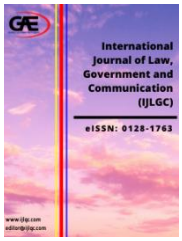
International Journal of Law, Government and Communication
EISSN : 0128-1763
IJLGC
Volume 10 Issue 40 (June 2025) PP. 244-262
DOI 10.35631/IJLGC.1040018



INTERNATIONAL JOURNAL OF LAW, GOVERNMENT AND COMMUNICATION (IJLGC)
www.ijlgc.com

INTEGRATING *MAQASID AL-SHARI'AH* IN THE DEVELOPMENT OF A HALAL DENGUE VACCINE

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Article Info:

Article history:
Received date: 27.03.2025
Revised date: 14.04.2025
Accepted date: 15.05.2025
Published date: 05.06.2025

To cite this document:

Rizal, N. M., Hasim, N. A., Arham, A. F., & Rusly, N. S. (2025). Integrating *Maqasid Al-Shari'ah* In The Development Of A Halal Dengue Vaccine. *International Journal of Law, Government and Communication, 10* (40), 244-262.

DOI: 10.35631/IJLGC.1040018

Abstract:

Dengue is the fastest spreading vector-borne disease in the world. In Malaysia, dengue fever has become a major public health burden. Malaysia has implemented various strategies to combat dengue, including public awareness campaigns, insecticide spraying, the use of technological innovations as well as biotechnology innovation approach. Developing a dengue vaccine has been a key initiative in disease control. However, current vaccines face challenges in terms of effectiveness and acceptance, particularly among Muslim communities, due to concerns over halal compliance. Thus, this study was conducted using a descriptive literature review. Data were collected from scholarly articles, reports from health organizations, websites, and religious sources to assess the significance of a halal-certified dengue vaccine. The study found that there is a growing demand for a halal dengue vaccine that aligns with Islamic principles. From the perspective of *Maqasid al-Shari'ah*, the development of a halal dengue vaccine is essential for protecting fundamental human values, including the preservation of religion (*Hifz al-Din*), life (*Hifz al-Nafs*), intellect (*Hifz al-'Aql*), lineage (*Hifz al-Nasl*), and wealth (*Hifz al-Mal*). The concept of *daruriyyat* underscores the necessity of vaccines in saving lives, while *hajiyyat* and *tahsiniyyat* support the need for safe, effective, and ethically produced vaccines. Ensuring compliance with halal principles could enhance vaccine acceptance among Muslim populations and contribute to global dengue prevention efforts. The study emphasizes the importance of developing a policy framework for halal dengue vaccine in Malaysia to address both medical and religious concerns. By integrating *Maqasid al-Shari'ah* into vaccine development, the acceptance and effectiveness of dengue vaccination programs can be improved, benefiting both Muslim communities and global public health initiatives.

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Keywords:

Halal Dengue Vaccine, *Maqasid al-Shariah*, Vaccine Acceptance, Public Health, Islamic Bioethics.

Introduction

Dengue fever has emerged as one of the most pressing global public health threats. Dengue is considered an outbreak due to its rapid transmission, significant morbidity and mortality, and the increasing frequency of epidemics globally. There are an estimated 390 million new cases each year, with endemic instances reported in over 100 countries (Sah et al., 2023). Recent statistics show that more than 5 million dengue fever cases were reported worldwide in 2023, with over 5,000 associated deaths. More than 7 million dengue cases have been reported globally as of April 30, 2024, surpassing the yearly total of illnesses recorded in 2023 (Ranjit et al., 2023). In the more than 100 nations where dengue is widespread, an estimated 4 billion individuals are at risk of contracting the disease (Brady et al., 2012). In addition, dengue fever requires high treatment costs, as well as the global economic burden due to dengue is enormous. A study published by Undurraga et al., (2016) estimates that the global cost of dengue treatment and lost productivity is USD 8.9 billion annually, especially in developing countries that have limited health infrastructure. Global dengue cases have increased due to several factors, including climate change, high humidity, and the El Niño phenomenon. Particularly in tropical areas like Malaysia, dengue has grown to be a significant public health issue.

In the first six months of 2024, MOH reported 75,263 cases and 60 deaths, which is a 27% increase in cases and a 50% increase in deaths over the same time period the previous year. According to statistics released by the *Bilik Gerakan Denggi Kebangsaan* (CPRC) of the MOH, the average case of dengue in Malaysia in 2024 is 208 cases a day. Dengue incidences have dramatically surged in Malaysia; 123,133 cases were reported in 2023, representing an 86.3% increase over the previous year. Moreover, dengue-related fatalities rose by 78.6%, with Selangor reporting the most cases. Most recently, from 31 December 2023 to 19 Nov 2024, Selangor recorded 56,528 cases. The Persekutuan regions of Kuala Lumpur and Putrajaya also witnessed a significant increase in the number of cases, with more than 12,000 cases reported (MOH, 2023). The population's health, the nation's healthcare system, welfare, and economy are all seriously threatened by the sharp rise in dengue incidence. In our nation, dengue fever has been a significant public health concern.

In fact, in 1988, dengue fever was made a notifiable disease under the *Akta Pencegahan dan Pengawalan Penyakit Berjangkit 1988*. *Akta Pemusnahan Serangga Pembawa Penyakit 1975* was also introduced in 1975 for the control of disease-carrying vectors. In connection with this, the government of Malaysia has planned a *Pelan Strategik Pencegahan dan Kawalan Denggi 2022-2026*. To lower the burden of sickness and dengue fever-related deaths, this plan intends to improve dengue prevention and control efforts. It is to achieve the specific objectives that have been outlined, which is a 5% reduction in the annual number of dengue fever cases and to maintain the case fatality rate below 0.2%. In short, this implementation is among the efforts of the Malaysian government in reducing the burden of dengue fever from the regulatory aspect.

