

Manuscript Title Research Trends in Construction Site Infectious Diseases Studies: A Systematic Literature Review

Authors Vivian Wong Shao Yun, Siti Hamidah Husain and Norhidayah Md Ulang

EARLY VIEW

Studies on Research Trends in Construction Sites Infectious Diseases: A Systematic Literature Review

Vivian Wong Shao Yun¹, *Siti Hamidah Husain¹, Norhidayah Md Ulang¹,

¹School of Housing, Building and Planning, Universiti Sains Malaysia, 11800, Penang, Malaysia.

*Corresponding author: sitihamidahhusain@usm.my

ABSTRACT

The construction industry has had longstanding issues with the prevalence of infectious diseases among on-site workers, particularly during the COVID-19 pandemic. However, academic literature lacks sufficient empirical evidence about the prevalence and impact of infectious diseases, specifically in the setting of construction sites. This study intends to identify the prevalence of infectious diseases at construction sites by formulating systematic data on the study of infectious diseases in this context. In this study, data on infectious diseases that are prevalent on construction sites were obtained from a secondary source based on a systematic literature review (SLR) following the Preferred Reporting Items for Systematic Review (PRISMA) standards, and by utilising thematic analysis. The related studies for each selected infectious disease were identified through this process. The findings, based on reputable academic databases such as Scopus, PubMed, Science Direct, and Emerald Insight, reveal eight prevalent infectious diseases on construction sites: Dengue, Tuberculosis (TB), Leptospirosis, Hepatitis B (HBV), HIV, Hepatitis C (HCV), Malaria, and Syphilis. As a result, this study contributes to theoretical understanding and practical insights into this crucial area, addressing methodological constraints and suggesting directions for future research and initiatives. At the same time, this study is applicable to encourage further empirical research and the development of preventive and treatment strategies for prevalent diseases in construction settings.

Keywords: Infectious diseases, Construction workers, Construction sites, Prisma, Systematic literature review

INTRODUCTION

Infectious disease is a human disease that may manifest in several forms. The presence of an infectious illness significantly affects the overall human health and well-being. The aetiology of this condition may be attributed to a specific microbe that flourishes and multiplies within the environment, including bacteria, viruses, protozoa, or fungus (WHO EMRO, 2021). The prevalence of

infectious diseases persists, resulting in the affliction of people and animals and sometimes leading to mortality. Infectious diseases can spread through people by direct contact with creatures, food, water, or the climate; these are called zoonotic sicknesses (McArthur, 2019).

According to Kementerian Kesihatan Malaysia (the Ministry) (2022), it has been determined that Malaysia is affected by seven groups of infectious diseases. Thus, preventing infectious disease outbreaks is a formidable challenge for the human population, specifically for Malaysian construction workers. However, because the researchers focused on the top ten diseases in Malaysia based on data from the Representative Office for Malaysia (2019), only five genera were included in this analysis (Table 1).

Table 1. Genus of infectious diseases in Malaysia is based on Kementerian Kesihatan Malaysia (2022)

Genus	Infectious Diseases
Vaccine-Preventable Diseases	<ul style="list-style-type: none"> • Hepatitis B
Vector-Borne Disease	<ul style="list-style-type: none"> • Dengue, Malaria
Tuberculosis/ Leprosy	<ul style="list-style-type: none"> • Tuberculosis (TB)
Sexually Transmitted Infection	<ul style="list-style-type: none"> • HIV, Gonorrhoea, Syphilis, Hepatitis C
Zoonosis	<ul style="list-style-type: none"> • HFMD, Leptospirosis

Literally, vaccine-preventable diseases are illnesses caused by infections that can be forestalled with antibodies, such as HBV. Vector-borne illnesses, such as dengue fever and malaria, are transmitted through being bitten by infected arthropods. Furthermore, Mycobacterium tuberculosis is the bacteria that causes TB, which mostly affects the lungs but may also harm the kidneys, spinal cord, and brain. TB illness can be fatal if not adequately treated (Minesh Khatri, 2020). Next, sexually transmitted infections, such as HIV, Gonorrhoea, Syphilis, and HCV, are illnesses that are spread through sexual contact from an infected person to an uninfected one. Also, zoonotic diseases are caused by bacteria, fungi, parasites, and viruses, which may cause minor to severe illnesses and death in humans and animals (Council, 2021).

According to Awolusi et al. (2018), construction employees face various health risks and are susceptible to a variety of diseases. Hence, it is important to get precise data in order to substantiate the assertion that infectious illnesses have a more pronounced influence on construction sites. However, there is a lack of data regarding infectious diseases on construction sites. Therefore, this research presents a summary of the data pertaining to ten infectious illnesses

that are often seen on construction sites based on the top 10 infectious diseases in Malaysia according to the 2019 Representative Office for Malaysia.

The Need for A Systematic Review

A systematic review is an objective, repeatable method to find answers to a specific research question by obtaining all relevant studies and reviewing and analysing their findings (Ahn and Kang, 2018). It involves a comprehensive and in-depth plan and search strategy to develop a priori, to reduce bias by recognising, evaluating, and synthesising all relevant studies on a specific topic (Patterson and Morshed, 2021).

Correspondingly, Kementerian Kesihatan Malaysia has conducted a significant number of previous studies on infectious diseases worldwide to investigate the likelihood of these diseases occurring on construction sites. These studies provide a local context for researchers and policymakers to comprehend the prevalence, incidence, and trends of diseases that directly affect the Malaysian population (Representative Office for Malaysia, 2019). Accordingly, using local data ensures that interventions and policies are tailored to the unique challenges and characteristics of the country. Nevertheless, there is a lack of research and established standards on infectious diseases in the Malaysian construction industry because most studies focus on specific diseases (Adnan et al., 2018).

Hence, the present study is vital because it provides information based on the top 10 infectious diseases according to the Kementerian Kesihatan Malaysia statistics. This information can aid future researchers in investigating these top 10 infectious diseases on-site and focusing future attention on the topic of infectious diseases at construction sites. The study of this systematic literature review aims to answer the research question "Which infectious illnesses have occurred at construction sites?". The principal focus of the investigation was on collecting the results of the previous study of the top 10 infectious diseases that were analysed by Kementerian Kesihatan Malaysia to prove that these illnesses had also been outbreaks within construction sites. In the final section, necessary actions are outlined, with an emphasis on approaches that future scholars can adopt to address the expressed concerns.

RESEARCH METHOD

The PRISMA methodology was utilised to carry out an SLR to analyse and identify infectious diseases on construction sites. The SLR process for this study followed the prescribed phases of preliminary, identification, screening, eligibility, and data abstraction and analysis (Shahrudin, Zairul and Haron, 2021).

Preliminary

The research topic for this SLR study was formulated in a concise, understandable, and logical manner to facilitate the discovery, screening, and retrieval of relevant publications that were related to the subject being investigated. Hence, this study topic was formulated by adapting the Cochrane acronym PICO concept, which stands for Population, Intervention, Comparison, and Outcome measurements (Patterson and Morshed, 2021). Therefore, the outlined research question is, "Which infectious illnesses have occurred at construction sites?"

