RESEARCH PAPER

A Comprehensive Review on Dengue Vaccines: Development and Future Prospects

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ABSTRACT
Dengue is a serious mosquito-borne viral infection that has become a major public health problem, especially in tropical and subtropical countries. The presence of four serotypes of dengue virus and an intricate immunological response to infection pose significant challenges to development of a safe and effective vaccine. Researchers have made substantial progress towards understanding the nature of this infection and developing an efficient vaccine over the last few decades. Live attenuated, chimeric, inactivated, recombinant, viral vector, and mRNA vaccines are among the various classes of dengue vaccines that have been investigated and proven to induce acceptable levels of immunogenicity. CYD-TDV (Dengvaxia) was the first licensed vaccine against dengue fever. However, other promising candidates including TAK-003 (Qdenga) and novel vaccines derived from the NIH TV003/TV005 platform have also been developed. The present work reviews the progress in development of dengue vaccines and provides an insight into their key characteristics, production methods, and regulatory status. Furthermore, it highlights the dengue vaccine scenario in India, with specific reference to recent advances and research efforts. Dengue vaccination in India bears great significance due to substantial local burden of disease. It has prompted indigenous vaccine development as well as partnerships with international organizations. Nevertheless, a number of challenges should be addressed for long-term impact of dengue vaccines on public health.
Keywords: DENV (Dengue virus), dengue vaccine, CYD-TDV (Chimeric Yellow fever Dengue), TAK-003 (Tetravalent Dengue Vaccine), ADE (Antibody Dependent Enhancement), PFU (Plaque-Forming Units), PDK (Primary Dog Kidney), NIH (National Institutes of Health), NIAID (National Institute of Allergy and Infectious Diseases), E protein (Envelope Protein), prM (Precursor Membrane Protein)
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Introduction:

Dengue is a major mosquito-borne viral infection that is mainly spread by *Aedes aegypti* and *Aedes albopictus*.[1] WHO clinical guidelines divide dengue into three main forms: dengue without warning signs, dengue with warning signs such as abdominal pain, persistent vomiting, mucosal bleeding, plasma leakage, and increased haematocrit with low platelet counts, and severe dengue, which can lead to serious plasma leakage, bleeding, or organ dysfunction.[2]

Dengue is endemic in more than 100 countries, affecting an estimated 2.5 billion people, or around 40–50% of the global population.[1] Dengue cases are not equally distributed across regions, with Asia contributing about 70% of the total burden, followed by Africa at 16% and the Americas at 14%.[1] The Global Burden of Disease Study estimated that dengue was responsible for an average of 9,221 deaths each year between 1990 and 2013.[3] WHO data showed that more than 4.5 million dengue infections and over 4,000 deaths were recorded in 80 countries from January through November 2023.[1]

India carries a substantial share of the global dengue burden, as nearly one-third of the population at risk of dengue worldwide lives in the country.[4] Dengue is reported from almost every state in India. By September 17, 2023, the country had recorded more than 94,198 cases and 91 deaths related to dengue.[1] The dengue fever cases are one of the significant challenges that have been threatening India. Earlier estimates had revealed that there were about 33 million dengue cases in just one year, that is, 2010 in India.[2] In particular, the disease has been persistent in such states as West Bengal, Uttar Pradesh, Punjab, Haryana, Delhi, Gujarat, Kerala, Karnataka, and Tamil Nadu.[5] Despite combined mosquito-control efforts, dengue continues to spread to previously unaffected areas due to rapid urbanization, increased travel, climate change and inadequate healthcare facilities. So, vaccination is an important strategy of dengue prevention and control.

Since there is no antiviral therapy against dengue, management is purely supportive, and hence, the need for development of safe, effective and affordable measures for prevention of the disease is emphasized. [6] This review addresses the development of dengue vaccines and encompasses a discussion of early attempts, current strategies, and the critical role of dengue vaccines in the control of the disease worldwide, with a focus on India.

History:

Early attempts to produce a live attenuated dengue vaccine were made in the 1940s and involved passing the virus through mouse brain tissue in an attempt to weaken it.