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Dengue is a virus-borne illness spread by Aedes mosquitoes (Jamal et al., 2025). Fever, joint pain, rashes, and, in extreme situations, bleeding are among the symptoms. Dengue has no particular treatment; only medical assistance is available (Esther Bartlett et al., 2020). Eliminating mosquito breeding grounds and avoiding mosquito bites are the primary preventative measures. Traditional approaches that have been implemented in controlling dengue transmission are eliminating mosquito breeding sites, awareness campaigns, and fogging. However, the implementation of new biotechnological interventions, such as the release of genetically modified mosquitoes (GMM), Wolbachia mosquitoes, and so on, has also been introduced in Malaysia. This new dimension also includes the development of a dengue vaccine as a preventive measure (Irfan A. Rather, 2017). There are now two approved dengue vaccines: Qdenga® (TAK-003) from Takeda and Dengvaxia@ (CYD-TDV) from Sanofi Pasteur. However, there is another dengue vaccine created at the National Institutes of Allergy and Infectious Diseases' (NIAID) Emerging Diseases Laboratory in the US that is presently nearing the end of its clinical trials.

Currently, vaccine development is not only limited to the medical angle but also needs to be considered in the context of halal and *Maqasid al-Shari'ah,* which emphasizes the importance of maintaining the welfare of the people. *Maqasid al-Shari'ah* refers to the objectives of the *Shari'ah* established by Allah, aimed at bringing good (*maslahah*) and preventing harm (*mafsadah*) to humans (Isa et al., 2022). The scholars also established the means to safeguard the five basic things (*kulliyat al-khams*): religion, life, mind, property, and offspring, which are the main objectives of *Maqasid* (Al-Raysuni 2006). In fact, in line with the socio-culture in Malaysia, which is predominantly an Islamic society, the concept of a halal dengue vaccine and meeting the demands of *Maqasid al-Shari'ah* is indeed a universal necessity. Thus, this paper will review dengue prevention strategies and the role of halal dengue vaccines within the framework of *Maqasid al-Shari'ah*.

Methodology

This study employed a descriptive literature review approach, collecting data from scholarly articles, health organization reports, government documents, and religious sources to evaluate the integration of *Maqasid al-Shari'ah* in the development of a halal dengue vaccine. The data were gathered from reputable sources, including peer-reviewed journals, institutional reports, and official publications, to ensure the accuracy and reliability of the findings. The analysis focused on the principles of *Maqasid al-Shari'ah*, including the preservation of religion (*hifz al-din*), life (*hifz al-nafs*), intellect (*hifz al-'aql*), lineage (*hifz al-nasl*), and wealth (*hifz al-mal*). The review covered materials published between 2010 and 2025, encompassing studies conducted in Malaysia, Saudi Arabia, and Indonesia, where halal vaccine development is particularly relevant. Data were synthesized to identify key themes, challenges, and policy implications for promoting halal vaccine acceptance among Muslim populations.

What is Dengue Fever?

The dengue virus is spread by female Aedes mosquitoes, specifically Aedes aegypti and Aedes albopictus (Beloukas, 2023; Zende et al., 2024). Aedes is a type of mosquito that can be found in the tropics. The name is taken from the Greek language, which means "unpleasant" because this mosquito spreads dangerous diseases (Sulaiman & Choy, 2016). Furthermore, dengue fever is caused by the Dengue Virus (DENV), which is a flavivirus carried by the Aedes mosquito (Centre for Disease Control and Prevention, CDC). In a nutshell, female Aedes

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mosquitoes, which are frequently found in tropical areas, are the main vectors of dengue fever, a sickness spread by mosquitoes and caused by the Dengue Virus (DENV).

DENV is a single-stranded RNA virus with positive polarity from the Flaviviridae family and belongs to the genus Flavivirus (Abdullah, 2016). The virus measures approximately 50nm in size and consists of three main structural proteins: the envelope protein (E), the membrane protein (M), and the capsid protein (C). These proteins play a role in viral replication and interaction with the host cell's immune system. The replication process of the dengue virus occurs within the host cell, starting with attachment to the cell surface, then entry through endocytosis, replication in the acidic environment, and finally the production of a polypeptide chain consisting of 10 proteins (Ranjit et al. 2023). In addition, there are four serotypes of dengue viruses, named Flaviviruses DEN-1, DEN-2, DEN-3, and DEN-4 (Sulaiman & Choy, 2016). Any of these four serotypes can cause an outbreak that can cause a variety of illnesses, ranging from a mild febrile condition that is not specific to typical dengue fever to more severe forms of the disease, including Dengue Hemorrhagic Fever (DHF) and Dengue Shock Syndrome (DSS), which can be fatal.

The symptoms of the illness can range from moderate to severe and include rash, vomiting, headaches, body aches, and a high temperature (Clement et al., 2023). Severe cases can cause serious bleeding, organ damage, cardiac shock syndrome, and potentially even leading to death. The existence of elements like urbanization and climate change, which promote the proliferation of mosquito vectors, may further exacerbate the disease's consequences (Jamal et al., 2025). Thus, for the disease to be effectively managed and its spread to be controlled, early diagnosis is crucial (Mahsa et al., 2024). In endemic locations, dengue fever is often diagnosed clinically based on physical examination and reported symptoms, with laboratory techniques such as full blood counts, cell culture, Polymerase Chain Reaction (PCR), and serology employed for confirmation (Clement et al., 2023). However, dengue fever is also often misdiagnosed as symptoms overlap with other febrile illnesses such as malaria, leading to under-reporting and insufficient management (Beloukas, 2023; Clement et al., 2023). As much as 2% to 5% of severe dengue fever can lead to death with proper treatment, but it can reach 50% if left untreated, especially in cases of co-infections (Ranjit, Abdel-Rahim, Siddiq., Bijaya, Kumar, Aroop, Ali, et al., 2023). Thus, increasing awareness and improving diagnostic capabilities are important for effective management and prevention of dengue fever.