Despite the significance of construction sites as potential drivers of infectious disease transmission, there is a lack of infectious disease statistics focusing on construction sites (Liang et al., 2018). Hence, the question encompasses four PICO concepts, i.e., construction party on-site (population), Malaysia's ranking of the most prevalent infectious diseases (intervention), infectious diseases study-related sectors (comparison), and the number of relevant studies pertaining to the top 10 infectious diseases in the construction industry (outcome). The keywords gathered from the titles and abstracts of the obtained articles were subsequently examined using a thesaurus and methodically organised in a logic grid table (Table 2).

Table 2. Logic grid with recognised keywords table

Population <i>(Construction party who is on-site)</i>	Intervention <i>(Malaysia's ranking of the most prevalent infectious diseases (MOH))</i>	Comparison <i>(Related study on construction site)</i>	Outcome <i>(the number of related studies based on the top 10 infectious diseases related studies on construction sectors)</i>
Main Contractor Subcontractors Clerk of Works Construction workers Designers	Dengue HFMD Tuberculosis Leptospirosis Hepatitis B	Proven evidence of site workers with diseases Transmission strategy Methods to prevent	Dengue Tuberculosis Leptospirosis Hepatitis B HIV
Project Manager	HIV		Hepatitis C

Quantity	Gonorrhoea	Malaria
Surveyor		
Principal Designer	Hepatitis C	Syphilis
Other consultants	Malaria	
	Syphilis	

Identification

The first phase of the SLR procedure involves identification, which was conducted in July 2023. By using relevant keywords, the researchers may enhance the dataset's capacity to retrieve a broader range of potential articles, as suggested by Mohamed Shaffril et al. (2021). Thus, by using the identification technique, this study aims to identify the previous study for selected infectious diseases that have been reported or confirmed on-site from 2013 to 2023 by four databases, namely, Scopus, PubMed, Science Direct, and Emerald Insight. Finally, a total of 10,563 articles were retrieved.

Screening

The subsequent step involves the screening procedure. Researchers examine the titles and abstracts of the studies to remove irrelevant materials using an abstract screening tool consisting of clear and concise questions that are based on the study's inclusion criteria. The abstract screening was conducted by examining the titles and abstracts that were identified as potentially relevant. Once an abstract is deemed eligible by the screeners, the full-text document of the study is obtained for further screening. Then, the researchers examine the full text of the articles for compliance with the eligibility criteria. At this stage, the researchers try to find the keywords and eligible data regarding this study (Table 3).

For this study, a total of 70 articles that are solely focused on specific infectious diseases on construction sites between 2013 and 2023 are relevant. Any journals containing review papers, conference papers, books, or types of infectious diseases were not included (Table 4). This aims to concentrate on the actual research, i.e., each listed infectious disease that is related to previous studies on-site.

Table 3. The search criteria employed in the systematic review

Databases	Keywords used
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Scopus	"dengue" OR "hand, foot, and mouth diseases" OR "tuberculosis" OR "leptospirosis" OR "hepatitis B" OR "HIV" OR "gonorrhoea" OR "hepatitis C" OR "malaria" OR "syphilis" AND "construction workers" OR "construction sites"
PudMed	"dengue" OR "hand, foot, and mouth diseases" OR "tuberculosis" OR "leptospirosis" OR "hepatitis B" OR "HIV" OR "gonorrhoea" OR "hepatitis C" OR "malaria" OR "syphilis" AND "construction workers" OR "construction sites"
Emerald Insight	"dengue" OR "hand, foot, and mouth diseases" OR "tuberculosis" OR "leptospirosis" OR "hepatitis B" OR "HIV" OR "gonorrhoea" OR "hepatitis C" OR "malaria" OR "syphilis" AND "construction workers" OR "construction sites"
Science Direct	"dengue" OR "hand, foot, and mouth diseases" OR "tuberculosis" OR "leptospirosis" OR "hepatitis B" OR "HIV" OR "gonorrhoea" OR "hepatitis C" OR "malaria" OR "syphilis" AND "construction workers" OR "construction sites"

Table 4. Inclusion and exclusion criteria of this study

Inclusion Criteria	Exclusion Criteria
Publication range 2013-2023	Publication before 2013
Journal (Articles with specific infectious diseases on construction sites or related to construction workers)	Review Paper, Conference Paper, Book, Types of infectious diseases not under the listing
Language English	Not with Language English
Availability full text	Not available full-text

Eligibility

The third step is the eligibility process, whereby articles are included or excluded according to the authors' specific criteria (Mohamed Shaffril et al.,

2020). For this study, during the eligibility process, 70 articles were manually screened for literature related to selected infectious diseases on-site based on inclusion and exclusion criteria.

Data abstraction and analysis

For this stage, the implemented articles underwent thorough analysis, and the result of the research was a concentration on precise studies pertaining to the defined research questions (Mohamed Shaffril et al., 2020). Figure 1 shows the PRISMA procedures for SLR of this study.

