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MINI-REVIEW

South Asia on the arboviral pandemic horizon: Understanding arbovirus transmission in the region and preparing for future pandemics

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Abstract

Arboviral diseases are escalating across South Asia, with ecological and socioeconomic factors positioning the region as a potential global pandemic epicenter. Traditional pathogens such as dengue, chikungunya, and Japanese encephalitis persist alongside emerging threats such as Zika, severe fever with thrombocytopenia syndrome (SFTS), Tamdy, and Karshi viruses, are all expanding geographically. Climate change accelerates vector range shifts, while rapid urbanization, inadequate healthcare infrastructure, cross-border mobility, and fragmented surveillance amplify transmission risks. High population density, limited vector control, and low vaccination coverage create ideal conditions for viral spread and recombination. Recent outbreaks reveal alarming trends, including expanded vector habitats, increased disease severity, and record-breaking epidemic rates. Without coordinated regional strategies integrating enhanced surveillance, vector management, and healthcare capacity building, South Asia's arboviral burden could catalyze global health crises. This synthesis underscores the urgent need for multidisciplinary interventions to address the complex drivers of arboviral proliferation in this vulnerable region.

Keywords: Arthropod-borne viruses; Arboviruses; Epidemic; Pandemic; South Asia

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1. Introduction

The global landscape of infectious disease threats has shifted dramatically in recent decades, with arboviruses emerging as significant challenges to public health systems worldwide. These pathogens, transmitted primarily by mosquitoes and ticks, have expanded their geographical reach and impact, raising concerns about potential pandemic threats.[1-3] Among regions experiencing the most alarming arboviral disease trends, South Asia stands at a critical crossroads, facing both established endemic arboviruses and novel emerging threats.[4] The convergence of ecological, climatic, demographic, and socioeconomic factors in South Asia has created a perfect environment for arboviral emergence and spread, potentially positioning the region as an epicenter from which future global pandemics could originate (Figure 1).[5]

Arboviruses have become significant hazards to public health, with the emergence and re-emergence of diseases nearly worldwide. The most populated Southeast Asia region is particularly vulnerable to arboviruses including dengue (DENV), Japanese encephalitis (JEV), West Nile (WNV), chikungunya (CHIKV) viruses, that are on the rise and spreading unprecedentedly, causing considerable disease burden. The emergence and re-emergence of these diseases are associated with complex factors, including viral recombination and mutation leading to more virulent strains, urbanization creating permissive environments for vector-host interaction, and increased air travel and commerce facilitating spread.[6]

Recent regional data illustrates the dynamic nature of arboviral epidemiology in the broader region. In the Americas, 2022 saw approximately 3.1 million cases of arboviral disease, with 90% being DENV and 9% CHIKV cases, representing a 119% increase compared to 2021.[7] In early 2023, countries such as Paraguay, Argentina, Bolivia, and Peru reported significant increases in CHIKV cases compared to previous years, with Argentina reporting local transmission in provinces that had never previously documented autochthonous cases.[3,8] These patterns demonstrate how quickly arboviral diseases can establish in new regions when conditions are favorable predicting significant risks for South Asia where similar ecological and demographic conditions exist.

In this narrative review, the authors aim to synthesize the current body of evidence on the escalating arboviral threat in South Asia. Its primary objectives are to consolidate the epidemiological trends of both established and emerging arboviruses in the region, critically analyze the interconnected ecological and socioeconomic drivers fueling their transmission, and evaluate the existing preparedness and response frameworks. By providing a comprehensive synthesis, this article seeks to highlight the urgent regional and global imperative for coordinated action to mitigate the risk of a large-scale arboviral pandemic originating from South Asia.

To achieve these objectives, this review was conducted through a systematic literature search and analysis of relevant scientific evidence. We identified peer-reviewed literature published between 2000 and 2025 through databases including PubMed, Scopus, and Google Scholar, using keywords related to arboviruses, South Asian countries, epidemiology, and transmission dynamics. Official reports from organizations such as the World Health Organization (WHO) and national health ministries were also incorporated. The epidemiological trends and projections up to 2025 presented in the analysis are synthesized from these published surveillance data and peer-reviewed modeling studies. As a narrative synthesis, this article does not propose new statistical or climatic models but rather interprets and contextualizes existing findings to provide a coherent overview of the regional threat landscape.