The Growing Burden of Dengue

Dengue is the fastest spreading vector-borne disease in the world (Arham, 2024; Selvarajoo et al., 2020). Statistics show that dengue fever is still a major global health concern, with both incidence and fatality on the rise. Around 56.7 million new cases were recorded globally in 2019, with Southeast Asia accounting for roughly 60% of infections (Ilic, 2024). Urbanization and climate variables increase the burden of the disease, especially in tropical areas where the Aedes aegypti mosquito is prevalent (Santos et al., 2024)(Dalpadado et al., 2024). In 2019, Malaysia recorded the highest dengue cases in history, with more than 130,101 cases reported. Four years prior, in 2015, the greatest incidence rate of dengue fever was also noted, with 396.4 cases per 100,000 people. Based on this finding, it is estimated that Malaysia has a significant dengue fever outbreak every four to five years. Over 600,000 dengue illnesses and over 1,200 deaths were reported in Malaysia between 2015 and 2021, a 100% increase over the seven years prior (Chem et al., 2024). In 2025 alone, Selangor experienced a significant surge, accounting for nearly half of the reported dengue cases nationwide. Meanwhile, most recently,

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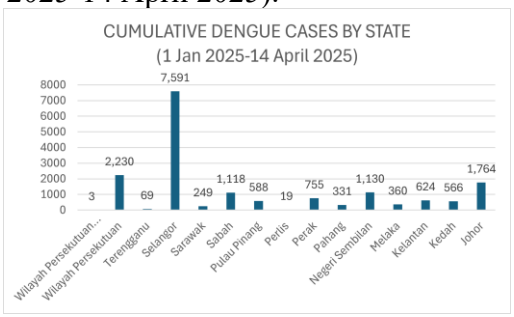
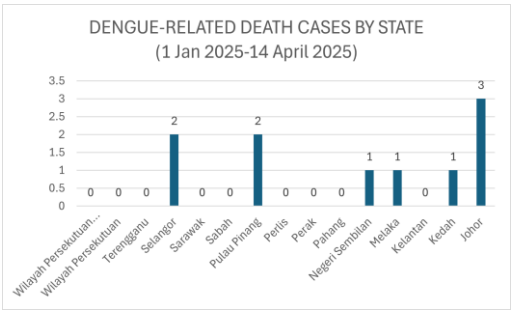
the number of deaths caused by dengue in 2025 was 10. Johor recorded the highest number of death cases of 3 people, and 34 areas in Johor have been announced as active dengue outbreak areas. Figure 1(a) shows the recent cumulative data of dengue cases (1 Jan 2025-14 April 2025) by state, while Figure 1(b) shows the current data of dengue-related death cases in Malaysia (1 Jan 2025-14 April 2025).



(a)



(b)

Figure 1: (a)Cumulative Dengue Cases by State and (b) Dengue Related Death Cases by State (1 Jan 2025-14 April 2025)

Source iDengue Portal, Ministry of Health Malaysia (2025)

Malaysia's Existing Approach in Combating Dengue

Understanding the necessity of reducing the number of dengue cases in Malaysia, the government of Malaysia, through the Ministry of Health, has carried out many dengue control and prevention initiatives up to this point (KKM, 2022). It involves cooperation and participation from various parties such as the community, government and non-government agencies, academia, and the private sector.

Awareness Campaigns and Law Enforcement

Awareness campaigns and public education are among the main strategies implemented in Malaysia to eradicate dengue. These initiatives seek to raise public awareness of dengue's risks, prevention strategies, and the role that both individuals and communities have in lowering the disease's risk (Radityo et al., 2024). For instance, information on the risks of dengue and the need to keep the environment clean and remove Aedes mosquito breeding grounds is spread by mass media, including radio, television, and newspapers (Trong et al., 2024). Awareness programs such as "1 House 10 Minutes" and the "*Jom Hapuskan Aedes*" campaign encourage residents to inspect and clean potential mosquito breeding sites weekly (KKM 2023). Operation *Gempur* (*Ops Gempur*) is also conducted in dengue hotspot areas through regular inspections to eliminate breeding sites (KKM 2023). Additionally, community *gotong-royong* programs are frequently held with the support of local authorities. In short, these ongoing awareness campaigns and community-based initiatives play a crucial role in empowering the public to take proactive measures, fostering a collective responsibility in the fight against dengue across Malaysia.

Furthermore, strict actions are taken against individuals or organizations that fail to comply with mosquito-borne disease prevention measures under the implementation of the *Akta Pemusahan Serangga Pembawa Penyakit 1975*, which was enforced beginning 23rd August 1982 (Pesuruhjaya Penyemak Undang-Undang Malaysia 2006). Under this act, health officers are authorized to enter any premises to inspect for mosquito breeding sites. If Aedes larvae are found, they may issue a directive to clean the area or impose a compound. Authorities have issued more than 13,000 notices and 22,660 criminal charges annually to individuals found

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with Aedes larvae on their premises (Seng, 2001). The enforcement of this act has shown positive outcomes in reducing dengue cases, especially in major cities. A study by Lee & Rohani (2015) found that areas with strict enforcement experienced a significant reduction in dengue cases compared to less monitored areas. In conclusion, the implementation of the *Akta Pemusahan Serangga Pembawa Penyakit 1975*, combined with public awareness initiatives, has contributed to the effective reduction of dengue cases in Malaysia.