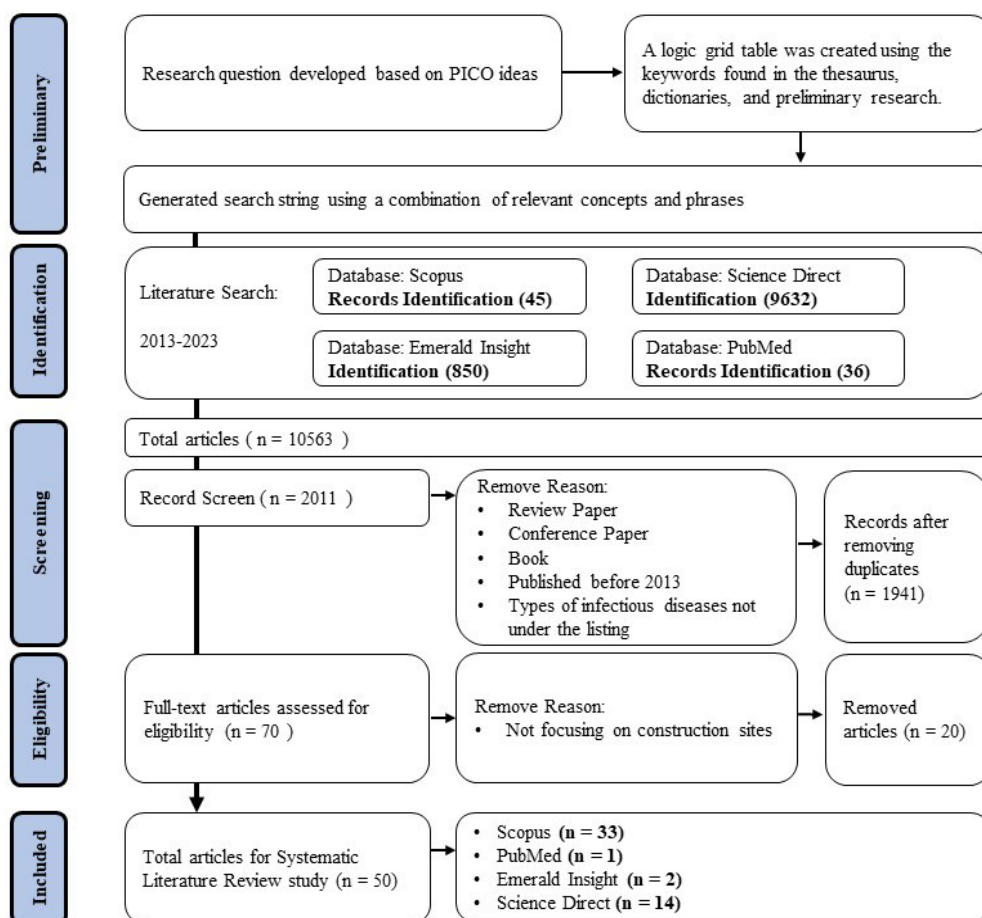


Figure 1. PRISMA procedures for SLR

Thematic Analysis

The remaining articles were evaluated, reviewed, and analysed using a thematic analysis approach (Figure 2); this process will generate the themes for this study. The total number of materials that were selected for thematic

evaluation was 50 articles. Using ATLAS.ti 9, a qualitative data analysis software, the initial coding of research on infectious diseases at construction sites was generated by directly quoting the empirical data. Subsequently, all the initial coding with comparable characteristics was classified into distinct code clusters. Every code group corresponds to a confirmed contagious illness that is seen at construction sites. For this study, themes are generated by the researchers (inductively generated themes) based on patterns and relationships within the data without being constrained by a specific theoretical perspective. The article quotation will be coded into the group, and finally, the final theme will be classified.

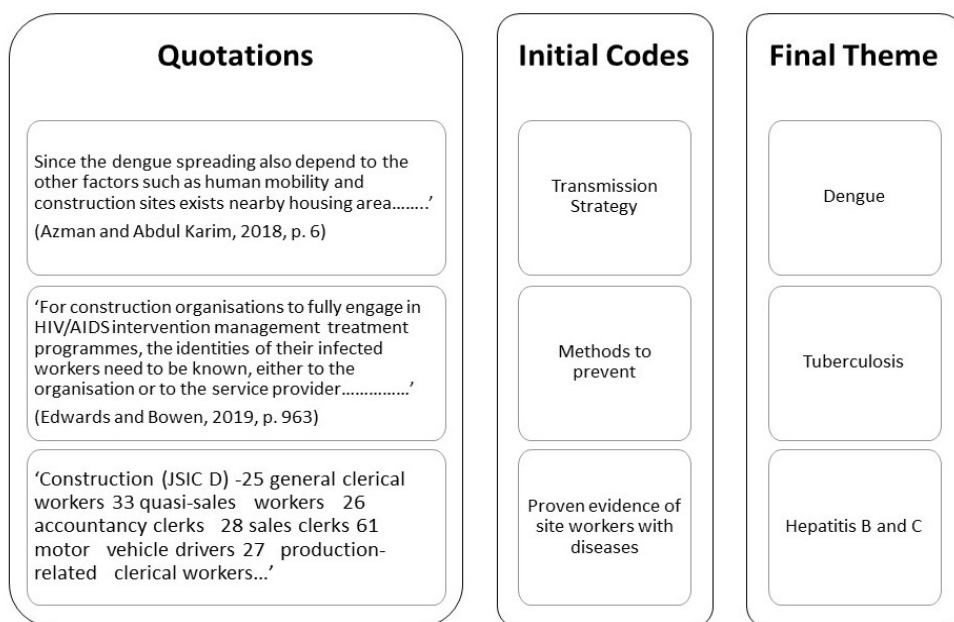


Figure 2. Example of thematic analysis

RESULTS

Descriptive Analysis

The review resulted in 50 articles from 21 countries, as shown in Figure 3. Eight out of 10 have a related article about the types of infectious diseases that may be found on construction sites. HFMD and Gonorrhoea were excluded from this study due to the absence of relevant citations in prior publications pertaining to these diseases on-site from 2013 to 2023.

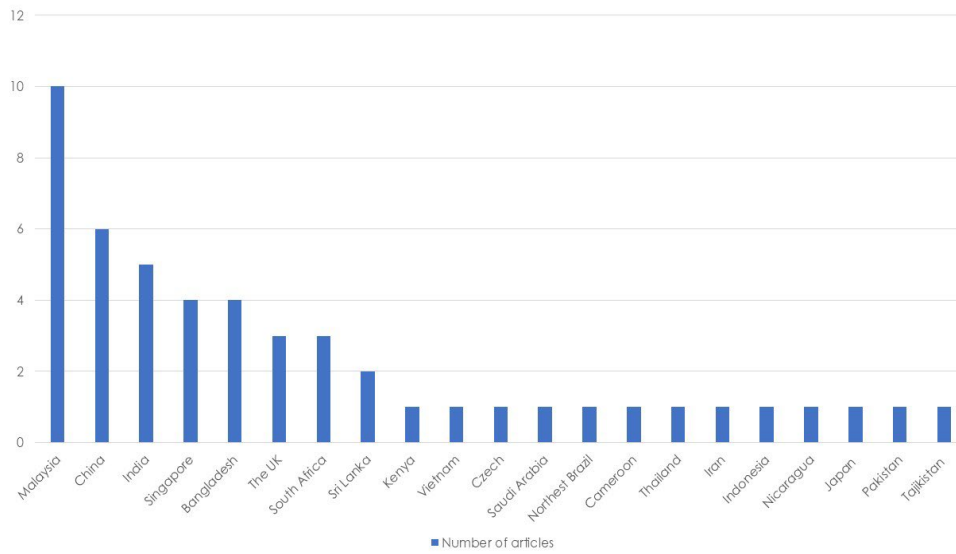


Figure 3. Publications of articles by nation

Finally, Table 5 shows the number of prior related studies for infectious diseases on-site from 2013 to 2023, together with additional information such as study design, search engine, and country using the PRISMA approach.

