Mapping the Resurgence: A Longitudinal Study of Dengue

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***Abstract*—**This longitudinal study investigates dengue occurrence from 2020 to 2024 to determine if global, national, and state-level trends align and to identify the unique epidemiological characteristics within Kerala. Utilizing data from the WHO, NCVBDC, and Kerala's DHS, the research analyses the shifting landscape of the disease. Results show a dramatic post-pandemic resurgence. Global cases soared from 1.7 million in 2021 to a record 14.4 million in 2024. India mirrored this growth, peaking at 289,235 cases in 2023. Kerala reached a five-year zenith of 20,674 cases in 2024. The study concludes that dengue has shifted from seasonal epidemic spikes to hyper-endemicity. These findings mandate a shift from reactive responses to a 365-day model of climate-integrated surveillance and genomic monitoring to combat the permanent environmental presence of the virus.

***Index Terms*—**Dengue, Incidence, Hyper-Endemicity, WHO, NVBDCP, ISDP.

I. INTRODUCTION

Dengue is a mosquito-borne viral disease that has undergone a rapid global proliferation. Primarily transmitted by female mosquitoes of the species Aedes aegypti — and to a lesser degree, Aedes albopictus — the incidence of dengue has surged dramatically. Reports to the World Health Organization (WHO) illustrate this crisis, with documented cases climbing from 505,430 in 2000 to a staggering 14.6 million in 2024 (WHO, 2025). The gravity of the dengue burden on human health and socioeconomic systems is exacerbated by several systemic challenges. Underreporting remains a significant issue, compounded by the clinical difficulty healthcare professionals face when diagnosing the disease based solely on symptoms. In India, the reliance on passive surveillance and insufficient reporting from the private sector further obscures the true scale of the epidemic. This expansion is driven by a synergy of factors, most notably global travel and trade, viral evolution, rapid urbanization, population growth, and climate change. The present study analyses dengue occurrence data from 2020 to 2024 through global, national, and state lenses.

II. MATERIALS AND METHODS

Data regarding the global incidence of dengue were aggregated from official reports submitted by member states to the World Health Organization (WHO). National statistics for India were compiled from the National Centre for Vector Borne Diseases Control (NCVBDC), under the Directorate General of Health Services, Ministry of Health and Family Welfare. For state-level analysis, data were extracted from the annual communicable disease reports published by the Integrated Disease Surveillance Programme (IDSP), Directorate of Health Services, Government of Kerala.

III. RESULTS

3.1 Global Patterns of Dengue Incidence

Table 1: Global Dengue Incidence (2020–2024) — Source: WHO

Sl. No	Year	Total Reported Cases
1	2020	2,333,026
2	2021	1,725,584
3	2022	2,829,141
4	2023	6,505,178
5	2024	14,434,584

The longitudinal data from 2020 to 2024 reveals a volatile and aggressively upward trajectory in global dengue transmission. After a period of suppression during the COVID-19 pandemic, the virus has surged to unprecedented levels, culminating in a historic public health crisis in 2024. The initial biennium presents a fascinating case study in how a global respiratory pandemic inadvertently reshaped the transmission of a vector-borne disease. In 2021, figures reached a quinquennial nadir of 1,725,584 cases, largely attributed to reduced human mobility and healthcare diversion. The year 2022 marked a critical inflection point, with transmission rebounding to 2,829,141 cases. The most alarming phase occurs between 2023 and 2024, characterized by exponential growth to 14,434,584 cases, representing a 122% year-over-year increase. This transition suggests a synergistic perfect storm of climatic anomalies, urbanization, and immunological naïveté.

3.2 Dengue Incidence in India

Table 2: Reported Dengue Incidence in India (2020–2024) — Source: NVBDCP

Sl. No	Year	Total Reported Cases (India)
1	2020	44,585
2	2021	193,245
3	2022	233,251
4	2023	289,235
5	2024	233,519

The epidemiological landscape of dengue in India over the current decade presents a compelling narrative of resilience, resurgence, and eventual hyper-endemic stabilization. Reporting 44,585 cases, 2020 represents a statistical outlier due to nationwide lockdowns disrupting the vector-host interface. As socio-economic activity resumed, cases surged by over 330% to 193,245. The period between 2022 and 2023 transitioned India from a state of recovery to one of record-breaking burden, with 2023 emerging as the most significant year at 289,235 cases. The progression from the 2020 nadir to the 2024 hyper-endemic state underscores a fundamental shift: dengue has transitioned from a cyclical seasonal threat to a persistent, year-round public health challenge.

3.3 Dengue Fever Trends in Keralam

Table 3: Dengue Incidence in Keralam (2020–2024) — Source: DHS, Keralam

S. No	Year	Confirmed Cases (Kerala)
1	2020	2,722
2	2021	3,251
3	2022	4,468
4	2023	16,766
5	2024	20,674

The five-year period marks a seminal shift in the regional epidemiological landscape, revealing a transition from random, sporadic spikes to a systemic, environment-driven escalation. During 2020 and 2021, case numbers remained relatively suppressed coinciding with the COVID-19 pandemic. The year 2023 represents a critical inflection point: the jump to 16,766 cases — a staggering 275% year-on-year increase — suggests a total collapse of the prior ecological equilibrium. While the growth rate slowed in 2024, the absolute volume (20,674 cases) reached a five-year zenith.