Use of Insecticide or Fogging

The use of insecticides is among other approaches in combating the dengue fever outbreak in Malaysia. Fogging is the method most often used to control mosquito populations in Malaysia (Siti et al., 2023). Chemical control through fogging using insecticides is a short-term measure to kill adult mosquitoes, especially in the dengue outbreak area. In terms of the optimum time for fogging to be carried out, most researchers suggest that fogging is most effective when carried out between the onset of the rainy season and when the vims is at its strongest, prompting the importance of planning interventions at specific times (Mika et al., 2011). The fogging method is practiced intensively in areas that have a high number of cases or where there are deaths due to dengue (Nazni et al. 2019). But in Malaysia, traditional vector management methods, including fogging and insecticide use, were expected to cost about RM 304.88 million annually in 2010 (Packierisamy et. al., 2015). However, the effectiveness of these traditional methods in preventing dengue transmission is lower, necessitating a re-evaluation of alternate prevention measures. (Quan-Ong, 2016). The widespread use of insecticides also poses challenges, including the development of mosquito resistance to the chemicals used, which has been reported in several areas in Malaysia (Hamid et al., 2020). This causes the effectiveness of fogging to decrease and requires further studies to improve the insecticide formula or replace existing chemicals with more effective ones. In conclusion, while insecticide application and fogging remain integral components of dengue control strategies in Malaysia, their declining long-term efficacy and the escalating problem of mosquito resistance underscore the imperative for the development and implementation of more sustainable and innovative vector control measures.

In addition to fogging, larvicides such as temefos are used to kill mosquito larvae in enclosed water areas. Larvicidal and adulticidal treatments are the use of larval toxins and insect venom sprays to reduce mosquito populations (Kamarudin et al., 2022). This technique is usually applied in enclosed water areas such as rainwater tanks, longkang, and uncovered water containers. Larvicides are frequently employed in conjunction with public education initiatives to raise awareness of the value of maintaining a clean environment (Radityo et al., 2024). While this measure can significantly reduce the number of larvae, its long-term efficacy remains questionable without the active involvement of local communities. In conclusion, although larvicides like temefos can effectively reduce mosquito larvae populations in stagnant water, their long-term success heavily depends on consistent application and active community participation to maintain a clean and mosquito-free environment.

iDengue System

Malaysia has also introduced a special integrated system for compiling dengue case statistics known as iDengue. This integrated system monitors the spread of dengue cases under MOH. The iDengue system uses Bayesian sequencing to forecast dengue outbreaks, achieving an average daily accuracy of 80% in predicting mortality, readmission, and hospital stay (Cai et al., 2016). It geographically tracks potential outbreak areas, allowing health authorities to

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effectively target interventions within a 400-meter radius (Murali et al., 2019). This collected data helps the local health authorities to detect high-risk areas and implement appropriate preventive measures (World Health Organization, 2022). This system allows vector control measures to be taken early before the outbreak becomes uncontrollable. This approach allows strategic design of vector control measures, such as fogging, can be done based on the environmental conditions in the area (Rini & Yonny, 2012). The iDengue system uses the Long Short-Term Memory (LSTM) model to analyze historical weather and dengue case data, achieving an R2 score of 0.75, indicating strong forecasting ability (Mayuri, 2024). In conclusion, iDengue is a smart health care system that uses real-time diagnostics and weather-based forecasting to control dengue outbreaks, which can provide early warning signals, allowing authorities to target high-risk areas and take appropriate action.

Use of Biotechnology Innovation

Besides traditional approaches, Malaysia has utilized various other biotechnology interventions approaches such as the release of genetically modified mosquitoes (GMM), Wolbachia mosquitoes, and dengue vaccines.

a)Genetically Modified Mosquitoes (GMM)

The usage of genetically modified mosquitoes (GMM) is one method that scientists have devised to reduce insect populations (Arham et al., 2022). Previous experiments have shown success in controlling fruit fly and Lepidoptera populations (Resnik, 2017; Rose, 2009), making this a widely studied strategy among geneticists. According to Beech et al., (2012), GMM uses a "self-limiting" approach, where genetically modified male Aedes mosquitoes produce offspring that do not survive to adulthood. This technology, developed by Oxitec using recombinant DNA methods, has shown up to 90% reduction in mosquito populations in targeted areas (Alphey et al., 2014). In Malaysia, the National Biosafety Board (NBB) granted approval on 5 October 2010 for field trials conducted by the Institute for Medical Research (IMR), with mosquito releases carried out in isolated areas of Bentong, Pahang, and Alor Gajah, Melaka to ensure compliance with safety and regulatory requirements (Ramatha & Andrew, 2012; Subramaniam et al., 2012). Over 6,000 GMMs were released into uninhabited forests (Arham et al., 2022).

However, five years later, the Chairman of the Malaysia Health Association announced the discontinuation of the genetically modified mosquito (GMM) field trials, citing high costs as the primary reason (Packierisamy, Ng, & Dahlui, 2015). Despite its technological potential, GMM research in Malaysia was halted due to limited cost-benefit analysis, uncertain effectiveness, and safety concerns (Arham et al., 2022). Estimates suggest GMM control could cost between RM9 to RM138 per case, amounting to RM716,166 to RM11 million in 2020 alone (Undurraga et al., 2016). Developers like Oxitec reportedly spent about RM3.5 billion on this method (Cumbers, 2019). In conclusion, while GMMs offer a promising approach to mosquito control, high costs and feasibility concerns have led to the discontinuation of their use in Malaysia.

b)Wolbachia Mosquitoes

Wolbachia is a type of common bacterium found in insects. It can be found in about 60% of insects, such as butterflies, bees, and beetles, but is not naturally present in *Aedes aegypti* mosquitoes. *Wolbachia* bacteria cannot make people or animals sick. Since *Wolbachia* bacteria are not found in the *Ae. aegpti* mosquitoes, scientists have utilized *Wolbachia* in *Aedes aegypti*