Table 5. List of previous studies of eight infectious diseases on construction sites from 2013 to 2022

Authors	Study Design	Search Engine	Country	Infectious Diseases							
				Dengue	TB	Leptospirosis	HBV	HIV	HCV	Malaria	Syphilis
Azman and Abdul Karim (2018)	QNS	Science Direct	Malaysia	•							
R. A. Adnan et al. (2021)	QNS	Science Direct	Malaysia	•							
Nazni et al. (2019)	CS	Science Direct	Malaysia	•							
Wevan Jebrail and Dawood (2020)	QNS	PubMed	Malaysia	•						•	
Majid et al. (2021)	CS	Scopus	Malaysia	•							
Shahrul Hamidun et al. (2021)	CS	Scopus	Malaysia	•							
Ahmad Zamzuri et al. (2022)	QLS	Scopus	Malaysia	•							
Liang et al. (2018)	CS	Scopus	Singapore	•							
X. Liu et al. (2021)	CS	Scopus	China	•							
Sim et al. (2020)	CS	Scopus	Singapore	•							
Salami et al. (2022)	CS	Scopus	Sri Lanka	•							

Authors	Study Design	Search Engine	Country	Infectious Diseases								
				Dengue	TB	Leptospirosis	HBV	HIV	HC V	Malaria	Syphilis	
Lutomiah et al. (2016)	CS	Scopus	Kenya	•								
Nguyen-Tien et al. (2019)	QLS	Scopus	Vietnam	•								
Dickin et al. (2014)	CS	Science Direct	Malaysia	•								
Yung et al. (2016)	CS	Scopus	Singapore	•								
Trojánek et al. (2016)	EX	Science Direct	Czech	•								
Zhang et al. (2022)	QNS	Scopus	China	•								
Louis et al. (2016)	QNS	Scopus	Sri Lanka	•								
Nagpal et al. (2016)	QNS	Scopus	India	•								
Jamjoom et al. (2016)	QNS	Scopus	Saudi Arabia	•								
de Macêdo et al. (2021)	CS	Scopus	Northeast Brazil	•								
Yang et al. (2014)	CS	Scopus	China	•								
Yoshikawa (2013)	CS	Scopus	Singapore	•								
Mamulwar et al. (2021)	CSS	Scopus	India					•				

Authors	Study Design	Search Engine	Country	Infectious Diseases							
				Dengue	TB	Leptospirosis	HBV	HIV	HC V	Malaria	Syphilis
Somerset et al. (2022)	QLS	Scopus	UK					•			
Somerset, Evans and Blake (2021)	QLS	Scopus	UK					•			
Middleton et al. (2020)	CS	Scopus	UK					•			
Tarkang and Pencille (2018)	CSS	Scopus	Cameroon					•			
Mendelsohn et al. (2015)	QLS	Scopus	China					•			
Sharif et al. (2022)	CS	Science Direct	Bangladesh	•							
Rahman et al. (2022)	QNS	Science Direct	Bangladesh	•							
Bashar et al. (2020)	QLS	Science Direct	Bangladesh	•							
Edwards and Bowen (2019)	QLS	Emerald Insight	South Africa		•			•			

Authors	Study Design	Search Engine	Country	Infectious Diseases							
				Dengue	TB	Leptospirosis	HBV	HIV	HCV	Malaria	Syphilis
Bowen et al. (2018)	QNS	Emerald Insight	South Africa		•			•			
Chandra Kashyap et al. (2021)	QNS	Science Direct	India		•						
Hishamshah et al. (2018)	EX	Scopus	Malaysia	•		•					
Tang et al. (2019)	QNS	Scopus	Malaysia			•					
Fang et al. (2018)	Case study	Science Direct	China		•						
Toemjai et al. (2022)	QNS	Science Direct	Thailand			•					
Garshasbi et al. (2018)	QNS	Science Direct	Iran			•					
Porusia et al. (2021)	QNS	Scopus	Indonesia			•					
Yih et al. (2019)	QNS	Scopus	Nicaragua			•					
Patel et al. (2014)	QNS	Scopus	India			•					

Authors	Study Design	Search Engine	Country	Infectious Diseases							
				Dengue	TB	Leptospirosis	HBV	HIV	HCV	Malaria	Syphilis
Nakazawa et al. (2022)	CS	Science Direct	Japan				•		•		
Arshad et al. (2016)	QNS	Scopus	Pakistan				•				•
D. Liu et al. (2013)	QNS	Science Direct	China					•			
Bowen et al. (2014)	QLS	Scopus	South Africa					•			
Weine et al. (2013)	QNS	Scopus	Tajikistan					•			
Dayanand et al. (2017)	QLS	Scopus	India								•
Haque et al. (2013)	QNS	Scopus	Bangladesh								•
QLS	=	Qualitative Study			EX	=	Experiment				
QNS	=	Quantitative Study			CC	=	Cross-sectional Study				
CS	=	Case Study			S						

Thematic Review

The thematic review was conducted by drawing upon professional-related and theoretical knowledge pertaining to infectious diseases that are prevalent at construction sites. For this study, eight themes were discussed: dengue (n = 27), followed by TB (n = 4), leptospirosis (n = 7), hepatitis B (n = 2), HIV (n = 11), hepatitis C (n = 1), malaria (n = 3), and syphilis (n = 1), as shown in Figure 4.

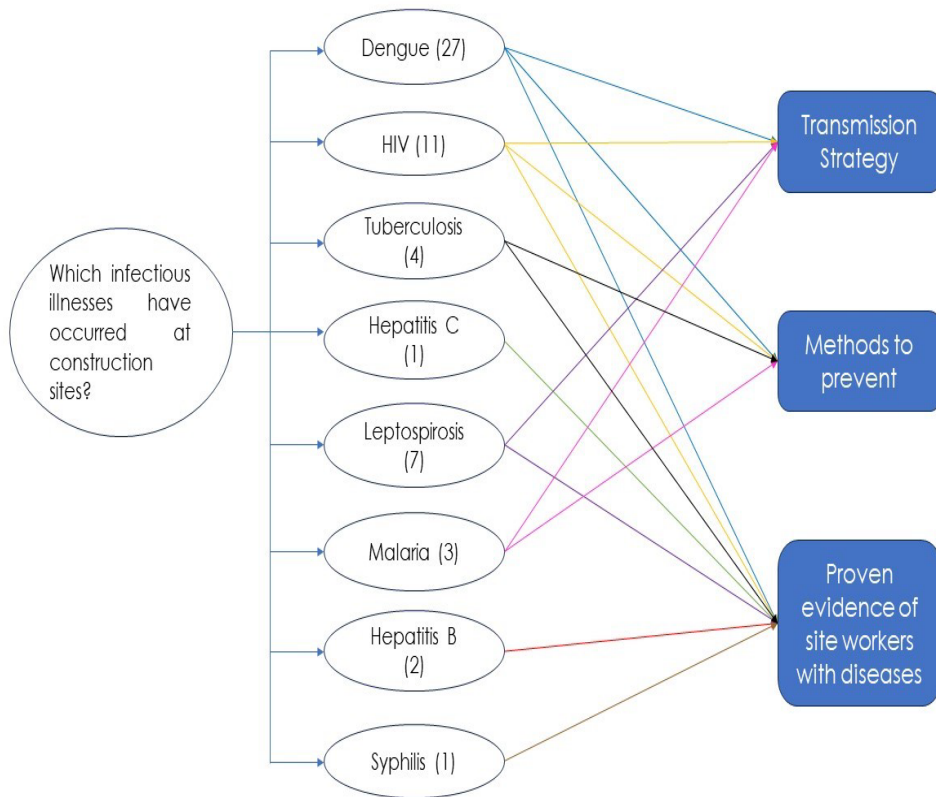


Figure 4. Thematic map

Dengue

Among these eight infectious diseases, dengue has the highest recorded study with nine out of 27 articles highlighting the prevalence of dengue on construction sites in Malaysia. As a response, the studies by Adnan et al. (2021), Ahmad Zamzuri et al. (2022), Liang et al. (2018), Louis et al. (2016), Salami et al. (2022), Lutomiah et al. (2016), De Macêdo et al. (2021), Nazni et al. (2019), Shahrul Hamidun et al. (2021), and Sim et al. (2020) have found that construction sites can increase the risk of transmissions during dengue outbreaks in construction sites. The problem of dengue fever spreading on construction sites is a concern in China as well (X. Liu et al., 2021).