However, challenges of immunology, such as the existence of four different serotypes, the possibility that antibodies might hinder rather than help the immune response against the virus, and the phenomenon of antibody-dependent enhancement, contributed to delays in the development of an effective vaccine, which was not licensed for almost seventy years after the introduction of the yellow fever vaccine.[6] An important contribution to the solution of this problem was made by the Paediatric Dengue Vaccine Initiative, established in 2003 with the support of the Bill & Melinda Gates Foundation. It brought together organizations such as the WHO, pharmaceutical companies, the U.S. military, and governments of dengue-endemic countries to support and coordinate vaccine development efforts.[7]

Classification or types of dengue vaccines:

Dengue vaccine candidates currently under development can be grouped into six main platforms, which differ in their mechanisms of action, manufacturing processes, and immune responses**.**

1. Live attenuated vaccines

Live-attenuated vaccines (LAVs) are among the most advanced dengue vaccine candidates in clinical development. These vaccines can be developed by repeatedly passing the virus through cell cultures to reduce its virulence or by using recombinant DNA methods, particularly by introducing deletions in the 3′ untranslated region (3′ UTR) of the viral genome.

Cell Culture Manufacturing:

Most live-attenuated dengue vaccines are produced in certified Vero cell cultures, which are derived from African green monkey kidney cells and provide a suitable environment for flavivirus replication. Butantan-DV, for instance, was produced as a freeze-dried tetravalent vaccine, a formulation that can be used for large-scale production.[8] Live attenuated vaccines are generally cheaper to produce than subunit or mRNA vaccines and thus are more valuable in the context of dengue-endemic, resource-limited countries.

- **CYD-TDV (Dengvaxia®)**:
  Dengvaxia® (CYD-TDV) is a tetravalent live-attenuated chimeric dengue vaccine derived from the yellow fever 17D vaccine strain. In the production process, the genes coding for the prM and E proteins of the yellow fever 17D virus were replaced by the homologous genes of DENV-1, DENV-2, DENV-3, and DENV-4, resulting in four recombinant vaccine viruses encoding the structural proteins of all four dengue serotypes. Each vaccine virus is produced separately in Vero cell culture, and the virus suspension is harvested and purified by membrane chromatography and ultrafiltration. The resulting monovalent vaccine components are then formulated and mixed in the appropriate proportion to obtain the final tetravalent Dengvaxia formulation. Dengvaxia is supplied as a lyophilized preparation that is reconstituted with the accompanying diluent before use.[9,10]
  It was licensed in Mexico in December 2015, making it the first dengue vaccine to receive regulatory approval worldwide across Asia and Latin America and later in the European Union and the United States.[11] Dengvaxia® received approval in several countries, this did not mean that it was routinely used in all of them. Its use was later limited because of safety concerns, particularly among individuals who had not been previously infected with dengue. Sanofi subsequently announced the discontinuation of the vaccine due to low demand worldwide.[12]
- **TV003/TV005**:
  TV003 and TV005 are live attenuated tetravalent dengue vaccine candidates derived from the NIH/NIAID platform. Each vaccine candidate comprises four different inserts that encode for the structural proteins of all four dengue serotypes. The four dengue virus serotypes have been engineered to contain deletions of 30 or 30/31 nucleotides in the 3′ untranslated region (3′ UTR) to reduce their replication capacity while eliciting an appropriate immune response. Specifically, TV003 is composed of rDEN1Δ30, rDEN2/4Δ30, rDEN3Δ30/31, and rDEN4Δ30, whereas TV005 is composed of rDEN1Δ30, rDEN2/4Δ30/31, rDEN3Δ30, and rDEN4Δ30. The DENV-2 component in TV003 is a chimeric virus in which the prM and E genes of DENV-2 are inserted into the rDEN4Δ30 backbone. TV003 and TV005 are manufactured by first generating the individual components. Indeed, live attenuated dengue vaccines are typically produced in certified Vero cells that allow flaviviruses to propagate. After individual component generation, the mixture of components is formulated into the tetravalent vaccine. Thus, TV003 contains 10 3 plaque-forming units (PFU) of each component, whereas TV005 contains 10 4 PFU of the DENV-2 component. Both TV003 and TV005 are investigational vaccines that have undergone clinical evaluation in early-phase clinical trials.[13,14]
  The U.S. National Institute of Allergy and Infectious Diseases developed this vaccine formulation using four components: rDEN1Δ30, rDEN2/4Δ30, a chimeric DENV-2 strain with a DENV-4 backbone, rDEN3Δ30/31, and rDEN4Δ30.[15,16] TV003 is administered at a dose of 10^3 PFU for each monovalent component, whereas TV005 contains 10^4 PFU of the DENV-2 component.[17]
- **TAK-003 (Qdenga®)**:
  TAK-003 (Qdenga®): TAK-003 is a live-attenuated tetravalent dengue vaccine developed by Takeda and Inviragen, and it is based on the attenuated DENV-2 PDK-53 strain. In the vaccine design, the attenuated DENV-2 PDK-53 virus is used as the genetic backbone, and three recombinant vaccine viruses are prepared by replacing the prM and E genes of the DENV-2 backbone with the corresponding genes of DENV-1, DENV-3, and DENV-4, respectively, which produce four vaccine components TDV-1, TDV-2, TDV-3, and TDV-4. The DENV-2 PDK-53 strain was attenuated by serial passage in primary dog kidney cells from the DENV-2 16681 isolate, leading to its reduced replication capacity. The four vaccine strains were produced by recombinant DNA technology in Vero cells and further processed under controlled manufacturing conditions. Finally, the individual components are combined in a defined formulation to produce the final tetravalent vaccine, which is able to elicit immune responses against all four dengue serotypes. Thus, unlike CYD-TDV, which is based on an attenuated yellow fever 17D