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mosquitoes to reduce their ability to spread the dengue virus. According to CDC (2024), *Wolbachia* mosquitoes are produced by first introducing Wolbachia bacteria into the eggs of male and female *Aedes aegypti* mosquitoes. Wolbachia-carrying mosquitoes are developed from these eggs. At the plant, these mosquitoes are then mass-produced. Afterwards, the male and female mosquitoes with *Wolbachia* will be screened, where only the males are retained. The female mosquitoes are not released into the environment but can be used for breeding in the laboratory. *Wolbachia* mosquitoes are released to areas with wild populations of *Aedes aegypti* mosquitoes. When Wolbachia-infected Aedes aegypti males (WiAMs) host wild female mosquitoes that do not have *Wolbachia*, the eggs produced will not hatch. As a result, the population of Aedes aegypti mosquitoes will be reduced. The male WiAMs are then released into the environment to mate with uninfected female Aedes mosquitoes. Due to cytoplasmic incompatibility, the fertilized eggs will not hatch because the embryos formed in the female mosquitoes die. Thus, the wild mosquitoes' fertility rate and population size decrease (Hoffmann et al., 2015). In summary, this biotechnology innovation reduces the population of Aedes mosquitoes by introducing the bacterium *Wolbachia* into the males.

In terms of effectiveness and success rate, *Wolbachia* has been shown to block dengue transmission in 37.5% of *Aedes* mosquitoes within 14 days of infection (Bian et al., 2023). Pilot projects in Selangor, the Federal Territories, and Penang in 2022 demonstrated significant reductions in dengue cases (KKM, 2022). Early assessments from Cohort I sites showed a marked decline in cases compared to pre-release levels. Research by Nazni et al., (2020) also confirmed decreased dengue incidence in Kuala Lumpur following Wolbachia releases. Field trials, led by the Institute for Medical Research (IMR) in collaboration with the Ministry of Health, continue across various locations (Arham et al., 2021). In conclusion, the Wolbachia technique shows strong potential as a sustainable and effective approach for dengue control in Malaysia.

c) Dengue Vaccine

The dengue vaccine is gaining increasing attention as a key preventive measure, particularly in high-risk tropical countries. Understanding the role of vaccines as a preventive strategy that has the potential to control the dengue epidemic. The dengue vaccine is a biological product designed to guard against the four serotypes of the dengue virus (DEN-1 to DEN-4) (Hasania et al., 2025). The vaccine, the result of years of study, is intended to lessen the public health burden of dengue in tropical and subtropical areas. Immunization is widely regarded as one of the most effective and cost-beneficial public health measures, and WHO affirms that vaccines are the best method to control infectious diseases by activating the body's immune response (WHO 2019). In conclusion, the dengue vaccine offers a promising tool to reduce the global burden of dengue through targeted protection against its multiple serotypes. Research on dengue vaccines is being vigorously carried out from all aspects to facilitate public acceptance and ensure their efficacy. There are now two approved dengue vaccines: Qdenga® (TAK-003) from Takeda and Dengvaxia@ (CYD-TDV) from Sanofi Pasteur.

i)Dengvaxia® (CYD-TDV) Vaccine

The first dengue vaccine to receive a license is Sanofi Pasteur's Dengvaxia® (CYD-TDV). Dengvaxia® is a live recombinant tetravalent dengue vaccine that is given to people in dengue-endemic countries or areas who are between the ages of 9 and 45 or 9 and 60 (depending on their country-specific screening criteria) in a course of three doses spaced six months apart (Niramaya, 2024). Before receiving the immunization, people must be screened for prior

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dengue virus infections. The vaccine should only be administered to people who test positive on certain pre-vaccination tests. Due to the need for a pre-vaccination screen, this vaccine is not currently in widespread use.

In Malaysia, the Drug Control Authority (*Pihak Berkuasa Kawalan Dadah*, PBKD) granted a two-year conditional registration for Dengvaxia, produced by Sanofi Pasteur, in 2016. This approval was specifically for a Phase IV post-registration clinical trial to gather further safety data. Additionally, Sanofi Pasteur had to fulfill seven requirements before the vaccine could be made available in Malaysia (Press release by Datuk Dr. Noor Hisham Abdullah, Chairman of the Malaysia Health Association, November 2, 2017). As of 2017, Dengvaxia® was available in 14 countries, including four Southeast Asian nations: the Philippines, Indonesia, Thailand, and Singapore. Clinical studies confirmed that it provides protection against all four dengue virus serotypes (Sridhar et al. 2018). The vaccine showed greater effectiveness against DEN-3 and DEN-4, with overall protection ranging between 60–80% against symptomatic dengue and an 80% reduction in hospitalizations for individuals previously infected (Sridhar et al. 2018). In conclusion, Dengvaxia® marks a significant breakthrough as the first licensed dengue vaccine, offering substantial protection and demonstrating promising effectiveness in reducing symptomatic cases and hospitalizations in dengue-endemic regions.

ii) Qdenga (TAK-003) Vaccine

The second dengue vaccine licensed is Qdenga (TAK-003), also referred to as DENVax, and created by Takeda (Menon & Wilder-Smith, 2023). It is a recombinant chimera vaccine with DEN-I, DEN-3, and DEN-4 components, based on a strain of dengue virus type 2 (DEN-2) as the genomic backbone (Osario et aL, 2011 ; Schwartz et al., 2015). Trial tests in the first and second phases were carried out in the US, Colombia, Thailand, Singapore, and Puerto Rico (Schwartz et al. 2015). Phase III trials demonstrated that Qdenga was successful in avoiding symptomatic dengue and demonstrated durable antibody responses against all four virus strains, independent of exposure (Liu, 2017)(Biswal et al., 2019). Its efficacy against serotypes other than DEN-2 is modest (Armstrong, 2019). The European Medicines Agency approved the tetravalent live attenuated dengue vaccine, Qdenga, on 5th December 2022, after concluding its benefits outweighed the risks. WHO recommends Qdenga for individuals aged 6–16 years in high dengue transmission areas, while noting lower efficacy in children under 6 years. The vaccine can also be considered for individuals with comorbidities aged 6–60 years living in endemic regions. The recommended vaccination schedule is two doses, with a minimum interval of three months. Delayed second doses do not require restarting the series (WHO 2023).