There were many reasons for dengue exploration on-site, for example, the workers family's construction projects generated a variety of factors that contributed to dengue outbreaks on-site (Nguyen-Tien et al., 2019), the public health department stored rainwater-collecting materials (Dickin et al., 2014) or construction sites and garbage were thought to cause dengue (Yung et al., 2016; Trojánek et al., 2016). Moreover, dengue can be caused by human mobility in nearby residential areas or logged forest areas (Azman and Karim, 2018; Wevan Jebrail and Dawood, 2020).

In contrast, stored water in tanks, allows *Aedes* mosquitoes to breed and potentially spread the outbreak from the construction site to the community (Zhang et al., 2022; Sharif et al., 2022; Nagpal et al., 2016). Water tanks are peri-domestic containers that are left unattended by contractors during construction (Jamjoom et al., 2016). Yang et al. (2014) indicated that the workers at construction site with poor living environments were infected with dengue fever. Hence, for dengue prevention, large construction companies should be involved in public health initiatives, as demonstrated by Singapore's vector control programme, although some may opt to pay fines rather than allocate money and personnel for vector control (Yoshikawa, 2013). Correspondingly, other related articles are by Rahman et al. (2022), Bashar et al. (2020), and (Hishamshah et al., 2018). In Malaysia, over the past 40 years, climate change has facilitated the spread of the dengue virus through higher temperatures, increased rainfall, and humidity (Azman and Karim, 2018).

Tuberculosis (TB)

Tuberculosis (TB) is a bacterial infection (*Mycobacterium tuberculosis* complex) (Natarajan et al., 2020), which is transferred through inhaling tiny droplets from an infected person's cough or sneezes. A total of four

studies have reported construction workers with TB. Notably, the related articles are by Chandra Kashyap et al. (2021), Fang et al. (2018), Bowen et al. (2018), and Edwards and Bowen (2019).

Leptospirosis

The third highest-reviewed infectious disease for this study is Leptospirosis. Leptospirosis is an infrequent bacterial infection that animals can spread to humans (Khatri, 2021). Leptospirosis pathogens can survive in the body through the eyes, nose, and skin cuts and abrasions. Employees should avoid touching their faces at work and practice good personal hygiene. For this study, seven previous articles are related to leptospirosis on-site. The related articles are by Hishamshah et al. (2018), Tang et al. (2019), Toemjai, Thongkrajai and Nithikathkul (2022), Garshasbi et al. (2018), Porusia et al. (2021), and Yih et al. (2019), all of which discuss the transmission strategy and the proven evidence of site workers with this infected illness.

Hepatitis B

Hepatitis B is a potentially fatal liver infection that produces swelling and can cause liver damage (WebMD Editorial Contributors, 2022). Based on the SLR procedure, only two articles are found in the associated study. Correspondingly, in Japan, construction workers were recorded with HBV (Nakazawa et al., 2022). Also, in Pakistan, an evaluation of the characteristics of the infections revealed that single construction worker donors had a greater likelihood of contracting the HBV virus (Arshad et al., 2016).

HIV

The second-highest disease for this study is HIV, with 11 related articles. The related articles are by Mamulwar et al. (2021), Somerset et al. (2021), Somerset et al. (2022), Middleton et al. (2020), Tarkang and Pencille (2018), Liu et al. (2013), Mendelsohn et al. (2015), Edwards and Bowen (2019), Bowen et al. (2018), Bowen et al. (2014), and Weine et al. (2013); these articles discussed the transmission strategy, the method of prevention, and the proven evidence of site workers with this illness. Notably, the Human Immunodeficiency Virus (HIV) is a viral infection that targets the body's immune system.

Hepatitis C

For this study, there is only one article related to Hepatitis C in the context of construction sites. Hepatitis C is a viral infection that primarily affects the liver, with the hepatitis C virus (HCV) being the causative agent (Chaudhari et al., 2021). A previous study was only in Japan. There were 710,269 construction workers with and without HCV present to test the HCV (Nakazawa et al., 2022).

Malaria

Malaria is an infectious illness caused by a parasitic organism that is transmitted by the bite of a particular kind of mosquito that primarily targets human hosts (World Health Organisation, 2022). Based on previous research, there are three articles discussing malaria in the context of construction sites. The related articles are written by Wevan Jebrail and Dawood (2020), Dayanand et al. (2017), and Haque et al. (2013).

Syphilis

Syphilis is a bacterial infection typically transmitted through sexual contact (CDC, 2022). On construction sites, only one article about Syphilis is present. According to Arshad et al. (2016), when the characteristics of the infections were compared, it was discovered that Syphilis and the Hepatitis B virus were more likely to infect unmarried donors than the other infections. However, compared to the other infections, Syphilis was more likely to infect construction workers and married organ donors. People with co-infections were infected by multiple pathogens, regardless of their marital status or occupation.

DISCUSSION

A comprehensive review of four databases yielded 50 articles about eight infectious diseases on construction sites. Previously, ten types of infectious diseases were considered. However, after a systematic literature review (SLR), only eight types of infectious diseases have been highlighted in related articles. Infectious diseases on construction sites can be a significant public health concern, and the findings can vary from one country to another. The differences in findings can be due to several factors, such as variations in the prevalence of specific diseases, differences in construction practices and regulations, and variations in the availability and use of preventive measures. For example, Gerami Seresht's (2022) study has proposed a framework for enhancing

resilience in construction against infectious diseases using a stochastic multi-agent approach. The proposed framework motivates future research on micro-level modelling of infectious diseases and efforts to intervene in the spread of diseases.

In general, the study demonstrates the importance of implementing preventive measures to protect workers and the public from the risks that are associated with exposure to biological agents. These measures can include hygiene facilities, protective clothing, respiratory protection, and vaccination programmes, as suggested by Public Services and Procurement Canada (2023). The differences in findings from one country to another can be due to variations in construction practices and regulations, as well as differences in the prevalence of specific diseases. For example, in construction, the risk of infection on construction worksites is compounded by overlapping exposures in the construction workforce, which includes a variety of workers, such as labourers, carpenters, electricians, and plumbers (Pasco et al., 2020). In contrast, a study that has been conducted in another country may find that workers in different industries or occupations are at higher risk for specific diseases. Therefore, it is important to consider the context and specific circumstances of each country when interpreting and comparing the findings of studies on infectious diseases at construction sites.