virus backbone, TAK-003 utilizes an attenuated DENV-2 backbone, and hence preserves dengue non-structural proteins, including NS1.[18,19,20]
while genetic components from DENV-1, DENV-3, and DENV-4 are incorporated to provide protection against all four dengue serotypes. [21,22] TAK-003 (Qdenga®) received its first approval in Indonesia in 2022 and was later approved in the European Union, the United Kingdom, Brazil, Argentina, Thailand, Malaysia, Vietnam, Australia, and several other countries. [23] QDENGA (TAK-003) had received regulatory authorization in 41 countries by September 2025. However, the vaccine was not clinically evaluated in all 41 countries. Its pivotal Phase III TIDES trial was conducted in eight dengue-endemic countries—Brazil, Colombia, Panama, the Dominican Republic, Nicaragua, the Philippines, Thailand, and Sri Lanka—while additional Phase I–III studies were conducted in other endemic and non-endemic populations. A separate Phase III study (DEN-302) was subsequently conducted in India to evaluate the vaccine's safety and immunogenicity in Indian participants aged 4–60 years.[24]

- **Butantan-DV**:
  Butantan-DV is a live attenuated tetravalent dengue vaccine derived from the dengue vaccine platform initially developed by the U.S. National Institutes of Health (NIH). The vaccine comprises four attenuated dengue virus strains that represent DENV-1, DENV-2, DENV-3, and DENV-4. The attenuated strains were developed by the NIH and transferred to the Butantan Institute for vaccine production.[25] For the manufacturing process, Vero cells that originated from the kidney of the African green monkey are used as a cell substrate for virus propagation. For the production of each dengue virus serotype, the cell bank is expanded from the working cell bank and inoculated with the respective dengue virus isolate and is subjected to controlled cultivation, allowing the virus to propagate. The suspension of the virus is then harvested and purified to obtain the active pharmaceutical ingredient for each monovalent component.44 The four purified monovalent components are then mixed with each other in the appropriate ratio to obtain the final formulation of the tetravalent vaccine. The vaccine is then filled into sterile vials, subjected to lyophilization or freeze-drying, thus removing moisture from the solution to obtain a dried and stable formulation. The reconstituted vaccine is obtained from the lyophilized and sterilized vaccine by adding the accompanying diluent before administration. Freeze-dried formulations promote the stability of the vaccine and can be stored at 2-8 degrees Celsius to allow transport and storage in tropical climates.[26,27]
  The Butantan-DV vaccine was developed using the NIH dengue vaccine platform. Instituto Butantan licensed the platform, and MSD later became a co-developer in 2018.[11] Approved by ANVISA in December 2025, It became Brazil's first domestically produced dengue vaccine. Its use in Brazil was temporarily discontinued in June 2026 as a precaution while rare unexpected safety events are investigated. [28,54]

