



## Strategy for Dengue Prevention and Control at Construction Sites

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### Abstract

Urbanization globally has led to increased construction sites, which often cause environmental disturbances and attract mosquitoes, leading to dengue outbreaks. Dengue fever cases in Selangor, Malaysia, have shown a worrying increase which statistics showing increasing cases from year to year. Construction sites are a key factor in the escalating number of dengue cases. This Focus Group Discussion will further discuss strategies for preventing and controlling dengue at construction sites. This discussion aims to assess challenges in construction site dengue prevention and identify innovative approaches, enhance coordination and collaboration among stakeholders for effective dengue prevention, and develop strategies to reduce construction site dengue risk using technology and data-driven solution. The discussion was structured into five main key points, which are 1) Identifying gaps and challenges, 2) Innovative Approaches and Best Practices, 3) Collaborative strategies and stakeholder engagement, 4) Policy and regulatory considerations, and 5) Implementation and Recommendation. By having a discussion with all the panellists, ideas on strategies for dengue prevention and control at construction sites can be implemented.

**Keywords:** industrialization, housekeeping, outbreaks

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## INTRODUCTION

Dengue, also known as dengue fever, is a viral infection caused by the dengue virus. It is transmitted to humans through the bites of infected female mosquitoes, primarily the *Aedes aegypti* mosquito. Dengue is a significant global health concern yearly (Basar et al., 2018). In Malaysia, the cumulative number of dengue cases reported until April 2023 shows a 195.3% increase for the same period in 2022 (WHO Western Pacific Region, 2023). Basar et al. (2018) state that the unexpected rise in dengue incidence in Malaysia may not be solely attributable to climate change. Complex factors such as environmental changes, weather patterns, the degree of urbanization, and the effectiveness of vector control services in urban areas may impact the rise of dengue incidence in tropical and subtropical countries.

The state of Selangor recorded 1,185 cases of dengue fever during EW20/2023, a 10.2% increase over the previous week's count of 1,075 cases (Jabatan Kesihatan Negeri Selangor, 2023). This highlights the increasing prevalence of dengue fever in Selangor and emphasizes the need for improved surveillance and intervention techniques to reduce its impact on public health. 21,926 cases were reported in 2023, a 100.7% increase from the same period in 2022 (Jabatan Kesihatan Negeri Selangor, 2023). The number of deaths from dengue fever in Selangor increased slightly in 2023, with four reported in 2023 compared to three in 2022. The Petaling district had the most dengue cases with 149 cases, Klang with 146 cases, Damansara with 113 cases, Sg. Buloh with 98 cases, Batu with 85 cases, and Sepang with 44 cases. **Table 1** shows Malaysia's current daily dengue outbreaks, highlighting Selangor as the highest case compared to other states.

As can be seen, urbanization is increasing globally, and the presence of construction sites is highly correlated with it (Likos et al., 2016). A construction site is a specially designated spot where work is done on various projects, including infrastructure, buildings, bridges, and other structures. The development of construction sites frequently causes environmental disturbances due to changes in land use, increased human presence, and increased trash, which negatively impacts flora and wildlife habitats (Knop, 2016). Dengue outbreaks in nearby communities are frequently attributed to construction projects. An excellent setting for the spread of vector-borne diseases like dengue exists on building sites. The case burden has increased in places with many of these locations. The quick and widespread migration of people and urbanization are likely to blame for the rise in dengue epidemic incidences. One study suggests that the construction developer was given instructions to work with a private pest control company to carry out fogging, larvicide, and "search and destroy" operations to destroy possible breeding containers to limit the number of mosquitoes (Shafie et al., 2021). Both the disease-causing virus and its vector, the *Aedes aegypti* mosquito, were already common in these regions.

Therefore, the primary objective of this article is to identify Dengue Prevention and Control at Construction Sites. Additionally, the article seeks to accomplish several specific objectives, including:

- Assessing challenges in construction site dengue prevention and identifying innovative approaches.