RECOMMENDATIONS FOR FUTURE STUDY

The current body of research indicates that there is a significant lack of knowledge about HFMD and Gonorrhoea. The researchers have encountered a dearth of literature pertaining to the occurrence of these two infectious diseases on construction sites throughout the time frame from 2013 to 2023. Therefore, the first suggestion entails conducting a comprehensive study, encompassing site surveys and interviews, to gather empirical data on HFMD and Gonorrhoea occurrences inside construction sites.

Second, there remains a dearth of studies for TB, HBV, HCV, Malaria, and Syphilis. Hence, it is recommended that future studies thoroughly investigate the reasons and prevention methods specific to construction sites or among construction workers. According to Shaffril et al. (2018), PRISMA, a standard systematic review writing guide that is frequently used in the health sciences, these infectious diseases are commonly reported on construction sites.

Based on all the reviews in the journal of these eight types of infectious diseases, the researcher concludes that the studies of these

diseases on construction sites are limited. Therefore, further studies are recommended because the construction sector is one of the sectors that drive infectious diseases. Based on the ILO (2018), work-related illness is a leading cause of death among workers. As a result, on-site infectious diseases should be given special care.

CONCLUSION

The introduction of this study emphasised the critical need for comprehensive research on infectious diseases occurring on construction sites, pointing out the lack of systematic literature reviews and empirical investigations in this area. The research problem highlighted the gap in understanding and addressing infectious diseases, specifically within the context of construction sites. In addressing the limitations of this study, it is important to acknowledge that while the systematic review has provided insights into the eight types of infectious diseases that are prevalent on construction sites, it may not have covered the entire spectrum of infectious diseases that are relevant to this setting.

However, by conducting a thorough examination of 50 articles, the study aimed to mitigate this limitation and provide a comprehensive perspective within the scope of its resources and timeframe. Although the study is extensive, it is important to acknowledge the potential for overlooking certain infectious diseases or research gaps because of limitations such as restricted access to certain literature sources or language hurdles. To address this issue, future researchers should aim to conduct more thorough literature reviews and empirical studies to fill these gaps and limitations.

The theoretical contributions of this study lie in its systematic approach to synthesising existing research on infectious diseases on construction sites. By identifying common diseases and analysing the strategies presented in the literature, the study provides a foundation for further theoretical development in understanding the dynamics of infectious disease transmission and prevention in construction settings.

The practical contributions of this research are significant for both academia and the industry. For academia, it provides a roadmap for future research endeavours, highlighting areas that warrant further investigation and emphasising that comprehensive literature reviews are essential in understanding infectious disease dynamics on construction sites. For industry stakeholders and policymakers, the study offers insights into potential strategies for mitigating the risk of infectious

diseases on construction sites, which ultimately contribute to the health and safety of the workers and the broader community.

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REFERENCES

- Adnan, R. A. *et al.* (2018) 'Environmental and sociology factors and its association for dengue cases in Kuala Lumpur , Malaysia', (October). doi: 10.20944/preprints201810.0212.v1.
- Adnan, R. A. *et al.* (2021) 'The Impact of Sociological and Environmental Factors for Dengue Infection in Kuala Lumpur, Malaysia', *Acta Tropica*, 216, p. 105834. doi: 10.1016/J.ACTATROPICA.2021.105834.
- Ahmad Zamzuri, M. I. *et al.* (2022) "'best of Both World": The Amalgamation of Fuzzy Delphi Method with Nominal Group Technique for Dengue Risk Prioritisation Decision-Making', *Journal of Function Spaces*, 2022. doi: 10.1155/2022/9581367.
- Ahn, E. and Kang, H. (2018) 'Introduction to Systematic Review and Meta-Analysis: A Health Care Perspective', *Korean J Anesthesiol*, 71(2), pp. 1–38.
- Arshad, A. *et al.* (2016) 'Prevalence of transfusion transmissible infections in blood donors of Pakistan', *BMC Hematology*, 16(1), pp. 2–7. doi: 10.1186/s12878-016-0068-2.
- Awolusi, I., Marks, E. and Hallowell, M. (2018) 'Wearable technology for personalized construction safety monitoring and trending: Review of applicable devices', *Automation in Construction*, 85(July 2016), pp. 96–106. doi: 10.1016/j.autcon.2017.10.010.
- Bashar, K. *et al.* (2020) 'Knowledge and beliefs of the city dwellers regarding dengue transmission and their relationship with prevention practices in Dhaka city, Bangladesh', *Public Health in Practice*, 1(May), p. 100051. doi: 10.1016/j.puhip.2020.100051.
- Binti Azman, N. N. and Abdul Karim, S. A. Bin (2018) 'Assessing Climate Factors on Dengue Spreading in State of Perak', *Journal of Physics: Conference Series*, 1123(1). doi: 10.1088/1742-6596/1123/1/012026.

- Bowen, P. *et al.* (2014) 'Guidelines for effective workplace HIV/AIDS intervention management by construction firms', *Construction Management and Economics*, 32(4), pp. 362–381. doi: 10.1080/01446193.2014.883080.
- Bowen, P. *et al.* (2018) 'HIV infection in the South African construction industry', *Psychology, Health and Medicine*, 23(5), pp. 612–618. doi: 10.1080/13548506.2017.1380836.
- CDC (2022) 'Detailed STD Facts - Syphilis', *Centers for Disease Control and Prevention*. Available at: <https://www.cdc.gov/std/syphilis/stdfact-syphilis-detailed.htm> (Accessed: 9 November 2022).
- Chandra Kashyap, G., Sharma, S. K. and Singh, S. K. (2021) 'Prevalence and predictors of asthma, tuberculosis and chronic bronchitis among male tannery workers: A study of Kanpur City, India', *Clinical Epidemiology and Global Health*, 9(May 2020), pp. 71–77. doi: 10.1016/j.cegh.2020.07.002j.cegh.2020.07.002.
- Chaudhari, R. *et al.* (2021) 'Metabolic complications of hepatitis C virus infection', *World Journal of Gastroenterology*, 27(13), pp. 1267–1282. doi: 10.3748/wjg.v27.i13.1267.
- Council, O. (2021) 'Zoonotic Diseases', *Emerging Avian Disease*, pp. 91–102. doi: 10.1525/california/9780520272378.003.0008.
- Dayanand, K. K. *et al.* (2017) 'Malaria prevalence in Mangaluru city area in the southwestern coastal region of India', *Malaria Journal*, 16(1), pp. 1–10. doi: 10.1186/s12936-017-2141-0.
- Dickin, S. K., Schuster-Wallace, C. J. and Elliott, S. J. (2014) 'Mosquitoes and vulnerable spaces: Mapping local knowledge of sites for dengue control in Seremban and Putrajaya Malaysia', *Applied Geography*, 46(2014), pp. 71–79. doi: 10.1016/j.apgeog.2013.11.003.
- Edwards, P. and Bowen, P. (2019) 'Language and communication issues in HIV/AIDS intervention management in the South African construction industry: Interview survey findings', *Engineering, Construction and Architectural Management*, 26(6), pp. 962–

988. doi: 10.1108/ECAM-12-2017-0260.