2. Inactivated Vaccines:

The virus is harvested and purified to obtain viral antigens. Following that, the virus is inactivated with formalin to produce an antigen that will not replicate and will not be able to cause infection. The four different purified and inactivated dengue virus antigens are mixed to make a tetravalent vaccine. Since the inactivated dengue viruses are poor activators of the immune response, it is possible that a vaccine will require adding an adjuvant, such as aluminium hydroxide (alum), to elicit an adequate response. It is assumed that the final preparation of the vaccine will undergo clinical evaluation to determine the vaccine's safety, immunogenicity, and its ability to elicit an antibody response against all four dengue virus serotypes.[10,29]

TDENV-PIV is an example of an inactivated whole-virus dengue vaccine developed through collaboration between WRAIR, Fiocruz, and GSK. Adjuvants are added to improve the immune response. Although this type of vaccine has a good safety profile, especially in seronegative and immunocompromised people, it generally requires several doses and the use of strong adjuvants.[8]

3. Recombinant subunit vaccine:

These vaccines use recombinant envelope proteins from DENV, either as complete proteins or as specific protein fragments.

- **V180 (DEN-80E)**:
  V180 (DEN-80E) is a recombinant subunit dengue vaccine that utilizes the envelope (E) protein of all four dengue virus serotypes. To produce this vaccine, the genes that encode the truncated form of the E protein with approximately 80% of the N-terminal region are introduced into Drosophila Schneider 2 (S2) cells. [31] As a result, the recombinant DEN-80E proteins for all four dengue serotypes are produced separately by the S2 cells. Next, these proteins are secreted into the cell culture medium and isolated and purified from each cell line to obtain the individual dengue antigens. Then, the purified DEN-80E proteins of DENV-1, DENV-2, DENV-3, and DENV-4 are combined to form a dengue vaccine formulation that can elicit a protective response against all four serotypes. This formulation can be mixed with the adjuvant, ISCOMATRIX™, to enhance the vaccine's performance. Since the V180 vaccine formulation consists of purified recombinant proteins, it cannot replicate in the vaccinated person.[30,32]
- **E domain III-based constructs**:
  EDIII-based dengue vaccine candidates are developed as recombinant subunit and utilize the third domain of the dengue virus envelope (E) protein as the key immunogen. EDIII was selected as it contained critical antigenic determinants that can elicit neutralizing antibodies and is engaged in the interaction with host-cell receptors. The production of EDIII-based vaccines requires designing the gene encoding the target domain and introducing it into an appropriate expression system, such as Escherichia coli or other recombinant

protein-producing hosts. These cells can then be induced to express the target protein, which is subsequently purified using standard molecular biology techniques. In the case of tetravalent vaccines, the proteins from all four serotypes are combined at the stage of the antigen to elicit a broad immune response against DENV-1, DENV-2, DENV-3, and DENV-4. The purified protein can then be formulated with an appropriate adjuvant and/or carrier system to further enhance the immunogenic potential. Finally, the obtained construct can be produced as a recombinant protein-based vaccine candidate for preclinical and clinical evaluations of its safety profile and protective efficacy.[33,34]

These vaccine constructs are designed around specific antigenic regions of the virus that are involved in receptor binding.[35]

4. DNA and mRNA Vaccines :

DNA and mRNA dengue vaccines represent nucleic acid vaccine platforms that utilize DNA or RNA molecules coding for specific dengue virus antigens, delivered directly to the host cell. The DNA vaccines consist of a plasmid DNA vector modified to carry genes encoding dengue antigens such as pre-membrane/envelope (prM/E) and non-structural protein 1 (NS1). Following the isolation and purification process, the plasmid DNA is formulated into a DNA vaccine. Upon vaccination, the plasmid DNA is internalized into the host cells where it encodes for the desired dengue antigen. Various DNA vaccines for the prevention of dengue have been designed to express prM/E proteins alone or together with NS1.[36,37]

For mRNA vaccines, the desired dengue antigen sequence is first introduced into the DNA template to produce messenger RNA (mRNA) molecules through an in-vitro transcription process. The obtained mRNA is then purified and formulated, typically using lipid nanoparticles (LNPs) as a delivery system, and further introduced into the host cells. The mRNA molecule is directly incorporated into the host cell's ribosomes, resulting in the synthesis of selected Dengue viral antigens. After processing and presentation to the immune system, the encoded protein elicits an antibody-mediated and cellular immune response. In this case, it is possible to use mRNA coding for dengue prM/E proteins or other desired viral antigens.[36,38,39]

the COVID-19 pandemic increased interest in mRNA-based vaccine technologies. One example is Moderna's mRNA-1893, which is designed to produce modified prM-E antigens from the dengue virus and is currently being studied in clinical trials.[40,41] DNA-based vaccines such as D1ME100/TVDV have entered Phase I trials.[8]