- To enhance coordination and collaboration among stakeholders for effective dengue prevention.
- To develop strategies to reduce construction site dengue risk using technology and data-driven solution

**Table 1:** Total Daily Cases from National Crisis Preparedness and Response Centre (CPRC), Ministry of Health Malaysia (MOH, 2023)

State	Daily Cases On 02 Jul 2023	Total Cumulative Cases From 29 Dec 2019 Until 02 Jul 2023
JOHOR	30	4,639
KEDAH	17	2,857
KELANTAN	10	945
MELAKA	2	500
NEGERI SEMBILAN	7	1,838
PAHANG	2	618
PERAK	7	1,741
PERLIS	2	445
PULAU PINANG	14	5,039
SABAH	13	4,327
SARAWAK	1	357
SELANGOR	108	29,485
TERENGGANU	1	126
WP KUALA LUMPUR	46	6,079
WP LABUAN	0	52
WP PUTRAJAYA	4	269
<b>MALAYSIA</b>	<b>264</b>	<b>59,317</b>

## IDENTIFYING GAPS AND CHALLENGES IN CONSTRUCTION SITES MANAGEMENT

Construction sites are frequently blamed for dengue epidemics in adjacent communities. The atmosphere is conducive to the development of young mosquitoes in the absence of predators and the convenience of female mosquitoes feeding on exposed construction workers (Abdul Rahim et al., 2022). Because of that, there will be challenges and gaps in preventing and controlling dengue epidemics caused by construction. The term "key gaps and challenges in dengue prevention" refers to the important areas of deficiency and obstacles that must be overcome to successfully control and eliminate the spread of dengue fever, a mosquito-borne viral disease. M. A. Zaki, (personal communication, June 19, 2023), lecturer from UiTM Puncak Alam, stated that vector resilience is one of the key gaps and challenges. Vector resilience is the ability of the *Aedes aegypti* mosquito to withstand environmental changes, adapt to new conditions, and maintain its population despite the control of its action. Alterations in temperature, humidity, rainfall patterns, urbanization, and land use are examples of environmental changes. These modifications may affect the behaviour, reproductive habits, and geographic distribution of *Aedes*

aegypti mosquitoes, which may alter dengue transmission dynamics. They can locate adequate breeding sites, endure in various climates, and persist in various geographical areas because of their ability to adapt to changing environmental conditions. Their capacity for adaptation strengthens their resistance to dengue as a vector.

S.M. Lau, (personal communication, June 19, 2023), a medical entomologist at Selangor State Health Department, stated that vector resistance is another challenge in reducing dengue outbreaks at construction sites. The widespread use of insecticides has caused the vector to become resistant, which makes vector control operations more difficult. Repeated exposure to pesticides over time may cause mosquito populations to develop resistance, making the insecticides less effective at controlling mosquito populations and preventing the spread of disease. Genetic alterations in the mosquito population that give pesticide resistance may cause this resistance. There was one study supporting this issue, and suggestion has been given. Insecticide resistance is now a major problem on a global scale, and there are few effective methods to stop it from spreading. Insecticides from unrelated classes with various modes of action should be used in a rotation at 6 month or a year basic. In areas where *Aedes aegypti* is allegedly highly resistant to pyrethroids but still vulnerable to organophosphate, rotational planning of insecticides applications by substituting pyrethroids with organophosphates is strongly advised (Rasli et al., 2021).