Fang, L. Q. *et al.* (2018) 'Travel-related infections in mainland China, 2014–16: an active surveillance study', *The Lancet Public Health*, 3(8), pp. e385–e394. doi: 10.1016/S2468-2667(18)30127-0.

Garshasbi, V. *et al.* (2018) 'Leptospirosis in Caspian Sea littoral, Gilan Province, Iran', *Acta Tropica*, 181(January), pp. 11–15. doi: 10.1016/j.actatropica.2018.01.010.

Gerami Seresht, N. (2022) 'Enhancing resilience in construction against infectious diseases using stochastic multi-agent approach', *Automation in Construction*, 140(April), p. 104315. doi: 10.1016/j.autcon.2022.104315.

Haque, U. *et al.* (2013) 'Risk factors associated with clinical malaria episodes in Bangladesh: A longitudinal study', *American Journal of Tropical Medicine and Hygiene*, 88(4), pp. 727–732. doi: 10.4269/ajtmh.12-0456.

Hishamshah, M. *et al.* (2018) 'Demographic, clinical and laboratory features of leptospirosis and dengue co-infection in Malaysia', *Journal of Medical Microbiology*, 67(6), pp. 806–813. doi: 10.1099/jmm.0.000750.

Jamjoom, G. A. *et al.* (2016) 'Seroepidemiology of asymptomatic dengue virus infection in Jeddah, Saudi Arabia', *Virology: Research and Treatment*, 2016(7), pp. 1–7. doi: 10.4137/VRT.S34187.

Kementerian Kesihatan Malaysia (2022) *Incidence Rate and Mortality Rate of Communicable Diseases, 2020*, Portal rasmi Kementerian Kesihatan Malaysia. Available at: <https://www.moh.gov.my/index.php/pages/view/324> (Accessed: 27 June 2022).

Khatri, M. (2021) *What Is Leptospirosis?* Available at: <https://www.webmd.com/a-to-z-guides/what-is-leptospirosis> (Accessed: 6 July 2022).

Liang, S. *et al.* (2018) 'Construction sites as an important driver of dengue transmission: Implications for disease control', *BMC Infectious Diseases*, 18(1), pp. 1–10. doi: 10.1186/s12879-018-3311-6.

Liu, D. *et al.* (2013) 'The study of KBP of road construction workers of

- highway AIDS prevention project before and after intervention', *Asian Pacific Journal of Tropical Medicine*, 6(10), pp. 817–822. doi: 10.1016/S1995-7645(13)60144-3.
- Liu, X. *et al.* (2021) 'Dengue fever transmission between a construction site and its surrounding communities in China', *Parasites and Vectors*, 14(1), pp. 1–14. doi: 10.1186/s13071-020-04463-x.
- Louis, V. R. *et al.* (2016) 'Characteristics of and factors associated with dengue vector breeding sites in the City of Colombo, Sri Lanka', *Pathogens and Global Health*, 110(2), pp. 79–86. doi: 10.1080/20477724.2016.1175158.
- Lutomiah, J. *et al.* (2016) 'Dengue Outbreak in Mombasa City, Kenya, 2013–2014: Entomologic Investigations', *PLoS Neglected Tropical Diseases*, 10(10), pp. 2013–2014. doi: 10.1371/journal.pntd.0004981.
- de Macêdo, S. F. *et al.* (2021) 'Scaling up of eco-bio-social strategy to control aedes aegypti in highly vulnerable areas in Fortaleza, Brazil: A cluster, non-randomized controlled trial protocol', *International Journal of Environmental Research and Public Health*, 18(3), pp. 1–23. doi: 10.3390/ijerph18031278.
- Mamulwar, M. *et al.* (2021) 'Community-based point-of-care testing to identify new HIV infections', *Medicine*, 100(46), p. e27817. doi: 10.1097/md.00000000000027817.
- McArthur, D. B. (2019) 'Emerging Infectious Diseases', *Nursing Clinics of North America*, 54(2), pp. 297–311. doi: 10.1016/j.cnur.2019.02.006.
- Mendelsohn, J. B. *et al.* (2015) 'Design and implementation of a sexual health intervention for migrant construction workers situated in Shanghai, China', *Emerging Themes in Epidemiology*, 12(1), pp. 1–13. doi: 10.1186/s12982-015-0033-8.
- Middleton, M. *et al.* (2020) 'Test@work texts: Mobile phone messaging to increase awareness of HIV and HIV testing in UK construction employees during the COVID-19 pandemic', *International Journal of Environmental Research and Public Health*, 17(21), pp. 1–23. doi: 10.3390/ijerph17217819.
- Minesh Khatri, M. (2020) *Tuberculosis (TB)*, *WebMD Editorial Contributors*. Available at: <https://www.webmd.com/lung/understanding-tuberculosis-basics> (Accessed: 27 June 2022).

- Mohamed Shaffril, H. A. *et al.* (2020) 'Systematic literature review on adaptation towards climate change impacts among indigenous people in the Asia Pacific regions', *Journal of Cleaner Production*, 258, p. 120595. doi: 10.1016/j.jclepro.2020.120595.
- Mohamed Shaffril, H. A., Samsuddin, S. F. and Abu Samah, A. (2021) 'The ABC of systematic literature review: the basic methodological guidance for beginners', *Quality and Quantity*, 55(4), pp. 1319–1346. doi: 10.1007/s11135-020-01059-6.
- Nakazawa, S. *et al.* (2022) 'Occupational class and risk of hepatitis B and C viral infections: A case-control study-based data from a nationwide hospital group in Japan', *Journal of Infection and Public Health*, 15(12), pp. 1415–1426. doi: 10.1016/j.jiph.2022.11.005.
- Natarajan, A. *et al.* (2020) 'A systemic review on tuberculosis', *Indian Journal of Tuberculosis*, 67(3), pp. 295–311. doi: 10.1016/j.ijtb.2020.02.005.
- Nazni, W. A. *et al.* (2019) 'Establishment of Wolbachia Strain wAlbB in Malaysian Populations of *Aedes aegypti* for Dengue Control', *Current Biology*, 29(24), pp. 4241–4248.e5. doi: 10.1016/J.CUB.2019.11.007.
- Nguyen-Tien, T., Probandari, A. and Ahmad, R. A. (2019) 'Barriers to engaging communities in a dengue vector control program: An implementation research in an urban area in Hanoi city, Vietnam', *American Journal of Tropical Medicine and Hygiene*, 100(4), pp. 964–973. doi: 10.4269/ajtmh.18-0411.
- Pasco, R. F. *et al.* (2020) 'Estimated Association of Construction Work with Risks of COVID-19 Infection and Hospitalization in Texas', *JAMA Network Open*, 3(10), p. 2026373. doi: 10.1001/jamanetworkopen.2020.26373.
- Patterson, J. T. and Morshed, S. (2021) 'Systematic Reviews and Meta-Analyses', *Evidence-Based Orthopedics: Second Edition*, (February), pp. 11–18. doi: 10.1002/9781119413936.ch3.
- Porusia, M. *et al.* (2021) 'Risk factors of leptospirosis incidence in agricultural area', *International Journal of Public Health Science*, 10(3), pp. 574–580. doi: 10.11591/ijphs.v10i3.20858.
- Public Services and Procurement Canada (2023) *Management and Prevention of Infectious Diseases on Construction Sites*, Public

Services and Procurement Canada. doi: <https://www.tpsgc-pwgsc.gc.ca/biens-property/sngp-npms/bi-rp/conn-know/securite-safety/infectieuses-infectious-eng.html>.