5. Virus- Vectored Vaccines :

Virus-vectored dengue vaccines are developed by introducing selected dengue virus antigen genes into a non-pathogenic or attenuated virus as a vector. In this approach, during the vaccine development process, the gene coding for the selected dengue virus antigen, such as the envelope (E) protein or other viral proteins, is incorporated into the genome of the vector virus. The recombinant vector virus is then generated and characterized to confirm the presence and expression of the dengue virus antigen. Depending on the vaccine platform, vectors such as modified vaccinia Ankara (MVA), adenovirus, or alphavirus can be used to carry the dengue virus antigen genes.[42,43] The recombinant vector virus is propagated in an appropriate qualified cell substrate and harvested to obtain the vaccine material. After purification and formulation, the final vaccine candidate is evaluated for its ability to express the dengue virus antigen and induce an appropriate immune response. For example, dengue vaccines based on modified vaccinia Ankara (MVA) have been developed to express the envelope protein of DENV-2 or DENV-4.[44,45]

Viral vector vaccines, including adenoviral vectors, have been investigated as a way to deliver dengue virus structural antigens. However, these vaccine candidates have not progressed beyond Phase I clinical development.[35,8]

6. Virus -Like Particle Vaccines:

Virus-like particle (VLP) dengue vaccines are manufactured by using recombinant dengue viral structural proteins that are able to self-assemble into particles that mimic the structure of the native dengue virus but lack the viral genome. In order to develop the VLP based vaccines, genes that encode for particular dengue structural proteins, for example, pre-membrane (prM) and envelope (E) proteins, are introduced into a suitable expression system such as yeast, insect cells or mammalian cells. Recombinant host cells can then be used to generate the desired dengue proteins, which are processed and self-assembled into VLPs. With regards to tetravalent dengue VLP vaccines, one can use the prM and E proteins of DENV-1, DENV-2, DENV-3, and DENV-4 to generate particles that represent all four serotypes of dengue. The produced VLPs can be collected from the culture system and subsequently purified from other cellular components and impurities. The VLPs are then characterized to ensure structural and immunogenic integrity and can be formulated with an appropriate adjuvant to boost the immune response. Finally, the formulated VLP vaccine candidate can be tested for safety and immunogenicity (ability to elicit protective immunity against the dengue serotypes). [46, 47, 48]

VLPs self-assemble without containing viral genome, offering safety advantages while presenting conformational antigens. Hepatitis B core antigen-based VLPs displaying DENV epitopes have been explored in preclinical studies.[35] vaccines are currently in the research and early clinical-development stage and are not yet licensed for routine human use.[49]

Vaccine Landscape and Status in India:

Disease Burden in India:

Nearly one-third of the global population at risk of dengue lives in India.[4] Dengue is found in almost every state of India, with states such as Maharashtra, West Bengal, Uttar Pradesh, Punjab, Haryana, Delhi, Gujarat, Kerala, Karnataka, and Tamil Nadu reporting some of the highest disease burdens.[5] India monitors dengue through a network of over 600 sentinel sites, supported by national disease surveillance programs and 52 Virus Research and Diagnostic Laboratories established by the Department of Health Research.[2]

Panacea Biotec Ltd:

Panacea Biotec received a license from the NIH to manufacture and sell the TV003 vaccine strains in India.[16] Panacea Biotec, in collaboration with ICMR, has developed DengiAll, a signal dose recombinant live attenuated tetravalent dengue vaccine based on the NIH TV003/TV005 platform. Following successful Phase I/II evaluation in Indian adults, DengiAll entered a multicentre Phase III clinical trial in August 2024. The Phase III trial enrolled more than 10,000 participants across multiple sites in India and has now completed enrolment and vaccination, with efficacy, safety, and immunogenicity evaluation ongoing.[50]

Future Indian Scenario:

India may advance the clinical development of two dengue vaccine candidates, with one involving the TAK-003 and Indian Immunologicals partnership and the other being Panacea Biotec's TV003-based vaccine developed in India.[4]

QDENGA Dengue Vaccine: Development and Approval:

According to the Ministry of Health and Family Welfare (MOHFW) , India is estimated to record around 3–4 million dengue cases each year, with outbreaks affecting large numbers of people and leading to thousands of deaths.

