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Viewpoint

Synchrony of dengue in Latin America: why national strategies are failing and how the region can respond together

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ABSTRACT

Dengue transmission in Latin America has reached its highest levels in recorded history, revealing a structural failure: the region continues to respond to a continental-scale phenomenon with fragmented national strategies. Accumulating evidence shows that dengue epidemics across Latin America are synchronized in time—driven by climate variability, human mobility, shifting serotype dominance, and co-circulating arboviruses. This synchrony sharply limits the effectiveness of isolated national responses, leaving countries repeatedly surprised by epidemic waves that propagate across borders. In this Viewpoint-informed analysis, we synthesize current scientific evidence and argue that Latin America must transition from reactive, country-by-country control to a coordinated regional strategy built on integrated surveillance, open data, joint early-warning systems, and cross-border policy governance. Only through regional cooperation can the continent anticipate and mitigate the coming cycles of large-scale dengue outbreaks.

Keywords. Dengue, Latin America, surveillance systems, regional approach

INTRODUCTION

Latin America is entering a new epidemiological era. In 2024, the region reported more than 13 million dengue cases — the largest number ever recorded — underscoring the collapse of traditional, country-based containment strategies [1]. Governments continue to operate under the implicit assumption that dengue can be controlled within national borders. However, the virus, its mosquito vector, and the climatic factors that drive transmission do not respect political boundaries.

Dengue control is further constrained by the lack of a universally scalable vaccine and by the absence of specific antiviral treatments [2]. The concurrent circulation of the four dengue serotypes, together with coinfections involving Zika, Chikungunya, and Oropouche viruses, further compounds the epidemiological complexity and increases disease severity.

A growing body of evidence now challenges the long-held belief that each country's dengue trajectory is unique. Instead, dengue epidemics across Latin America unfold as part of a synchronized regional system [3]. Recognizing this synchrony is not an academic exercise — it fundamentally alters how preparedness, forecasting, and control must be conceived. A virus that moves in continental waves demands a regional response.

This article expands the scientific discussion on dengue synchrony and explores its implications for health policy, arguing that the region must act collectively to reduce the human and economic burden of future epidemic cycles.

Scientific Evidence of Dengue Synchrony

Wavelet-based analyses of more than three decades of surveillance data from 241 localities across 14 Latin American countries reveal two distinct temporal patterns in dengue transmission: seasonal cycles (8–16 months) and continent-scale multi-annual cycles (17+ months) [3]. Critically, the multi-annual peaks — representing major epidemic events — occur nearly simultaneously across vast distances, often with phase differences of only a few months between regions separated by up to 10,000 km.

This phenomenon is not unique to the Americas. In Southeast Asia, major dengue waves propagate across national borders in predictable temporal sequences [4]. What is different in Latin America is the scale: synchronized epidemics have been documented from northern Mexico to southern Brazil.

Why does this matter? Because synchrony drastically reduces the predictability gained from observing neighboring countries. When outbreaks rise nearly everywhere at once, countries cannot rely on staggered warning signals or redistribute resources from unaffected regions.

Genomic studies reinforce this epidemiological picture. Viral lineages move frequently across borders before establishing local dominance [5,6]. These findings support the idea that dengue behaves less like a collection of isolated national epidemics and more like an interconnected, dynamic regional system.

The implication is unavoidable: Latin America's dengue problem is not a national one. It is continental.

Key Determinants Shaping Regional Synchrony

Dengue synchrony reflects the convergence of four major drivers — each inherently transboundary:

1. Climate variability

Temperature and humidity govern mosquito abundance and viral replication. Large-scale climate anomalies, such as El Niño, create regional environmental conditions favorable to *Aedes aegypti*. The most significant continental epidemics correspond to strong ENSO events [3,7].

2. Rapid and fragmented urbanization

Unplanned urban growth, water storage practices, and deficient sanitation facilitate vector proliferation. Many cities across the region share similar vulnerabilities [8].

3. Human mobility

Movement of people — within and between countries — accelerates the spread of viral lineages [9]. This mobility explains why genetically similar viruses appear almost simultaneously in geographically distant regions.

4. Serotype dynamics and cross-immunity cycles

The introduction or resurgence of dengue serotypes produces multi-year waves modulated by population immunity. Examples include the emergence of DENV-4 in Peru [10] and shifts in DENV-2 lineages in Brazil and Colombia [11].