Multicultural society exists in Malaysia. Malaysians tend to be quiet, restrained, and discreet. They frequently exhibit modesty in their appearance and body language and approach daily life with a lot of tolerance. Besides, Malaysia is a country that accepts foreigners to work in our industry, especially construction sites. Two panellists from our discussion, M.H. Ab Rahman and Hafiz and S. Idris (personal communication, June 19, 2023), talked about how reducing dengue cases at construction sites was difficult due to the varied cultural behaviours of foreign workers. Foreign workers at construction sites may come from various cultural backgrounds and have different degrees of knowledge and behaviour regarding illnesses spread by mosquitoes, like dengue. They did not know how dangerous dengue cases were and how to prevent them from arising at their workplace. Foreign employees may come from nations where dengue is rare or where different precautions are taken. They need to be made aware of the dangers of dengue and how to stop mosquito reproduction. Some employees may have difficulties to accept new procedures or preventive measures. The employer needs to educate and give proper training and communicate well with them to ensure they understand the risk of dengue cases at their workplace.

Lack of effective communication among stakeholders is another gap and challenge in preventing dengue at construction sites. Effective communication between stakeholders is essential to undertake preventative measures, maintain a coordinated effort, and reduce the risk of dengue transmission at construction sites. Based on the discussion, V. Supramaniam, (personal communication, June 19, 2023), stated that good communication among market players is important because the implementation of the appropriate preventive measure may be affected if stakeholders, such as construction workers, contractors, project managers, and health authorities, are not sufficiently informed about the hazards connected with dengue and the necessary preventive measures. This statement was supported by one study that

showed that the absence of sufficient involvement of the community, health sector, and local government officials made the dengue vector control program ineffective. Their issues originate from the local people's committee's attitude of dependence on the health sector's activity, lack of excitement from mass organizations and community leaders, heavy workloads, and poor communication skills from the health sector (Nguyen-Tien et al., 2019). Other than that, during a discussion, the panelist highlighted the issue of the language barrier among foreign workers, especially with the employer, which became one of the challenges in preventing dengue cases at construction sites. Workers from various areas or nations are frequently present at construction sites. It might be challenging to achieve uniform use of dengue prevention techniques across the site due to language and cultural differences that can disrupt good communication and understanding.

### **INNOVATIVE APPROACHES AND BEST PRACTICES TO PREVENT DENGUE OUTBREAKS AT CONSTRUCTION SITES**

"Prevention is better than cure" is the main key of the Focus Group Discussion (FGD) in finding a strategy for dengue prevention and control at the construction site. This is because all the panellists believe it is better to stop something bad before than to deal with it after it has happened. Often, fines will be given by authorities such as the Department of Safety and Health, the Construction Industry Development Board (CIDB), and the Ministry of Health (MOH) in the event of an outbreak of dengue in a construction site or nearby residential area. Therefore, we are looking for some initiatives to reduce punishment and increase education and rewards for companies and employees who take initiatives to reduce dengue epidemics in their respective areas.

"The common breeding site in construction areas, particularly due to shared houses inhabited by foreign workers. The location was identified as a common breeding site including bathing areas, open burning, and leaking plumbing areas" - M.R. Abdul Jalil (personal communication, June 19, 2023)

Implementation of continuous training and programs is vital to address this issue by implementing a comprehensive syllabus in dengue management for foreign workers and employers along with specific Standard Operation Procedures (SOPs) to ensure the matter can take as their priority. Furthermore, these SOPs should outline the responsibilities of employers and workers in preventing mosquito breeding and responding to dengue outbreaks. All the panellists suggest a comprehensive training program that is proposed as per **Table 2**. These training programs should provide workers with a comprehensive understanding of dengue, mosquito biology, and breeding, identification of breeding sites, preventive measures, workplace hygiene and maintenance, reporting and response protocols, employers' responsibilities, ongoing awareness campaigns, and evaluation and feedback mechanism

**Table 2:** Propose A Comprehensive Training Modules, and Programs for construction workers to prevent dengue outbreaks.