2. Arboviruses in South Asia

2.1. Current landscape

Arboviruses represent a diverse group of pathogens united by their shared arthropod-mediated transmission cycles. In South Asia, the most significant arboviruses include DENV, CHIKV, JEV, WNV, and more recently, Zika virus (ZIKV).[2,4,9,10] The arboviral threat in South Asia is particularly concerning due to the region's high population density, limited healthcare infrastructure, and ecological conditions favorable for vector proliferation. Moreover, the interface between human, animal, and vector populations creates numerous opportunities for viral emergence, adaptation, and spread.[5,11] Climate is a major factor in determining the geographic and temporal distribution of arthropods, the characteristics of arthropod life cycles, the dispersal patterns of associated arboviruses, the evolution of arboviruses, and the efficiency of transmission from arthropods to vertebrate hosts.[5,11]

The burden of arboviral diseases in South Asia has grown substantially over recent decades. Dengue remains the most prevalent arboviral infection, with the WHO estimating approximately 390 million infections annually worldwide, a significant proportion occurring in South Asian countries.[12] The region has witnessed a dramatic expansion in the geographic distribution of DENV, with countries such as Pakistan reporting unprecedented outbreaks in areas previously considered non-endemic. For instance, the 2011 Lahore epidemic resulted in over 500,000 suspected dengue cases in a city of 5 million, with subsequent dengue IgG seroprevalence reaching 67.9% the following year in an area where dengue was not previously endemic.[13,14] This alarming infection rate demonstrates the explosive potential of arboviral outbreaks in susceptible populations.

Table 1 provides a historical overview of major arbovirus outbreaks, illustrating the evolving chronology and significant impact of these diseases in the region. It is important to note the variability in data completeness, reflected in the use of 'not confirmed (NC)' and 'not applicable (N/A)', which underscores the historical challenges in consistent laboratory confirmation and comprehensive reporting across different health systems and time periods. The 'Key features' column highlights critical epidemiological nuances, such as a virus's first regional appearance, re-emergence after decades, or

outbreaks distinguished by unusually high mortality rates, providing context for the numerical data.

The data presented in the 'Cases' and 'Deaths' columns are compiled from national surveillance reports and peer-reviewed outbreak investigations cited in the references. The 'Cases' category primarily represents suspected and/or laboratory-confirmed infections as reported by national authorities during an outbreak, with the specific case definition often varying by country, year, and available diagnostic resources. Similarly, the 'Deaths' column enumerates fatalities temporally associated with and often attributed to the arboviral outbreak in official reports, though the level of certainty regarding direct causation may vary. This inherent variability in surveillance methodologies and the challenges in post-mortem confirmation across different healthcare settings are important considerations when interpreting the historical data presented in Table 1.

Figure 2 illustrates the trends in arboviral disease incidence across South Asia from 2000 to 2025, expressed as the annual number of cases per 100,000 population. DENV demonstrated the most substantial disease burden, exhibiting a steady upward trajectory from 2000 to 2015 (8.2 to 64.8 cases/100,000), punctuated by a major outbreak in 2015. While temporarily disrupted during the COVID-19 pandemic (2020–2021), DENV incidence resurged to pre-pandemic levels by 2023, with projections indicating continued escalation through 2025. CHIKV displayed distinct epidemic emergence in 2006 (12.5/100,000) followed by a secondary outbreak in 2015 (31.7/100,000), subsequently transitioning to stable endemic transmission. ZIKV manifested explosive emergence during the 2016 pandemic (12.8/100,000) before settling into persistent low-level circulation. WNV exhibited gradual amplification throughout the period (0.4 to 3.0/100,000), with only minor pandemic-related attenuation. JEV maintained stable endemic transmission (1.1 to 3.7/100,000) with modest progressive increases likely attributable to expanded vaccination coverage, demonstrating the least volatility during public health disruptions. Notably, the COVID-19 pandemic (2020–2021) caused transient incidence reductions across all arboviruses, though pre-pandemic transmission dynamics resumed by 2022–2023. Epidemiological trends were synthesized from regional surveillance systems[12,15] and peer-reviewed literature,[16-19] with projections based on climate-driven transmission models.[19,20]

