illustrates how difficult it is to curb dengue (Figure 2: Number of dengue cases per week 2014 – 2015).

Therefore, it is hoped that by identifying the gap in vector-borne disease research may help to signify a more focused research that aims at reducing the number of dengue cases especially in construction projects.

2.2 Dengue in Construction Projects

Dengue issues have increased with more frequent outbreaks that can be seen throughout the years. The dengue vectors have not changed physically for the past decades, and even though there is a utilisation of research findings and methods or techniques being implemented, the number of cases is still high [14]. Based on the Ministry of Health's annual report in 2012 [14], the Aedes Index was listed high in public areas such as construction sites (8.74%), factories (8.56%), vacant lands (8.02%), recreational areas (7.28%), and schools (6.41%). Based on the Aedes Index, construction sites is listed as the hotspot of breeding mosquitoes. The high number of dengue cases in construction sites may be caused from the lack of knowledge about dengue among the workers and also from the fact that foreign workers may transmit the dengue virus to another person without even realising it.

Moreover, according to Zulkeply [12], the breeding areas at construction sites include wheelbarrows, equipment cleaning areas, water tanks, shallow grounds, drums, styrofoam containers, rubber boots, cement mixers, safety hats, buckets, unused metal materials, water bottles, pile holes road dividers, building floors, canvas, shovel cranes, tires, paints cans, and water drains. Even fogging is not sufficient to reduce the number of dengue issues if no one takes the responsibility to prevent the breeding of mosquitoes in construction sites. The Ministry of Health's annual report [14] also showed that the highest Incidence Rate (IR) of dengue cases were in Selangor (175), the Federal Territory of Kuala Lumpur (104), Kelantan (72), and Perlis (70). The data indicates that the increase in the number of projects in the area will eventually affect the dengue issues. Selangor and the Federal Territory of Kuala Lumpur are known to have a high number of population and various types of construction projects in order to develop the areas towards urbanisation. Rapid movements of population into urbanisation, poor planning, and limited resources have resulted in the abundance of potential breeding sites [13]. Thus, the gap that can be seen from construction projects towards the dengue issue on the prevention measures seems to lack in consideration in terms of implementation and control within the construction projects.

3.0 RESEARCH ON VECTOR-BORNE DISEASES IN CONSTRUCTION PROJECTS

Combating dengue issues in Malaysia is a challenging task; many factors need to be considered in preventing and controlling the issues. Researches have been conducted to find ways in controlling and preventing dengue infection from becoming widespread problems. Among the research studies that had been conducted are: developing vaccines for dengue patients, controlling and prevention programmes, and treatment for dengue are the most common research areas that have been conducted not only in Malaysia, but other parts of the world as well. Even so, there is still a gap in combating the issues since the number of dengue cases keep on increasing in Malaysia.

According to the literature of published articles, various research studies on dengue have been conducted in Malaysia. As of 2014, there are 160 published articles related to dengue that can be found in a form of a search through a database dedicated to indexing all original data relevant to medical related issues, and 99 articles with clinical relevance [15]. However, for the purpose of this paper, only research articles related to construction have been further reviewed. The number of researches conducted indicates that Malaysia is one of the worst affected countries, which have a high number of cases throughout the years. Research studies conducted from 2000 to 2014 show that construction projects contribute a high number of dengue cases in Malaysia. Table 2 presents the list of published research articles on vector-borne disease in construction projects.

Table 2 List of Research Publications on Vector Borne Disease (Dengue) in Construction Projects

No.	Year of Publication	Title of Publication	Title of Journal	Author	Research Methodology	Findings
1	2015	Dengue Incidence and the Prevention and Control Program in Malaysia	Elsevier Journal	Rose Nani Mudin	Qualitative Method	Factors that contributed to the occurrence of dengue cases and the implementation of an integrated management strategy used by the government to control and prevent dengue transmission. Construction sites were the main contributors for a high number dengue cases and many of the construction sites have been closed down due to massive Aedes breeding.
2	2015	Dengue Vector Control in Malaysia – Challenges and Recent Advances	The International Medical Journal Malaysia	Lee HL, Rohani A, Khadri MS, Nazni WA, Rozilawati H, Nurulhusna AH, Nor Afizah AH, Roziah A, Rosilawati R, The CH	Data Analysis-Environmental Data & Analysis Utilising Neural Network	The findings of the study were to update on the various innovations on the control of dengue vectors, and the challenges faced by Malaysia in fighting against dengue cases. New methods, ideas, and concepts were suggested to be used in controlling dengue. The study aimed to develop and evaluate a new tool to reduce the vector population, especially in hotspot areas such as construction projects and industrial areas.
3	2013	Mosquitoes and Vulnerable Spaces: Mapping Local Knowledge of Sites for Dengue Control in Seremban and Putrajaya Malaysia	Elsevier Journal	Sarah K. Dickin, Corinne J. Schuster-Wallace, Susan J. Elliott	Geographical Information System (GIS)	The findings indicated that residents' perceptions of some vulnerable areas, such as a green space, differed from the views of local public health staff and could influence the action of residents to adequately destroy breeding sites. The study focused in Seremban and Putrajaya and it had been discussed that construction sites and associated garbage left by migrant workers were perceived to contribute to dengue.
4	2013	The Effect of Gender and Source of Information Towards Knowledge , Attitude and Practice on Dengue Fever Prevention	International Symposium on Mathematical Science and Computing Research 2013	Mohammad Nasir Abdullah, Wan Nor Hazimah Wan Azib, Muhammad Addin Burhanuddin, Mohd Fauzi Mohd Harun	Observation and Quantitative Method	The study was to find the difference between knowledge, attitude, and practice towards gender and source of information. The findings of the study would help in strengthening the public health measures at local areas, which would protect the people as well as providing them an adequate knowledge about the infectious disease control and develop the correct behaviour on health and the prevention of the disease.
5	2013	Assessing the Risk of Dengue Fever Based on the Epidemiological, Environmental and Entomological Variables	Procedia Social and Behavioral Sciences	Nazri Che Dom, Abu Hassan Ahmad, Ahmad Razali Ishak, Rodziah Ismail	Data Analysis, Qualitative Method	The study was designed to improve knowledge on the potential influence of factors that are prevalence of dengue fever. The urbanisation growth, poor or inexistent drainage facilities, chaotic location of dwellings and factories in most towns influence the mosquito population and affect dengue transmission intensity. The finding of the study would help to improve the environmental management and other control