Taken together, these drivers create a continent-wide network of synchronizing forces — one that no national strategy can alter on its own.

Limitations of Current Regional Approaches (fortalecido en tono crítico)

Despite improved surveillance systems, dengue monitoring in Latin America remains fractured. Passive case reporting, heterogeneous diagnostic capacity, inconsistent data harmonization, and underuse of climate and mobility data undermine preparedness.

The lack of a regional governance structure means countries act sequentially rather than jointly. This produces a predictable dynamic:

- **Outbreaks grow silently in multiple countries simultaneously.**
- **Early-warning signals lose predictive value across borders.**
- **Resource shortages appear everywhere at once.**
- **Regional learning is fragmented and slow.**

A synchronized epidemic, coupled with uncoordinated national responses, results in collective vulnerability.

Period / Epidemic	Climate Event	Affected Countries	Mean Observed Delay
1997–1998	El Niño (strong)	Mexico, Puerto Rico, Ecuador, Dominican Republic	~5 months
2001–2002	La Niña (persistent)	Venezuela, Brazil	Variable
2007–2008	Regional epidemic	Andean region + Caribbean	~6 months
2009–2010	El Niño + regional outbreak	Brazil, Colombia, Mexico, and the Andean region	~6 months
2014–2016	El Niño + Zika/Chikungunya	Entire region	~6 months

Table 1. Regional synchrony of dengue epidemics in Latin America (1997–2016)

The repetition of similar lags across decades demonstrates that continental synchrony is structural, not incidental.

Implications for Health Policy

Dengue synchrony compels a fundamental shift: countries must transition from independent national control to coordinated regional governance.

We argue that effective regional action must rest on four central pillars:

1. Integrated regional surveillance

Real-time epidemiological reporting must be interoperable, standardized, and shared across borders, incorporating climate indicators, vector data, and human mobility patterns. Open data platforms, ideally coordinated by PAHO/WHO, are essential [8]. These needs align closely with existing global frameworks. Adopted by the World Health Organization (WHO) in 2017, the Global Vector Control Response (GVCR) seeks to strengthen vector control worldwide by expanding capacity, improving surveillance, enhancing coordination, and promoting integrated, multisectoral action [12].

2. Continental early-warning systems

Advances in machine learning and high-performance computing — including resources from the Barcelona Supercomputing Center and scientific networks in Brazil and Mexico — can support models capable of forecasting outbreaks months [3,13].

3. Cross-border operational coordination

Shared ecosystems and migration corridors require binational and trinational public health alliances, including harmonized diagnostics, coordinated entomological surveillance, and synchronized vector control strategies.

4. Governance and long-term financing

Dengue will not wait for political cycles. Regional agreements, supported by development banks such as IDB and CAF, must institutionalize long-term programs with protected funding.

The alternative is predictable: continued megacycles of dengue, each larger than the last.

Additional Considerations: other arboviruses and immune interactions

Crossreactive immunity among flaviviruses — Dengue, Zika, Oropouche — can intensify disease severity [14,15]. This interaction magnifies the stakes of failing to adopt a regional approach. A continental surveillance program that monitors dengue without tracking co-circulating arboviruses is incomplete and potentially misleading.

Recommendations

Scientific

- Consolidate multicenter research on dengue genomics, immunology, and modeling.
- Develop standardized protocols for cross-country data synthesis.

Public Health

- Harmonize diagnostic algorithms and case definitions across Latin America.
- Implement joint vector control initiatives at high-risk borders.

Policy

- Establish a Latin American Dengue Observatory.
- Promote regional agreements for data sharing, training, and outbreak response.

Financial

- Secure long-term regional funding insulated from election cycles.
- Engage development banks to support infrastructure for surveillance and early warning.