2.2. Emerging arboviruses

ZIKV is among the newest arboviral concerns in South Asia, which gained global attention following the 2015–2016 epidemic in the Americas that revealed its association with severe congenital abnormalities and Guillain–Barré syndrome.[21] While large-scale ZIKV outbreaks have not yet been documented in South Asia, serological evidence and sporadic case reports suggest the virus is circulating in the region.[22] The presence of competent vectors, primarily *Aedes aegypti* and *Aedes albopictus*, combined with immunologically naïve populations, creates conditions conducive to potential ZIKV outbreaks. Japanese encephalitis continues to cause significant mortality and neurological sequelae, particularly among children, despite the availability of effective vaccines.[23] Severe fever with thrombocytopenia syndrome virus (SFTSV), a tick-borne phlebovirus, has emerged as another significant concern, with case fatality rates ranging from 10% to 30%.[24,25] Similarly, Tamdy (TAMV) and Karshi (KSIV) viruses, both tick-borne arboviruses from the *Nairovirus* genus, have been detected in neighboring Central Asian countries and represent potential emerging threats to South Asia.[26,27]

2.3. Pakistan

In Pakistan, the arboviral disease landscape has been significantly shaped by climate change, deforestation, urbanization, inadequate sanitation, and natural disasters.[28] A concerning CHIKV outbreak erupted in Karachi beginning in November 2016, with health authorities estimating more than 30,000 cases, of which over 4,000 were confirmed through reverse transcriptase polymerase chain reaction (RT-PCR).[29] Historical evidence indicates that CHIKV had been circulating in Pakistani rodent populations as early as 1983, with a few human cases reported during the 2011 DENV outbreak in Lahore.[29] Pakistan's vulnerability to arboviral diseases is further compounded by its deplorable sanitary conditions and rising temperatures, which have nurtured the outbreak of multiple vector-borne illnesses including malaria and dengue. Recent years have also witnessed outbreaks of WNV, while hospital-based surveillance has detected Japanese encephalitis virus circulation.[11,30]

2.4. Bangladesh

Bangladesh presents a compelling case study through its nationally representative seroprevalence survey, which estimated a national CHIKV seroprevalence of just 3.6% in 2016. This indicated that only approximately 5.6 million individuals in this densely populated country had been previously infected, revealing a largely immunologically naive population. The study, which analyzed samples from 4,695 participants, further highlighted notable variations, with seropositivity significantly higher in urban divisions such as Dhaka (7.8%) and notably associated with the community presence of *Aedes aegypti* mosquitoes. This widespread susceptibility and distinct spatial pattern

Table 1. Historical overview of major arbovirus outbreaks in South Asia

Year	Country	Arbovirus	Location/Region	Cases	Deaths	Key features
1955	India	JEV	Vellore, Tamil Nadu	NC	NC	First case in India
1963–1964	India	DENV	Eastern Coast	NC	NC	First epidemics in India
1963	India	CHIKV	Kolkata	NC	NC	Major outbreak
1965	India	CHIKV	Pondicherry, Chennai	NC	NC	Significant outbreak
1985	Pakistan	DENV	Various locations	NC	NC	First reported cases in Pakistan
1995	Pakistan	DENV	Hub, Baluchistan	75	57	High mortality rate
2005	India	CHIKV	Multiple states	N/A	N/A	Re-emergence after 32 years
2006	Pakistan	DENV	Sukkur, Islamabad, Rawalpindi, Karachi	5,400	55	Multi-city outbreak
2011	Pakistan	DENV	Lahore, Rawalpindi, Sargodha, Faisalabad	>20,000	300	Worst dengue outbreak in Pakistan
2015–2016	Pakistan	WNV	Sindh	105	NC	Large outbreak caused by WNV
2017	Sri Lanka	DENV	Nationwide	NC	NC	Large outbreak caused by DENV-2
2024	Bangladesh	DENV	Nationwide	NC	NC	Higher cases than same period in 2023, CFR of 1.09%

Abbreviations: CFR: Case fatality rate; CHIKV: Chikungunya virus; DENV: Dengue virus; JEV: Japanese encephalitis virus; N/A: Not applicable; NC: Not confirmed; WNV: West Nile virus.