<p><b>Introduction to Dengue</b></p> <ul style="list-style-type: none"> <li>• Overview of dengue fever such as causes, symptoms and potential complications</li> </ul>
<p><b>Mosquito Biology and Breeding</b></p> <ul style="list-style-type: none"> <li>• Education on life cycle of mosquito and their breeding habitat.</li> </ul>
<p><b>Identification of breeding sites</b></p> <ul style="list-style-type: none"> <li>• Focus on training workers to identify breeding sites within construction site. Encouraging workers to conduct regular inspections and report potential breeding sites.</li> </ul>
<p><b>Preventive Measures</b></p> <ul style="list-style-type: none"> <li>• Equipped with knowledge and personal protective measures to minimize mosquito bites.</li> <li>• Emphasizing the importance of mosquito repellents, wearing protective clothing and utilizing bed nets.</li> <li>• Physical control e.g. using netting and mosquito nets</li> </ul>
<p><b>Workplace Hygiene and Maintenance</b></p> <ul style="list-style-type: none"> <li>• Ensure regular cleaning and disinfection practices and targeting areas of mosquito breeding sites</li> </ul>
<p><b>Employer Responsibilities</b></p> <ul style="list-style-type: none"> <li>• Encouraging the establishment of specific SOPs, for dengue management, conducting regular site inspection and providing mosquito control measures such as fogging, larvae treatment.</li> <li>• Legal compliance under DDBIA 1975, PDCA 1988, LGA 1976</li> </ul>

The Construction Industry Development Board (CIDB) has suggested that a points system or rating and rewards system be created for companies that take good care of construction areas and are free from dengue outbreaks. This would be a valuable tool in preventing dengue outbreaks in construction areas by incentivizing companies to implement preventive measures, maintaining a safe and healthy workplace, and protecting workers from the disease. The points system could be based on various factors, such as the number of mosquito breeding sites on the construction site, the number of dengue cases reported, and the frequency of preventive measures implemented. Companies that score well in these areas could be awarded points, which could then be redeemed for rewards, such as discounts on insurance premiums or training courses. The rewards and rating system would also help create healthy competition between companies, leading to a more concerted effort to prevent dengue outbreaks. In addition, the system would help to maintain the company's image, as it would be seen as being proactive in preventing dengue. Appointed contractors should also be credited by the CIDB, MOH, and Local Authorities if they regularly implement preventive measures. This would help ensure that contractors take the necessary steps to protect workers from dengue and encourage other contractors to follow suit.

“Proper chemical usage is a key strategy to contain and control dengue in construction areas” - M. A. Zaki, (personal communication, June 19, 2023)

He specifically noted that changing the frequency of an insecticide spray can help prevent the development of resistance in mosquito populations. Furthermore, mosquitoes can develop resistance to insecticides over time if they are exposed to the same insecticide repeatedly. The mosquito will likely survive and reproduce, passing its resistance genes to

its offspring. In addition, it is also important to use different insecticides in combination to make it more difficult for mosquitoes to develop resistance to any one insecticide.

Self-monitoring and compliance are innovative approaches that can be improved to curb dengue in the construction site area. These two concepts are often used together in the context of regulatory compliance. In the joint discussion, the panelists opined that training should be conducted for the authorities regarding dengue management in the construction area along with the rewards and rating system. Self-monitoring will be one of the cultures to reduce the dependence of the construction company on the authorities by taking the initiative in reviewing the activities carried out and ensuring that they comply with the applicable guideline in preventing dengue in the construction area.

The panelists are in agreement on the setting up of a joint system by the Construction Industry Development Board (CIDB) and the Ministry of Health (MOH) addresses the challenges of obtaining information from government agencies regarding dengue outbreaks in construction areas. It acknowledges the existence of grey areas in standard operating procedures (SOPs), guidelines, and jurisdiction for containing dengue outbreaks in construction sites. The proposed joint system would share construction site inspection data from CIDB and dengue inspection data from MOH. Combining these datasets aims to identify construction sites that may be contributing to dengue spread in hotspot localities. This collaborative approach would facilitate information integration and enable the implementation of more effective and efficient control measures. The lack of accessible and comprehensive data and the limited availability to the public pose challenges in developing effective control measures for dengue outbreaks. Therefore, the panel believes that developing this system in collaboration with government agencies like CIDB, MOH, universities, and other relevant entities would enhance the integrity of information and enable more comprehensive control measures. Making this system open to all would ensure transparency and allow various stakeholders to access and utilize the data for research, analysis, and developing strategies to combat dengue. Multiple agencies' involvement and comprehensive data availability would enable a more coordinated and efficient response to dengue outbreaks in construction areas.