As of 2024, Qdenga has been approved in over 30 countries, including the EU, UK, Brazil, Argentina, Indonesia, Thailand, and Vietnam (Takeda Malaysia 2024). Clinical trials demonstrated 80.2% efficacy against symptomatic dengue within 12 months, 90.4% efficacy in preventing hospitalization within 18 months, and long-term protection of 84.1% against hospitalizations and 61.2% against symptomatic cases up to four and a half years post-vaccination (Takeda Malaysia 2024). Qdenga, has been approved by the National Pharmaceutical Regulatory Agency (NPRA), and this decision was made after NPRA was satisfied with the results of a thorough assessment of the efficacy, safety, and quality of the vaccine submitted by the product registration holder (PRH) (KKM, 2024). In short, Dengvaxia® and Qdenga show great potential in dengue prevention. However, efficacy alone is insufficient without addressing the Muslim community's need for compliance with the halal

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principle. Therefore, *Maqasid al-Shari'ah* serves as a guiding framework for understanding the broader goals of Islamic law, ensuring that the preservation of human welfare and societal well-being remains central to its application in addressing contemporary challenges.

Maqasid al-Shari'ah

Maqasid, derived from the word "*qasada*" meaning intention or purpose, has been defined by scholars such as al-Ghazali, al-Amidi, Ibn 'Ashur, and 'Alal al-Fasi. Ibn 'Assyria (2014) defines maqasid as "the objective of syarak to safeguard human interests," while 'Alal al-Fasi (2013) calls it "the objective and secret of syarak in every law." A1-Raysuni (1995) emphasizes that this definition is referred to by other scholars. *Maqasid* is often associated with the concepts of wisdom and *maslahah*, and is discussed in *fiqh, al-qawa'id al-fiqhiyyah*, and *usul al-fiqh* (Awang, 2020). The term "*Maqasid al-Shari'ah*" refers to the greater goals of Islamic law, which are to advance social fairness, equilibrium, and compassion. It emphasizes a holistic analysis of the text to address contemporary issues while preserving the fundamental principles of sharia (Muhammad Nazir et al., 2024). In essence, the concepts of *Maqasid al-Shariah* are important in Islamic legislation, guiding ethical decision-making and basic rulings. According to Imam al-Ghazäli (1993), *Maqasid al-Shari'ah* is based on the preservation of five (5) objectives, namely protecting religion (*hifz al-din*), protecting life (*hifz al-nafs*), protecting intellect (*hifz al-'aql*), protecting lineage (*hifz al-nasb*), and protecting property (*hifz al-mal*) as described below;

Protecting Religion (Hifz al-Din)

Allah SWT created humans as the best of creation and made other creations, such as the heavens and the earth, to submit to humans to achieve the original purpose of human creation itself. Through the preservation of religion, human rights are subject to an individual's obedience to God, their relationship with other human beings, and with nature (Nasr, 2010). The development of dengue vaccine, which comes with inherent risks, calls for a renewed understanding of the importance of ethical living based on religious principles. Human rights must be emphasized, and it goes hand in hand as an obligation to put the preservation of religion at the top of the list.

Protecting Life (Hifz al-Nafs)

Apart from protecting life, which is the main *maqasid* or main objective of *Maqasid al-Shari'ah*, Islam emphasizes *wasa'il,* i.e., the means that lead to the preservation of life (al-Din 2000). In Islam, vaccination is justified in parallel with *hifz al-nafs*, or the preservation of life, which is a key component of *Maqasid al-Shari'ah* (Ali et al., 2018). Immunization is supported in Islam in tandem with *hifz al-nafs*, or the protection of life, which is a fundamental tenet of *Maqasid al-Shari'ah*. Its use is required even if it contains unclean elements, if there is no alternative holy material. In conclusion, lives need to be safeguarded and protected from any threats and health issues, despite the various innovations in modern biotechnology. Any risks arising in modern biotechnology must be effectively addressed through preventive measures and solutions to avoid any potential hazards that have been identified (Siti Fairuz, 2014). In conclusion, protecting life (*Hifz al-Nafs*) is a fundamental objective of *Maqasid al-Shari'ah*, where Islam not only prohibits actions that endanger life but also encourages measures, such as vaccination, that promote health and prevent harm, ensuring the preservation of life as a core tenet of Islamic teachings.

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Protecting Intellect (Hifz al-'Aql)

The application of modern biotechnology is an extension of the development of traditional biotechnology. This development encourages scientists and industries to explore and develop the potential of modern biotechnology for human use. This technology is also proven to solve various problems (Idris et al., 2020). For example, one of the benefits of contemporary biotechnology is the creation of the dengue vaccine, which provides a remedy for a persistent worldwide health concern (Arham et al., 2022). However, the progress of modern biotechnology must be limited by the potentially mind-destroying negative aspects of modern biotechnology, including the creation of uncontrollable organisms. Scientists may be driven to ideas that go beyond their limits (Idris et al., 2020). In conclusion, protecting intellect (*Hifz al-'Aql*) is a crucial aspect of *Maqasid al-Shari'ah*, as it encourages intellectual growth, the pursuit of knowledge, and responsible innovation, while cautioning against the potential misuse of modern biotechnology that may undermine moral and ethical boundaries, thus preserving the wisdom and balance ordained by Allah.