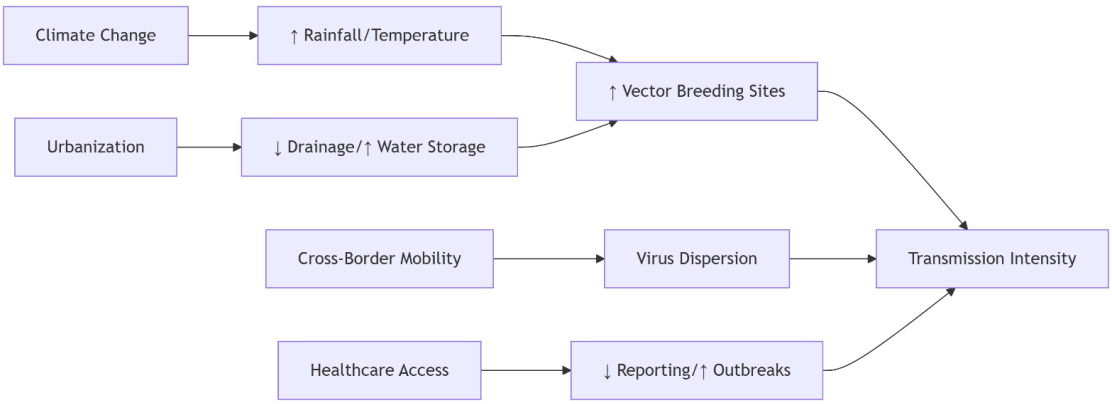


Figure 1. Flowchart representing the interplay of several factors affecting arboviral transmission in South Asia

were critical factors that facilitated the rapid spread and magnitude of the subsequent major nationwide outbreak in 2017.[31]

2.5. Sri Lanka

Sri Lanka represents one of the most thoroughly studied countries regarding arboviral seroprevalence in the region. Research involving 149 healthy adult volunteers revealed exceptionally high dengue seroprevalence, with 94.6% demonstrating dengue IgG antibodies. Additionally, 37.5% tested positive for CHIKV IgG, and 5.3% showed positivity for ZIKV IgG antibodies.[32] The country is considered