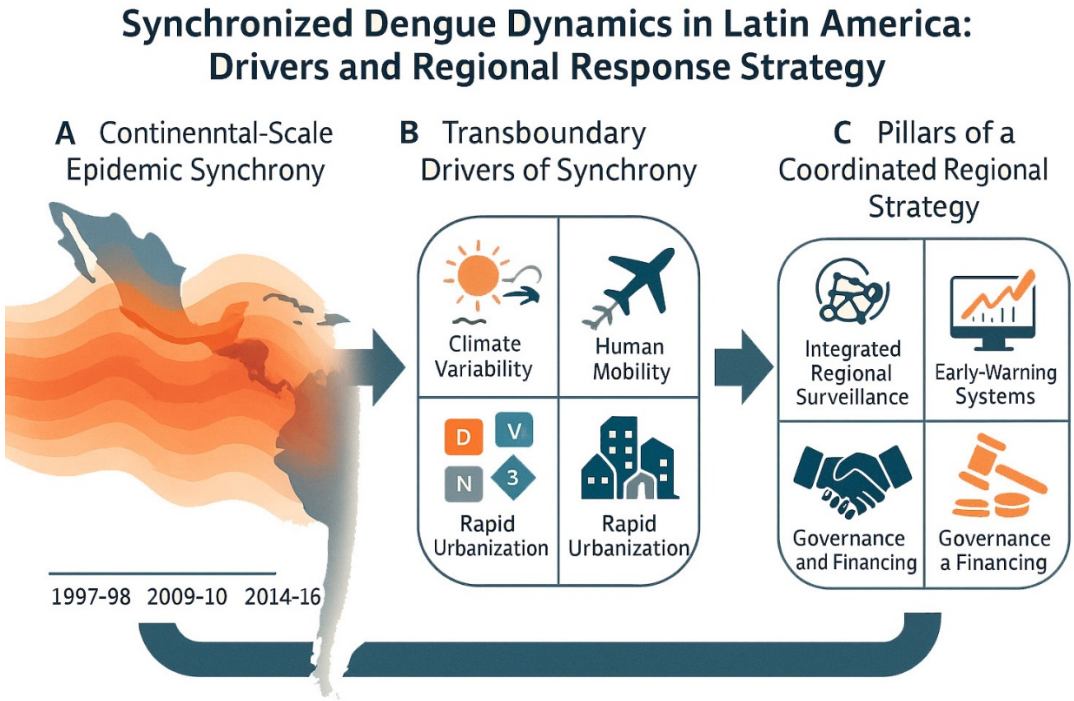

Figure 1. Dengue in Latin America operates as a synchronized continental system that requires a coordinated response beyond national borders. Panel A shows the propagation of synchronized dengue waves across the continent during the major epidemic peaks between 1997 and 2016, with color intensity reflecting epidemic

magnitude and burden. Panel B illustrates the four main drivers of this synchrony: climate variability (particularly ENSO events), human mobility, serotype dynamics, and urbanization. Panel C presents the proposed regional approach with its four fundamental pillars. The arrows indicate the causal relationship among the drivers, the observed synchrony, and the necessary regional strategy.

CONCLUSIONS

Dengue in Latin America is not merely a national challenge — it is a synchronized continental phenomenon shaped by climate, mobility, immunity, and social vulnerability. Persisting with isolated national strategies is no longer a viable option. Science is clear: epidemic waves will continue to rise and propagate across borders, outpacing disjointed control efforts.

With coordinated governance, integrated surveillance, and region-wide predictive tools, Latin America can move from reacting to anticipating dengue's cycles. Without this shift, the region will remain locked in a pattern of recurring megacycles — each more costly and disruptive than the last.

The coming years will reveal whether the region embraces a collective approach or continues confronting a continental threat with fragmented tools. The scientific evidence makes clear which path offers lasting resilience.

Author Contributions

Conceptualization, L.G.G. and A.P.O.; literature review, L.G.G.; critical analysis, L.G.G. and A.P.O.; writing—original draft preparation, L.G.G.; writing—review and editing, L.G.G. and A.P.O.; visualization, L.G.G.; supervision, A.P.O. Both authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

The funders had no role in the design of the study, the collection, analysis, or interpretation of data, the writing of the manuscript, or the decision to publish the results.

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All figures and tables were created by the authors using publicly available data and the scientific resources cited in this manuscript. Figure 1 was generated using author-supervised AI-assisted illustration workflows (OpenAI Copilot) based exclusively on established scientific knowledge; no AI tool generated new data or scientific interpretations. Generative artificial intelligence was used solely for linguistic editing, grammatical correction, and formatting standardization, always under full human supervision. No AI system was used for data generation, data analysis, or the creation of original scientific content. The authors independently verified all scientific information, interpretations, and conclusions in accordance with BioNatura Journal's policy on AI-assisted content (https://bionaturajournal.com/artificial-intelligence--ai-.html).

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