Protecting Lineage (Hifz al-Nasb)

From the aspect of scientific advancement, innovations such as the dengue vaccine promise various benefits to human life, including improving health quality, reducing disease burden, and protecting individuals from life-threatening infections. The development and use of dengue vaccines can play a crucial role in safeguarding future generations from the threat of widespread outbreaks and complications caused by the disease (Hasim, 2019). However, there are concerns among some users regarding the long-term effects of certain vaccine technologies, especially those involving genetic modification or recombinant components. Such products naturally require thorough scientific and medical evaluation. This is because any unforeseen long-term effects could indirectly impact future generations (Hasim, 2019). In summary, protecting lineage (*Hifz al-Nasb*) is a key goal of *Maqasid al-Shari'ah*, guaranteeing the welfare and success of coming generations. While vaccines like those for dengue offer essential protection and health advancement, their development and application must be carefully managed to uphold ethical standards and prevent any harm to future offspring.

Protecting Property (Hifz al-Mal)

One of the five main goals of *Maqasid al-Shari'ah* is the preservation of wealth or property, or *Hifz al-Mal*. This concept emphasizes the importance of protecting and managing property fairly and ethically. Safeguarding wealth refers to efforts to develop it and protect it from damage, loss, or reduction (Mustapha, 2015). Wealth is considered the lifeblood of human beings, which is a necessity of daily life (Basyiri, 2016). From a positive perspective, the development of the dengue vaccine offers significant benefits, including reducing the disease burden and improving public health, particularly in dengue-endemic regions. However, challenges arise when financial and accessibility issues hinder equitable vaccine distribution. Violations of wealth protection occur when monopolies and profit-driven motives limit access to essential medical advancements. In the case of vaccines, pharmaceutical companies may hold exclusive patents, restricting production and distribution to only authorized manufacturers (Smale, 2009). As a result, some populations, particularly in lower-income countries, may face higher costs for vaccination compared to more accessible traditional disease prevention methods (Bennet, 2006). In conclusion, integrating the principles of *Maqasid al-Shari'ah* in the development of a halal dengue vaccine becomes increasingly essential to ensure both equitable access and compliance with Islamic ethical values.

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Integration of *Maqasid al-Shari'ah* in the Development of a Halal Dengue Vaccine

Currently, there is no definitive cure for dengue, and no antivirals are available, even if they are only a form of preventive measure, management involves maintaining support, and relieving symptoms (Clement et al., 2023). Current clinical management of dengue only provides support for patients to recover. The main prevention strategies for dengue include vector control measures and vaccine development, as there are currently no effective treatments available for the disease (Jorge et al., 2024; Sandra Bos, 2018). Additionally, individuals who are infected a second time have a higher risk of developing severe dengue, which can lead to death. This emphasizes the importance of more vigorous scientific research on the issue of the dengue vaccine. In the Malaysia context, the development of a halal vaccine is potentially a more acceptable solution based on *Maqasid al-Shari'ah* principles (Nordin et al., 2022). The development of halal dengue vaccines is a critical area of research, especially in predominantly Muslim countries where compliance with halal standards is important (Yusof et al., 2022). Table 1 illustrates halal vaccine development in Muslim-Majority Countries. For countries where most of the population is Muslim, it is important to use a halal dengue vaccine technology platform.

Table 1: Halal Vaccine Development in Muslim-Majority Countries

Country	Key Milestone in Halal Vaccine Development	Notable Institutions	Reference
Saudi Arabia	Pioneered halal vaccine initiatives	Saudi FDA	Salisu et al., 2025
Indonesia	Developed pentavalent vaccines through Majlis Ulama Indonesia (MUI)	Ministry of Health Indonesia	Ministry of Health Indonesia, 2020
Malaysia	Ongoing efforts to develop halal dengue vaccines	National Pharmaceutical Regulatory Agency (NPRA)	Yusof et al., 2022

Additionally, with the advent of social media, it has become easier for anti-vaccine groups to promote their agenda. Among the reasons often put forward by this group on social media platforms include charges that the ingredients used in vaccine production come from elements forbidden to Muslims, such as pig DNA, conspiracy theories claiming the World Health Organization (WHO) is trying to reduce and control the world's population, as well as accusations that millionaire Bill Gates has a hidden agenda through 'Plandemic' (Bernama, 2021; Kompas.com, 2023). The heavy charges issued by this group must have caused a bit much irritation in the hearts of the public, especially Muslims, while the teachings of Islam prohibit its people from using haram things. Even in the context of food, Islam emphasizes the concept of *halalan toyyiban*. In Malaysia, efforts to build *halalan tayyiban* compliance are seen to be carried out continuously by strengthening applications such as halal screening procedures, building Malaysian halal standards and controlling the halal concept through regulatory control (Mustaffa et al., 2017). This can also prove that the production of cleaner vaccines that meet halal requirements and the use of the latest technology, such as genetic engineering and biotechnology, are in line with Islamic demands. However, in making decisions about vaccines, Muslims need to refer to the Qur'an, hadith, as well as the views of scholars and medical experts. In the current context, Muslim medical experts need to ensure the epistemological integrity and axiological significance of a technology. This is important to ensure that the pragmatic benefits of the technology can be enjoyed not only by Muslims but also all humans

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(M. A. Yusof, 2024). In fact, according to Islam, every disease has a cure and antidote. Every disease that exists must have a cure, whether it has been known or is still undiscovered by humans. Islam encourages its people to seek treatment and not despair in the face of any disease. This is in line with the concept of *ikhtiyar* (effort) in Islam, where humans are required to find a cure through methods that are justified by syarak, including through medical research and the development of health technology. Apart from treating diseases, Islam also encourages its followers to prevent diseases. There is a recommendation from the Prophet S.A.W. to eat some seeds of tamarind Ajwah for the purpose of protecting oneself from diseases.