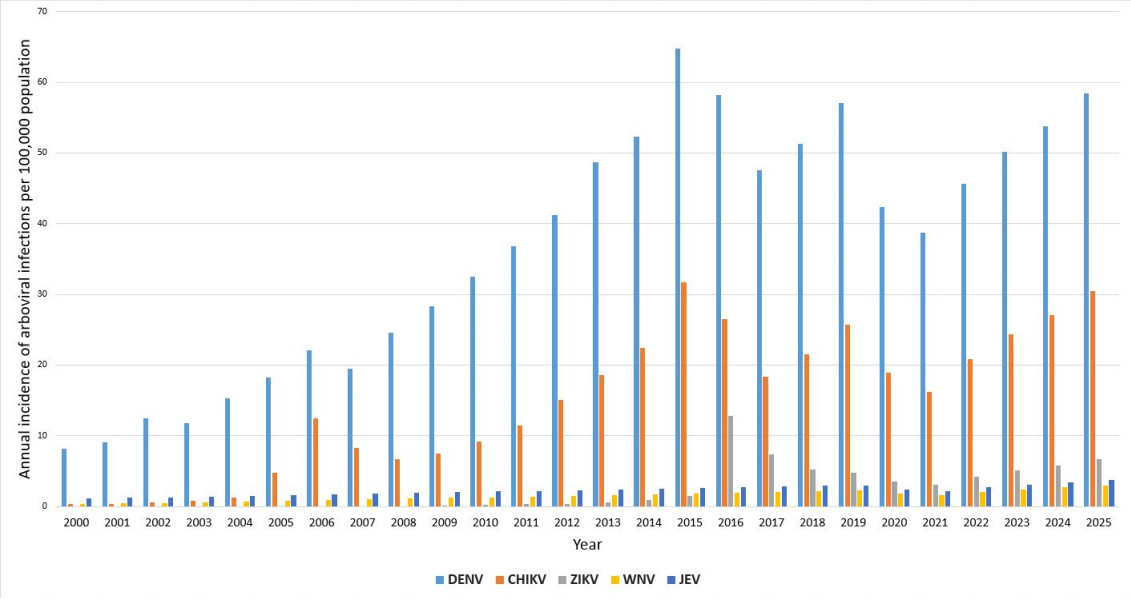


Figure 2. Epidemiological trends of arboviruses in South Asia (2000-2025) based on annual incidence rates per 100,000 population
Abbreviations: CHIKV: Chikungunya virus; DENV: Dengue virus; JEV: Japanese encephalitis virus; WNV: West Nile virus; ZIKV: Zika virus.

hyperendemic with co-circulation of all four DENV serotypes and cyclical dominance of subtypes contributing to major outbreaks.[32] The most devastating DENV epidemic in Sri Lankan history occurred in 2017, resulting in 186,101 reported cases and 440 deaths, which coincided with the reemergence of DENV-2.[33] This was followed by another surge in 2019, with 99,120 cases reported.[34] DENV seroprevalence remains particularly high among adults over 44 years, with more than 90% being seropositive.[32]

2.6. India

Apart from the already prevailing arboviruses, among tick-borne arboviruses, Kyasanur Forest disease (KFDV) and Langat (LGTV) represent the only group B arboviruses definitively known to occur in the region, with KFDV in India and LGTV in Malaysia.[35,36] KFDV has demonstrated a pattern of geographic expansion in recent decades. Between 1957 and 2017, an estimated 9,594 cases were reported across 16 districts in India. The most significant outbreaks occurred in 1957–1958 (681 cases), 1983–1984 (2,589 cases), 2002–2003 (1,562 cases), and 2016–2017 (809 cases).[37,38] The disease has shown a troubling pattern of expansion, appearing in Goa in 2015 and emerging in new districts such as Belgaum in Karnataka state and Sindhudurg in Maharashtra state by 2016. While initially isolated to a small focus in Mysore, human and animal sera containing neutralizing antibodies to KFDV have been found sporadically in widely scattered areas.[37,38]

3. Factors affecting arboviral transmission

3.1. Climate change

The rapid emergence and spread of arboviruses in South Asia can be attributed to multiple interconnected factors. Climate change stands as a fundamental driver, altering temperature and precipitation patterns in ways that expand vector habitats and prolong transmission seasons. Rising temperatures have enabled *Aedes* mosquitoes to establish populations at higher elevations and latitudes previously unsuitable for their survival. Changing rainfall patterns affect vector breeding site availability, while extreme weather events can disrupt public health infrastructure and vector control efforts. These climatic changes interact synergistically with human activities to amplify arboviral transmission risks.[39,40]

3.2. Urbanization

Urbanization represents another crucial factor in arboviral emergence across South Asia. The region is experiencing one of the world's fastest rates of urban growth, often characterized by unplanned development, inadequate housing, and insufficient water and sanitation infrastructure. These conditions create ideal breeding environments for *Aedes* mosquitoes, which thrive in human-modified habitats. Containers used for water storage in areas with intermittent supply become productive breeding sites, while discarded containers and

poor drainage systems provide additional habitats. The high human population densities in South Asian cities facilitate rapid viral transmission once introduced, as evidenced by the explosive dengue outbreaks observed in urban centers throughout the region.[5,11]