Rahman, M. S. *et al.* (2022) 'A case-control study to determine the risk factors of dengue fever in Chattogram, Bangladesh', *Public Health in Practice*, 4(June), p. 100288. doi: 10.1016/j.puhip.2022.100288.

Representative office for Malaysia, B. and S. (2019) 'Country Fact Sheet Public Helath Data at a Glance', pp. 4–4.

Salami, B. A., Ajayi, S. O. and Oyegoke, A. S. (2022) 'Coping with the Covid-19 pandemic: an exploration of the strategies adopted by construction firms', *Journal of Engineering, Design and Technology*, 20(1), pp. 159–182. doi: 10.1108/JEDT-01-2021-0054.

Shaffril, H. A. M., Krauss, S. E. and Samsuddin, S. F. (2018) 'A systematic review on Asian's farmers' adaptation practices towards climate change', *Science of the Total Environment*, 644, pp. 683–695. doi: 10.1016/j.scitotenv.2018.06.349.

Shahrudin, S., Zairul, M. and Haron, A. T. (2021) 'Redefining the territory and competency of architectural practitioners within a BIM-based environment: a systematic review', *Architectural Engineering and Design Management*, 17(5–6), pp. 376–410. doi: 10.1080/17452007.2020.1768506.

Shahrul Hamidun *et al.* (2021) 'Distribution and abundance of Aedes mosquito breeding sites at construction site workers' hostel in Gelang Patah, Johor, Malaysia', *Serangga*, 26(3), pp. 57–68.

Sharif, M. *et al.* (2022) 'Spatial association of Aedes aegypti with dengue fever hotspots in an endemic region', *Heliyon*, 8(11), p. e11640. doi: 10.1016/j.heliyon.2022.e11640.

Sim, S. *et al.* (2020) 'A greener vision for vector control: The example of the singapore dengue control programme', *PLoS Neglected Tropical Diseases*, 14(8), pp. 1–20. doi: 10.1371/journal.pntd.0008428.

Somerset, S. *et al.* (2022) 'Opt-in HIV testing in construction workplaces: an exploration of its suitability, using the socioecological framework', *BMC Public Health*, 22(1), pp. 1–16. doi: 10.1186/s12889-022-13787-5.

- Somerset, S., Evans, C. and Blake, H. (2021) 'Accessing voluntary hiv testing in the construction industry: A qualitative analysis of employee interviews from the test@work study', *International Journal of Environmental Research and Public Health*, 18(8). doi: 10.3390/ijerph18084184.
- Tang, R. Y. et al. (2019) 'A 5-year retrospective study of melioidosis cases treated in a district specialist hospital', *Medical Journal of Malaysia*, 74(6), pp. 472–476.
- Tarkang, E. E. predictors of consistent condom use among migrant road construction workers in the southwest region of C. using the health belief modelg and Pencille, L. B. (2018) 'Psychosocial predictors of consistent condom use among migrant road construction workers in the southwest region of Cameroon using the health belief model', *Pan African Medical Journal*. doi: 10.11604/pamj.2018.29.215.15130.
- Toemjai, T., Thongkrajai, P. and Nithikathkul, C. (2022) 'Factors affecting preventive behavior against leptospirosis among the population at risk in Si Sa Ket, Thailand', *One Health*, 14(December 2021), p. 100399. doi: 10.1016/j.onehlt.2022.100399.
- Trojánek, M. et al. (2016) 'Dengue fever in Czech travellers: A 10-year retrospective study in a tertiary care centre', *Travel Medicine and Infectious Disease*, 14(1), pp. 32–38. doi: 10.1016/j.tmaid.2015.06.005.
- WebMD Editorial Contributors (2022) *Hepatitis B*, *WebMD Editorial Contributors*. Available at: <https://www.webmd.com/hepatitis/digestive-diseases-hepatitis-b> (Accessed: 9 November 2022).
- Weine, S. et al. (2013) 'HIV sexual risk behaviors and multilevel determinants among male labor migrants from tajikistan', *Journal of Immigrant and Minority Health*, 15(4), pp. 700–710. doi: 10.1007/s10903-012-9718-z.
- Wevan Jebrail, E. and Dawood, M. M. (2020) 'Studying the Impacts of Land Use Changes on the Occurrence of Vector Mosquitoes in Sabah, Malaysia', *Journal of Tropical Biology and Conservation*, 17(February), pp. 285–295.
- WHO EMRO (2021) *Infectious Disease*, WHO. Available at: <http://www.emro.who.int/health-topics/infectious-diseases/index.html> (Accessed: 27 June 2021).

- World Health Organization (2022) *Malaria*, World Health Organization. Available at: <https://www.who.int/news-room/fact-sheets/detail/malaria>.
- World Statistic. (2011) 'World Statistic - The enormous burden of poor working conditions', p. 1. Available at: https://www.ilo.org/moscow/areas-of-work/occupational-safety-and-health/WCMS_249278/lang--en/index.htm.
- Yang, F. *et al.* (2014) 'Molecular identification of the first local dengue fever outbreak in Shenzhen city, China: A potential imported vertical transmission from Southeast Asia?', *Epidemiology and Infection*, 142(2), pp. 225–233. doi: 10.1017/S0950268813000897.
- Yih, W. K. *et al.* (2019) 'Investigating possible infectious causes of chronic kidney disease of unknown etiology in a Nicaraguan mining community', *American Journal of Tropical Medicine and Hygiene*, 101(3), pp. 676–683. doi: 10.4269/ajtmh.18-0856.
- Yoshikawa, M. J. (2013) 'Vector control and surveillance operations in the Republic of Singapore', *Tropical Medicine and Health*, 41(2), pp. 61–66. doi: 10.2149/tmh.2011-04.
- Yung, C. F. *et al.* (2016) 'Epidemiological risk factors for adult dengue in Singapore: An 8-year nested test negative case control study', *BMC Infectious Diseases*, 16(1), pp. 1–9. doi: 10.1186/s12879-016-1662-4.
- Zhang, M. *et al.* (2022) 'Epidemiological Characteristics and the Dynamic Transmission Model of Dengue Fever in Zhanjiang City, Guangdong Province in 2018', *Tropical Medicine and Infectious Disease*, 7(9). doi: 10.3390/tropicalmed7090209.