3.4 Dengue Trends Across Kerala Districts

Table 4: Keralam District-wise Confirmed Dengue Cases (2020–2024) — Source: DHS, Keralam

District	2020	2021	2022	2023	2024
Thiruvananthapuram (TVM)	631	485	844	2,451	2,668
Kollam (KLM)	460	114	597	2,473	2,154
Pathanamthitta (PTA)	99	31	88	313	439
Idukki (IDK)	38	74	21	309	224
Kottayam (KTM)	226	139	68	154	237
Alappuzha (ALP)	221	110	281	586	550
Ernakulam (EKM)	295	945	1,468	3,855	6,092
Thrissur (TSR)	143	299	213	1,972	1,007
Palakkad (PKD)	47	99	152	1,063	1,445
Malappuram (MLP)	60	169	267	2,035	1,353
Kozhikode (KKD)	69	209	44	834	2,002
Wayanad (WYD)	49	32	88	363	292
Kannur (KNR)	268	116	110	227	933
Kasaragod (KSD)	117	429	227	131	1,278
STATE TOTAL	2,723	3,251	4,468	16,766	20,674

The most striking feature of the dataset is the emergence of Ernakulam as the primary engine of dengue transmission in the state, surging from 295 cases in 2020 to 6,092 cases by 2024 — a twenty-fold increase. A significant epidemiological shift occurred in 2024, as the burden intensified in the northernmost districts: Kozhikode (2,002 cases) and Kasaragod (1,278 cases) reached their decadal peaks. The district-wise analysis confirms that dengue in Kerala has evolved from a series of isolated urban outbreaks into a contiguous state-wide epidemic.

3.5 Monthly Temporal Dynamics (2020–2024)

Table 5: Keralam Monthly Confirmed Dengue Cases (2020–2024) — Source: DHS, Keralam

Month	2020	2021	2022	2023	2024
January	443	91	185	390	664

Month	2020	2021	2022	2023	2024
February	201	117	102	344	609
March	92	154	149	437	563
April	76	124	179	509	741
May	322	130	443	1,029	1,770
June	709	508	774	3,369	3,556
July	453	938	617	5,502	4,142
August	153	327	450	1,732	1,702
September	54	194	425	1,093	1,720
October	63	215	400	851	1,941
November	71	192	422	811	1,847
December	86	261	322	699	1,419
TOTAL	2,723	3,251	4,468	16,766	20,674

The seasonal distribution of dengue in Kerala over the last five years reveals a profound transformation. The data demonstrates a temporal expansion where the virus has transitioned from a seasonal guest to a perennial resident. June and July consistently function as the epicentre months. In July 2023, cases reached a staggering 5,502, nearly sixfold above July 2021. Perhaps the most significant finding is the rising baseline of pre-monsoon cases: January 2021 recorded only 91 cases, while January 2024 reached 664. December 2024 (1,419 cases) carried a burden nearly 16 times higher than December 2020 (86 cases), indicating that the ecological off-season for dengue has virtually disappeared.

IV. DISCUSSION

On the global stage, the years 2020 and 2021 functioned as a biological pause, where the strictures of the COVID-19 pandemic starved the Aedes aegypti mosquito of its primary transmission fuel. By 2024, the world witnessed an explosive resurgence, with cases surging toward a historic zenith of 14.4 million. This global escalation is not merely a return to the old status quo; it is a 'new normal' dictated by climatic forcing. The warming of the planet has expanded the mosquito's geographic footprint, turning once-temperate zones into hospitable habitats. Within India, the post-pandemic years saw a rapid restoration of dengue's foothold, peaking dramatically in 2023. India deals with the co-circulation of all four dengue serotypes, increasing the risk of severe clinical manifestations and ensuring that the virus remains a constant rather than a seasonal threat. Kerala serves as a microcosm for the ultimate evolution of the disease, with the traditional concept of a "dengue season" effectively dissolving as the virus now persists through traditionally dry months.

V. A COMPARATIVE SYNTHESIS

5.1 The Points of Convergence

The most striking similarity across all scales is the 'Post-Pandemic Elasticity.' Global, national, and Kerala-specific data all recorded a significant nadir during 2020–2021. The subsequent explosion in 2023 and 2024 demonstrates that the virus was merely dormant, waiting for the restoration of the human-vector-human transmission cycle.

5.2 The Points of Divergence

While the upward trajectory is shared, Peak Synchronicity diverges significantly between the scales. Globally, 2024 stands as the historic high-water mark, while India's national data reached its definitive peak in 2023. A critical divergence is found in the seasonal reset: Kerala's data indicates a radical departure toward perpetual transmission. In Kerala, the pre-monsoon and post-monsoon months in 2024 carried a burden exceeding the monsoon peaks of previous years.

VI. CRITICAL REFLECTION

The synthesis of these scales reveals a sobering reality: we have transitioned from a world of Epidemic Dengue characterized by predictable seasonal waves to Hyper-Endemic Entrenchment characterized by a high, steady baseline. The "Kerala Paradigm" — where the off-season has virtually vanished — serves as a sentinel for the rest of the world. The path forward requires a move away from event-based responses toward a model of continuous, 365-day vigilance, necessitating a sophisticated fusion of genomic monitoring to track viral evolution and climate-integrated surveillance to predict shifts in vector behaviour.

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