3.3. Population mobility

Population mobility further compounds the arboviral threat in South Asia. The region experiences substantial internal migration, cross-border movement, and international travel, all of which can introduce arboviruses to new areas.[15] Labor migration between rural and urban areas creates bidirectional pathways for viral spread, while porous international borders facilitate transnational disease movement. The expansion of international air travel connects South Asia to global arboviral hotspots, enabling rapid virus importation.[15] For instance, data from one region showed that approximately three-quarters of imported arboviral cases originated from Southeast Asia, highlighting the importance of regional connectivity in disease spread.[9]

3.4. Demographic transition

The demographic transition occurring across South Asia adds another dimension to the arboviral threat. Countries such as Thailand and Singapore have reported increasing age of dengue infection, with more young adults rather than children acquiring the disease.[41,42] This shift significantly impacts the risk to blood supplies and transfusion safety, as asymptomatic viremic individuals may donate blood during arboviral outbreaks. Studies from various endemic regions have detected DENV in blood donations at rates ranging from 0.014% to 0.4%, depending on local transmission intensity.[43] The potential for transfusion-transmitted arboviral infections represents an often-overlooked aspect of the regional public health threat.

3.5. Diagnostic challenges and differential diagnosis in hyperendemic regions

Accurate and timely diagnosis of arboviruses in South Asia is fraught with significant challenges, primarily due to hyperendemic co-circulation and substantial clinical overlap. The foremost obstacle is the high degree of cross-reactivity in serological assays, particularly IgG-based tests, between antigenically related flaviviruses such as DENV, ZIKV, and JEV. This often renders it difficult to pinpoint the specific virus, especially in secondary infections, and can complicate seroprevalence studies. Furthermore, the nonspecific febrile presentation of most arboviral diseases viz. dengue, chikungunya, zika, and others, mimics many other common illnesses in the region, including malaria, leptospirosis, typhoid, and rickettsial infections, leading to potential misdiagnosis and inappropriate clinical management. These diagnostic dilemmas are exacerbated in areas with limited laboratory capacity, where access to advanced, discriminatory tests such as plaque reduction neutralization tests or multiplex PCR is scarce. The resulting surveillance gaps not only obscure the true burden of individual arboviruses but also delay the detection of emerging threats, underscoring an urgent need for enhanced access to affordable, pan-arboviral, and point-of-care differential diagnostic tools across the region.

3.6. Coronavirus disease (COVID) pandemic

The coronavirus disease (COVID) pandemic has demonstrated both vulnerabilities and opportunities in arboviral disease management across South Asia. On the one hand, movement restrictions and enhanced protective behaviors likely reduced arboviral transmission in some contexts. For instance, data from Zhejiang, China showed a drastic decrease in arboviral cases during 2020–2022 compared to pre-pandemic periods.[9] On the other hand, the pandemic strained healthcare systems, diverted resources from vector control programs, and disrupted routine surveillance activities, potentially allowing silent arboviral spread in some areas.

3.7. Additional factors

The potential for South Asia to become an epicenter for global arboviral pandemics is underscored by several concerning trends. First, the region's high population density and mobility create conditions for rapid viral amplification and spread. Second, the co-circulation of multiple arboviral pathogens increases the risk of unusual clinical presentations, diagnostic confusion, and potentially genetic recombination events that could produce novel viral strains. Third, the expansion of vector habitats due to climate change and urbanization continuously increases the population at risk. Fourth, limited healthcare infrastructure and emergency response capacity in many parts of the region may allow outbreaks to escalate before effective containment measures can be implemented.[5,11,15]

Inadequate surveillance systems further complicate the arboviral situation in South Asia. Limited laboratory capacity, clinical misdiagnosis, and insufficient reporting infrastructure all contribute to incomplete epidemiological pictures. This surveillance gap masks the true burden of established arboviruses and delays recognition of emerging threats, hampering timely public health responses. The challenge is particularly acute for novel arboviruses such as SFTSV, TAMV, and KSIV, which may require specialized diagnostic capabilities not routinely available throughout the region.