QDENGA represents years of research and development to create India's first dengue vaccine.[51]

Vaccine Development:

Developed by Takeda Pharmaceutical Company, a leading Japanese pharmaceutical company with extensive vaccine expertise. Clinical development began in 2008; Phase 3 trials initiated globally. The vaccine is a live-attenuated tetravalent formulation, scientifically known as TAK-003, and it is intended to provide protection against all four dengue serotypes.[52] One important correction first: as of July 21, 2026, India has approved TAK-003 as Qdenga®. The Indian approval is not a collaboration with Indian Immunologicals Ltd. The CDSCO approval states that Qdenga is manufactured by Takeda GmbH, Germany, and imported by Takeda Biopharmaceuticals India Pvt. Ltd.[52] Takeda did announce a separate collaboration with Biological E. Ltd. in 2024 to accelerate access to dengue vaccine in India, but at that time Takeda explicitly stated that TAK-003 was not yet approved in India.[53]

Clinical Trial Data:

Based on the pivotal Phase 3 TIDES trial:

In this included around 20,000 participants from several dengue-endemic countries, including India, Mexico, the Philippines, Thailand, and Brazil. Indian study sites enrolled around 3,000 participants, providing important data on the vaccine's effectiveness in the Indian population. Overall vaccine efficacy: 80 to 84 percent against symptomatic dengue. Efficacy varied by serotype and prior dengue exposure. Safety profile: Well-tolerated with mild to moderate adverse events.[51]

India Approval Timeline:

QDENGA dengue vaccine **QDENGA Vaccine Details: Mechanism and Protection.**

QDENGA is a live attenuated tetravalent dengue vaccine with unique characteristics.[51]

Vaccine Characteristics:

Type: Live attenuated tetravalent dengue vaccine(TAK-003)

Components: contains weakened live virus of all four dengue serotypes:

- DENV-1, DENV-2, DENV-3, DENV-4.[51]

Mechanism:

Uses attenuated (weakened) dengue viruses that stimulate an immune response without causing disease. TAK-003 helps trigger both types of immune responses against the four dengue serotypes. Provides durable protection lasting a minimum of 3 to 5 years (ongoing monitoring for longer duration).[51]

Efficacy Data:

According to clinical trial results:

Overall efficacy: 80 to 84 percent against symptomatic dengue across all serotypes. Efficacy higher in dengue-naive individuals (approximately 84 percent). Efficacy in dengue-experienced individuals (approximately 78 percent). Protection against severe dengue: Approximately 90+ percent.

received CDSCO approval in 2024. Approval based on comprehensive clinical trial data from global and India-specific studies. The vaccine was launched in India in mid-2024 through the private sector; government programs are being initiated.[51]

Conclusion:

According to Indian Council of Medical Research (ICMR), dengue incidence in India has risen about 30-fold over the last two decades. The increasing burden of the disease highlights the need for effective prevention measures, including vaccination, and adds importance to the approval of QDENGA.

Developing an effective dengue vaccine has been difficult because the virus exists in four different serotypes, there is a risk of antibody-dependent enhancement (ADE), and reliable markers of protection have not been clearly established. CYD-TDV provided an important early demonstration of the potential for dengue vaccination, but safety concerns were later identified in people who had not previously been exposed to dengue. In contrast, TAK-003 (Qdenga) has.

Importantly, in July 2026, Qdenga became the **first dengue vaccine approved in India** for individuals aged 4–60 years, regardless of previous dengue exposure. This marks a significant step forward in preventing dengue.

Future research on dengue vaccines is expected to focus on newer platforms such as mRNA, viral vectors, and VLPs to develop improved vaccines with reduced doses and enhanced safety profiles. Besides vaccination, vector control and improved surveillance will play a critical role in the future management of the disease.

Disclaimer:

The vaccine names, formulations, and manufacturer or developer information mentioned in this review are included solely for scientific and academic discussion. Their inclusion does not imply endorsement, criticism, commercial promotion, or any allegation regarding the respective manufacturers, developers, institutions, or organizations. The information is presented based on published scientific literature and is intended only to summarize the current state of dengue vaccine research and development.

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