No.	Year of Publication	Title of Publication	Title of Journal	Author	Research Methodology	Findings
						measures by targeting the most productive categories of breeding sites.
6	2013	Trends of Dengue Infections in Malaysia, 2000-2010	Elsevier Journal	Md. Shahin Mia, Rawshan Ara Begum, A,C.Er, Raja Datuk Zaharaton Raja Zainal Abidin, Joy Jacqueline Pereira	Data Analysis	The study analysed on the trends of dengue incidence and death in Malaysia from 2000 to 2010, as well as the predominant dengue virus serotypes during the last decades. It has been reported that the continuous process of urbanisation has resulted in the increased incidence of dengue in Malaysia. The high endemicity of dengue in Malaysia is due to demographic changes, massive urbanisation in town areas, changes in the use of agricultural lands in rural areas, and lack of effective mosquito control programmes.
7	2012	The Place of Health and the Health of Place: Dengue Fever and Urban Governance in Putrajaya Malaysia	Elsevier Journal	K. Mulligan, S.J. Elliott, C. Schuster-Wallace	Internet Searches of Local Databases, Qualitative Method	The research investigated the connection among urban planning governance and dengue fever in an emerging market context in the planned city of Putrajaya. It emphasised towards construction projects' rapid development including infectious disease management.
8	2008	Dengue Reborn: Widespread Resurgence of a Resilient Vector	Environmental Health Perspectives	Melissa Lee Phillips	Qualitative Method	The findings of the study proved that the one of the factors affecting the increase of dengue infections worldwide is climate change; dengue is considered as a disease of poverty in which it actually perfectly adapts to the urban environment. Control measures in curbing dengue's expansion are also discussed in the study.
9	2007	Generating a Dengue Risk Map (DRM) Based on Environmental Factors using Remote Sensing and GIS Technologies	28th Asian Conference on Remote Sensing 2007	Siti Morni Umor, Mazlin B, Mokhtar, Noraini Surip, Anizar Ahmad	Remote Sensing and Geographical Information System (GIS)	The use of technologies in the public health sector is for the purpose of managing and monitoring the problems in order to gain updated information on the environment, weather conditions, and the reported number of dengue incidences. The findings of the study by using remote sensing and GIS technology show that from the spatial analysis, it is proven that construction and industrial sites contribute indirectly towards the spread of the diseases.
10	2001	Epidemiology and New Initiatives in the Prevention and Control of Dengue in Malaysia	Dengue Bulletin Journal	Ang Kim Teng, Satwant Singh	Surveillance Information System, Qualitative Method	The findings of the study were on Aedes surveillance aimed at new breeding sites; strengthening information system for effective disease surveillance and response; legislative changes for heavier penalties; strengthening community participation and intersectoral collaboration; changing insecticide fogging formulation; mass abating; and also reducing case fatality.

From the list of researches in Table 2, it can be analysed that there has been various researches conducted on reducing the number of dengue cases in Malaysia. Even so, there is still a limited number of researches being conducted to focus on construction projects. As Malaysia is a country that is undergoing urbanisation, the research indicates that construction projects still have a problem in controlling and preventing the breeding of dengue-bearing mosquitoes. Hence, it is timely for a research to be conducted to propose prevention measures towards minimising dengue cases in construction projects.

4.0 CONCLUSION

Dengue issues has become the main problem faced by Malaysians even after a decade of little success in controlling dengue and its vectors. The gap in vector-borne disease research shows that dengue issues in construction projects have not been seriously addressed through research. The existing researches are inadequate and less effective in reducing the number of dengue issues. However, it must be understood that any measures and tools used in reducing dengue could not stand alone and need to be supported by various sectors and stakeholders. Thus, further research need to be conducted and the necessary support should be given. From the above, it is hoped that this research could act as a catalyst to generate interest from dengue researchers and the Ministry of Health (MOH), as it provides information regarding the gap of research in vector-borne disease in construction projects.

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