4. Addressing the arboviral threat

4.1. Global arbovirus initiative

Addressing the arboviral threat in South Asia requires a comprehensive, multilayered approach spanning surveillance, prevention, and response capacities. The WHO's plans to launch a Global Arbovirus Initiative represents an important step in this direction.[44] The initiative aims to strengthen coordination, communication, capacity-building, research, preparedness, and response to mitigate arboviral disease risks. Its pillars include monitoring risk, reducing epidemic risk, strengthening vector control, preparing for pandemics, building partnerships, and enhancing innovation.[44] Regional consultations for this initiative have highlighted the need for alignment with health systems for health security, clinical management improvement, strengthening vector surveillance and entomological capacity, and operational research.

4.2. Vector control and vaccination

Vector control efforts must evolve beyond traditional approaches to address the adaptive nature of arboviral vectors. Integrated vector management combining multiple control methods tailored to local ecological and social contexts offers the most promising framework. Community engagement is essential, as sustainable vector control requires active participation from affected populations. Vaccination represents another critical intervention for certain arboviruses, yet its application across South Asia remains complex and uneven. While effective vaccines for JEV have been successfully integrated into childhood immunization programs in several endemic countries, such as Nepal and parts of India, achieving high coverage in remote and rural areas remains a persistent challenge.[23] For dengue, the situation is more nuanced; the first-generation CYD-TDV vaccine and subsequent options such as TAK-003 have demonstrated partial, serotype-dependent efficacy, necessitating pre-vaccination screening or administration primarily to seropositive individuals with prior exposure to mitigate the risk of antibody-dependent enhancement in naïve recipients.[45] This requirement poses significant logistical and economic hurdles for widespread public health implementation. Furthermore, for other significant arboviral threats in the region, including chikungunya and Zika, no licensed vaccines are yet available, highlighting a critical gap in the preventive arsenal.[10] Therefore, vaccination strategies must be highly pathogen-specific and context-driven, involving robust serosurveillance to identify target populations, strategic deployment to maximize herd immunity in high-transmission zones, and continued investment in research and development for vaccines against emerging and currently unaddressed arboviral threats.

4.3. Strengthening healthcare systems

Health system strengthening constitutes an essential component of arboviral preparedness in South Asia. This includes enhancing clinical management capabilities for severe arboviral diseases, establishing referral systems for complicated cases, and ensuring adequate supplies of diagnostic tests and supportive care materials. Healthcare worker training on recognition and management of both common and emerging arboviral diseases is vital, particularly as clinical presentations may overlap with other febrile illnesses endemic to the region. Regional cooperation represents perhaps the most critical element for effective arboviral disease control in South Asia. Arboviruses do not respect national boundaries, and unilateral control efforts are unlikely to succeed without coordinated regional approaches.

4.4. Personal measures

The effectiveness of arboviral disease control is significantly enhanced by the consistent adoption of evidence-based personal protective measures by communities in endemic areas.[5] These measures primarily focus on reducing human-vector contact and eliminating peri-domestic breeding sites. The application of U.S. Environmental Protection Agency (EPA)-approved insect repellents containing active ingredients such as N,N-diethyl-m-toluamide (DEET), picaridin, or oil of lemon eucalyptus on exposed skin and clothing has been demonstrated to reduce biting rates from *Aedes aegypti* and *Aedes albopictus* mosquitoes.[1] The use of physical barriers, including wearing long-sleeved clothing and the installation of window and door screens, further minimizes indoor exposure. Given the container-breeding behavior of *Aedes* mosquitoes, the environmental management of water-holding receptacles such as covering water storage containers and properly disposing of discarded tires and other waste that can collect rainwater, is a critical component of source reduction.[5,39] The strategic use of insecticide-treated bed nets, particularly for day-time rest, can offer protection for vulnerable populations.