#### **COLLABORATIVE STRATEGIES AND STAKEHOLDER ENGAGEMENT IN PREVENTING DENGUE OUTBREAKS AT CONSTRUCTION SITES**

Malaysia's biggest health issue is dengue. The failure to act to combat dengue is one of its primary causes. Stakeholder involvement is considered the best strategy to increase participation and is the most productive way to establish good governance. Collaboration between different stakeholders can greatly impact preventing dengue cases at construction sites (Arham et al., 2021). Preventing dengue at construction sites requires a collaborative approach and active stakeholder engagement. Stakeholder involvement is crucial to preventing dengue outbreaks on construction sites since the strategies, plans, methods, and procedures used by stakeholders significantly impact how well the sustainable building is implemented in averting such cases (Adhi & Muslim, 2023). CIDB panelists highlighted this issue, and their suggestion for getting support from other agencies and stakeholder participation is to have a specific requirement for renewing CIDB's contractor license. According to the conversation, one

of the criteria for the contractor to maintain their CIDB license is to perform well and have no dengue outbreaks at their location. They must make sure they are eligible to renew their licenses. This may include having a valid and active contractor's license, complying with CIDB rules, and fulfilling any specifications or restrictions, including having no dengue cases and adhering to dengue training at construction sites. Besides, suggestions to renew the license include implementing mosquito control measures at their company, providing worker education on dengue prevention, and demonstrating compliance with waste management protocols. It contributes to a decrease in dengue cases at construction sites by improving the process for contractors to renew their licenses.

Another collaborative strategy and stakeholder engagement that can be implemented is by having Safety Health Officer (SHO) curriculum in Environmental Health practice. Mr. Redwan from the DSH Institute of Technology suggested that SHO competency must be implemented among environmental health practitioners. For improving workplace safety and health standards, environmental health practitioners may benefit from implementing Safety Health Officer (SHO) expertise. SHOs, experts in occupational safety and health management, create and uphold secure working conditions. Environmental health professionals can manage workplace dangers and ensure workers' well-being by including SHO competence in their job duties. Environmental health practitioners typically focus on the broader aspects of public health, including environmental factors that can impact public well-being. By incorporating SHO competency, they can expand their scope to include occupational health and safety, ensuring workplace safety. Panellist agree that at the university level, courses on environmental health and safety should be hand-in hand so that students have better knowledge and understanding of both safety and environmental aspect. This collaboration can lead to better coordination in addressing workplace hazards and promoting a safe and healthy work environment once they graduate and work, especially at construction sites. Besides, the proper instruction and training in occupational safety and health concepts, hazard identification and control, risk assessment, regulatory compliance, and emergency response are essential for implementing SHO competency among environmental health practitioners. Continual professional development and interaction with occupational safety and health experts can improve their proficiency in this field.

Based on the discussion among panellists, collaborative strategies and stakeholder engagement must have clear boundaries of responsibility with specific actions and measures, including policies and guidelines. Making wise decisions and managing problems to stop dengue outbreaks at construction sites is crucial. Each stakeholder's specific roles and responsibilities in the collaborative process must be defined. This makes it easier to avoid misunderstandings and guarantees everyone is aware of their contributions and duties. Besides, they should clearly state the goals and expected results of the cooperative endeavour. This helps stakeholders to have a common understanding, which in turn helps direct their actions and decisions. One of the ways to have a clear boundary of responsibility is by creating efficient communication routes to encourage continual discussion and information sharing among stakeholders. Regular gatherings, seminars, online forums, and other types of communication are means these approaches can be implemented.