According to Maqasid al-Shari'ah, one of the five primary objectives that must be protected is health and well-being (Shompa et al., 2024). Protecting life (*hifz al-nafs*) is an important principle, and vaccines serve as a tool to preserve life from infectious diseases. In situations of anxiety or without other alternatives, vaccines that may contain haram elements may be used under the concept of emergency, if there is no legitimate option in terms of Sharia (A1-Qaradawi, 1994). However, the development of halal vaccines is important to ensure that the Islamic community can use them without any doubt regarding the halal status of the product, fulfilling the need for health protection while complying with Shariah ruling.

Although the dengue vaccine has been developed and introduced to the Malaysian market, the findings of this study underscore significant gaps in Muslim community acceptance concerning the dengue vaccine in Malaysia. While dengue vaccination is increasingly recognized as a vital element in Malaysia's efforts to prevent and control the spread of the disease (Thomas, 2023), concerns over the vaccine's halal status and its necessity continue to hinder widespread uptake. The main factor affecting this acceptance is the certainty regarding its halal status and necessity. This study highlights a rising demand for a halal dengue vaccine that adheres to Islamic principles. From the *Maqasid al-Shari'ah* perspective, developing such a vaccine is crucial in safeguarding core human values, including the protection of religion (*hifz al-din*), life (*al-nafs*), intellect (*al-'aql*), lineage (*al-nasl*), and wealth (*al-mal*) (Kholil, 2025). The principle of *daruriyyat* (necessities) emphasizes the life-saving role of vaccines, while *hajiyyat* (needs) and t*ahsiniyyat* (enhancements) support the pursuit of vaccines that are not only effective and safe but also ethically and religiously appropriate. Thus, Table 2 shows the application of *Maqasid al-Shari'ah* principle in halal vaccine development.

Table 2: The Application of *Maqasid Al-Shari'ah* Principle in Halal Vaccine Development

***Maqasid al-Shari'ah* Principle**	**Application in Halal Vaccine Development**	**Example**
Hifz al-Din	Ensures vaccine ingredients are halal	Avoiding haram substances
Hifz al-Nafs	Prioritizes health and well-being	Life-saving role of vaccines
Hifz al-'Aql	Promotes scientific innovation within ethical bounds	Use of biotechnology
Hifz al-Nasl	Protects future generations	Prevents disease transmission
Hifz al-Mal	Prevents economic loss from pandemics	Reduces healthcare costs

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Aligning vaccine development with halal principles could significantly boost acceptance among Muslim populations and strengthen global dengue prevention strategies. The study further underscores the need for a clear policy framework in Malaysia that addresses both medical efficacy and religious compliance. Integrating *Maqasid al-Shari'ah* into the vaccine development process can enhance both the reach and impact of dengue vaccination programs, benefiting Muslim communities and contributing to broader public health goals. This gap highlights the need for a policy framework that not only ensures vaccine safety and efficacy but also promotes religious compliance to improve acceptance among Muslim populations. Bridging this gap is essential for improving vaccine acceptance, fostering inclusive public health strategies, and advancing ethically grounded biomedical innovation in Muslim-majority contexts.

Conclusion

In summary, the integration of *Maqasid al-Shari'ah* into the development of a halal dengue vaccine represents an essential and timely advancement in addressing both public health and religious concerns, particularly in Muslim-majority countries like Malaysia. Particularly in tropical areas, dengue fever is a severe and growing hazard to world health. The sharp rise in cases and fatalities in recent years highlights the urgency for continuous surveillance and effective prevention strategies. The development and approval of dengue vaccines such as Dengvaxia® and Qdenga mark significant progress in reducing the global dengue burden and offer promising hope for protecting lives. While dengue remains a growing health threat, the effectiveness of vaccination programs is closely tied to community acceptance. For Muslim-majority countries, particularly Malaysia, the halal status of vaccines plays a crucial role in public acceptance. Studies show that religious concerns, safety, and ethical considerations are key factors influencing vaccine uptake. The use of the vaccine is further supported by this review's emphasis on the incorporation of *Maqasid al-Shariah* in assessing such biotechnological interventions, since it is consistent with the values of bringing good (*maslahah*) and preventing harm (*mafsadah*). Through a scoping review approach, this study has identified a clear research and policy gap in integrating religious values into biomedical innovation. This contributes academically by enriching the scholarly discourse on the intersection of Islamic jurisprudence and modern biotechnology. It offers industrial relevance by proposing a values-based framework that can guide ethical vaccine development in pharmaceutical settings. Overall, the objectives of this study have been achieved. The review successfully highlights the urgent need for a policy framework for halal dengue vaccine and demonstrates how integrating *Maqasid al-Shari'ah* can improve both vaccine acceptance and public health outcomes. Ultimately, this interdisciplinary integration of biotechnology and Sharia offers a holistic and culturally sensitive path forward for ethically responsible public health advancements.

Acknowledegment

The research was funded by the Ministry of Higher Education (MOHE) through the Fundamental Research Grant Scheme (FRGS), grant number FRGS/1/2023/SSI03/UKM/02/4 and Universiti Kebangsaan Malaysia for supporting this research.

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International Journal of Law, Government and Communication
EISSN : 0128-1763
IJLGC
Volume 10 Issue 40 (June 2025) PP. 244-262
DOI 10.35631/IJLGC.1040018

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