4.5. Health promotion and community engagement

Sustained arboviral management requires a foundation of robust health promotion and active community engagement, which are essential for the long-term success of both vector control and personal protection initiatives.[44] Effective strategies involve disseminating clear information about arbovirus transmission risks, symptom recognition, and the rationale behind preventive measures, thereby fostering community ownership of public health

interventions.[5] Educational campaigns that are culturally and linguistically tailored have been shown to improve compliance with source reduction activities and the correct use of protective measures.[1,5] Furthermore, empowering community members to organize local clean-up campaigns and to conduct peer education can create a self-reinforcing cycle of prevention and vigilance, extending the reach of formal public health systems.[44] This collaborative approach between health authorities and communities is vital for building resilience and ensuring the sustainability of arboviral control programs in the complex socioecological landscape of South Asia.[5,44]

4.6. One Health approach integrating veterinary and wildlife surveillance

The circulation of arboviruses is fundamentally enmeshed in a complex transmission cycle involving human, animal, and vector populations, necessitating a One Health perspective for effective surveillance and control. Many arboviruses of public health concern in South Asia are zoonotic, with wild birds, livestock, and rodents serving as key amplification hosts or reservoirs. For instance, JEV is maintained in a cycle involving ardeid birds and pigs, which act as amplifying hosts, while WNV also circulates in wild bird populations.[11,15] Similarly, the geographic expansion of tick-borne viruses such as SFTSV and KFDV is intrinsically linked to the movement and abundance of their wildlife hosts and tick vectors.[24,37] Current surveillance systems in the region, however, remain overwhelmingly anthropocentric, creating a critical blind spot. The lack of integrated veterinary and wildlife surveillance means that silent transmission in animal populations often goes undetected until spillover events cause human outbreaks. Establishing systematic surveillance in livestock, such as monitoring pigs for JEV and sentinel chickens for WNV, alongside wildlife studies, can provide an early warning signal for increased human transmission risk.[5,11] Therefore, strengthening cross-sectoral collaboration between public health, veterinary services, and wildlife authorities is paramount. This integrated One Health approach, focused on detecting pathogens at the animal-human-ecosystem interface, is essential for predicting, preventing, and responding to the ongoing and emerging arboviral threats in South Asia.[5,27,38]

5. Limitations

While this review provides a comprehensive overview of the arboviral threat in South Asia, several limitations must be acknowledged. Firstly, as a narrative review, the analysis is inherently qualitative and dependent on the variable quality and availability of existing data, which introduces potential for selection bias. A significant constraint is the substantial heterogeneity and fragmentation of arboviral surveillance systems across the region; disparities in diagnostic capacity, case definitions, and reporting completeness between and within countries can obscure the true disease burden and complicate temporal and spatial comparisons.[5,15] This is further exacerbated by the widespread challenge of clinical misdiagnosis, where the nonspecific febrile presentation of arboviruses leads to underreporting and the conflation of incidence data for co-circulating pathogens. The projections of future incidence, while based on established models, are subject to the uncertainties inherent in climate-driven forecasting and cannot account for unpredictable socioeconomic disruptions or public health interventions.[19,20] Another key limitation is the focus on human epidemiology, which necessarily omits detailed discussion of the intricate enzootic transmission cycles and the full scope of veterinary surveillance data, a critical component of the One Health approach.[11,24] Finally, the review's scope, while broad, is not exhaustive and may not capture every emerging arbovirus or the full depth of country-specific nuances. These limitations collectively highlight the urgent need for more standardized, integrated, and laboratory-confirmed surveillance to refine our understanding of arboviral dynamics in this pivotal region.

6. Conclusion

In conclusion, South Asia faces a complex and evolving arboviral threat landscape that demands urgent attention from national governments, regional bodies, and the international community. The convergence of ecological, demographic, and socioeconomic factors has created conditions highly favorable for arboviral emergence and spread, positioning the region as a potential epicenter for future global pandemics. The established burden of DENV, CHIKV, and JENV is now compounded by emerging threats including ZIKV, SFTSV, TAMV, and KSIV, creating a multilayered public health challenge. Addressing this challenge requires enhanced surveillance systems, innovative vector control approaches, strengthened healthcare infrastructure, and unprecedented regional cooperation. Without comprehensive action, South Asia's arboviral burden will likely continue to grow, with implications for global health security in an increasingly interconnected world. The present and future arboviral threats must be mitigated by priority actions such as improving surveillance and outbreak response, establishing collaboration and communication intersectorally, and strengthening prevention and control programs along with improving biosafety aspects given the highly infectious nature of these arboviral diseases.

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