## **POLICY AND REGULATORY CONSIDERATIONS USED TO PREVENT DENGUE OUTBREAKS AT CONSTRUCTION SITES**

The panellists' suggestions for policy and regulatory considerations to reduce the risk of dengue transmission in construction sites are:

**Introduce dengue risk assessment (DRA).** This would involve developing a standardized DRA process that all contractors must follow. The DRA would identify the risk of Aedes mosquito breeding in the construction site area and the control measures that need to be taken to prevent and control transmission. The DRA process could be based on the Hazard Identification, Risk Assessment, and Risk Control (HIRARC) process, the main reference for Safety and Health practitioners in the work area.

**Encourage stakeholder and policymaker involvement.** This would involve ensuring that various stakeholders, such as vector control agencies, healthcare providers, and public health officials, are involved in developing and implementing policies to reduce the risk of dengue transmission. Policies should cover a range of factors, such as vector control, healthcare infrastructure, surveillance systems, public awareness campaigns, and research activities. These two initiatives would help to ensure that dengue risk is effectively managed in construction sites. The DRA process would provide a systematic way to identify and control the risk of Aedes mosquito breeding, while stakeholder and policymaker involvement would ensure that a comprehensive approach to reducing the risk of dengue transmission is taken.

## **IMPLEMENTATION AND RECOMMENDATION IN PREVENTING DENGUE OUTBREAKS AT CONSTRUCTION SITES**

Liu et al. (2020) concluded that cutting off the transmission routes and properly controlling vectors in communities should be recommended as primary measures for dengue prevention and control at construction sites. But having a safety culture and awareness in the workplace makes this challenging to implement, especially for foreign workers, since they need to understand why they must follow existing dengue prevention activities. V. Supramaniam, (personal communication, June 19, 2023) proposes an alternative approach, advocating for a greater emphasis on health promotion, community engagement, education, and training rather than resorting to penalties. M.S. Abd Samad (personal communication, June 19, 2023) echoes this sentiment, stressing the significance of raising awareness among contractors and foreign workers. M.R. Jaffar (personal communication June 19, 2023) highlights the language barrier as a major hurdle, hindering effective communication between those in charge and the contractors on construction sites.

To overcome these challenges, M.H. Ab Rahman (personal communication June 19, 2023) emphasizes the importance of stakeholder cooperation. He suggests implementing new guidelines and policies specific to the tasks at hand, accompanied by an increased frequency of audits and inspections. These solutions aim to raise awareness among all employees, from top management to the workforce, regarding dengue prevention and control at construction sites. Expanding on these ideas, S.M. Lau, (personal communication, June 19, 2023), proposes an integrated and

systematic monitoring approach, ensuring a comprehensive solution. As the discussion continues, M.S. Awang (personal communication, June 19, 2023) suggests conducting a pilot project in a selected district, with a local authority taking the lead. This project would involve creating an integrated information system and a contractor rating system.

## CONCLUSION

Dengue outbreaks in Malaysia are difficult to control from year to year. The case of dengue keeps arising even though there was much awareness given. Rapid urbanization is a good thing for developing Malaysia's economy, but at the same time, it has a inferior impact on the environment and health, whereby dengue cases arise due to the construction works. Therefore, it is important for all parties, including the government, contractors, and workers, to participate in preventing and controlling dengue outbreaks, especially from construction sites.

## CONTRIBUTION STATEMENT

The MAEH Urban Health Forum was held at the National Institute of Health Setia Alam from 19-20 June 2023. NNA, MAA, MHM, MLH and FAS conceived the forum, applied for and obtained funding from the Malaysian Association of Environmental Health and Universiti Teknologi MARA, and drafted the first version of the article. The issue was analyzed by MAZ, MRAJ, MSAS, MSA, SI, MHAR, LSM, VS, and MRJ. All participants at the forum contributed to the focus group discussion that produced the article, and all approved the final version.

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