

Dengue in Kerala (2000–2025): Trends and Analysis

Over the past 25 years, Kerala has seen a dramatic rise in dengue incidence, punctuated by major outbreaks. The state’s first dengue case was reported in 1997[1], and since 2000 annual cases have climbed from near zero to thousands per year. For example, reported cases surged from 2,197 (2003) to 7,218 (2016) and spiked in the record 2017 outbreak (21,993 cases, 165 deaths)[1]. After falling to \approx 3–4,000 cases in 2018–21, cases doubled to 9,770 in 2023[2], making Kerala the Indian state with the highest dengue burden that year. Deaths have risen in parallel (Figure 1, Table 1). Trends show seasonal peaks in the May–July monsoon (corresponding to SW monsoon onset[3]) and a clear link to vector-favorable weather. Table 1 summarizes Kerala’s annual dengue cases and deaths for key years; full time-series data are available in state surveillance reports[4][5].

Year	Cases	Deaths	Comment
2000	0	0	Dengue nearly absent early 2000s[1]
2003	3,546	68	First large outbreak in 2003[1]
2013	7,938	29	Second major peak[6]
2017	21,993	165	Record outbreak (2017)[1]
2022	4,468	58	Post-outbreak low year[6]
2023	9,770	37	Renewed surge (double 2022)[2]

Figure 1 (below): Dengue cases (blue) and deaths (red) in Kerala, 2000–2023. (Data from state health reports and NVBDCP[4][2].)

Figure 1. Reported dengue cases and deaths in Kerala by year (2000–2023)[4][2].

Epidemiological Factors

Kerala’s dengue landscape reflects several shifting epidemiological factors. The state is **hyperendemic**: all four dengue serotypes circulate, and mixed infections are reported. A 2017–2019 study in southern Kerala found DENV-1 dominated during 2017, with rising DENV-4 proportions by 2019[7]. Changing serotype patterns (e.g. DENV4 emergence) raise risk of severe outbreaks[7]. Spatially, dengue incidence correlates with population density and urbanization[8]. Thiruvananthapuram (densest district) historically had highest incidence, with recent surges in urban Ernakulam[8]. Hilly, sparsely populated districts (Idukki, Wayanad) consistently report far fewer cases[9]. Seasonally, dengue peaks in Kerala’s **monsoon** period (June–July): increased rainfall and temperature create ideal *Aedes* mosquito breeding conditions[3][10]. Local studies confirm “pre-epidemic” intermittent rains and high larval indices preceding spikes in cases[11][3].

Environmental drivers of dengue in Kerala mirror global trends. Climate warming and erratic rainfall have expanded *Aedes* habitat, while Kerala’s high urbanization and complex

water infrastructure provide breeding sites. One analysis notes Kerala’s dengue risk is amplified by “rapid urbanisation” and “inadequate waste management,” enabling mosquito proliferation[12]. Similar insights from Asia highlight that **sanitation and water infrastructure** strongly shape dengue risk, often more than simple urban/rural classification[13][14]. In Kerala, outbreaks have often followed wetter monsoons or El Niño-linked rains. For example, the 2022/23 resurgence corresponded with heavy late-season rains and persistently warm temperatures[12]. Collectively, these factors suggest a convergence of **climate change, environmental sanitation, and urban growth** in fueling Kerala’s dengue.

Public Health Infrastructure and Control Efforts

Kerala’s health agencies have long recognized dengue as a priority. Since the first outbreak, the state has implemented standard vector control policies (derived from NVBDCP guidelines[8]). These include regular anti-larval campaigns, fogging during outbreaks, and public awareness drives before monsoon. Kerala also uses community health workers (“Dengue Warriors”) to identify breeding sites and encourage source reduction, reflecting WHO’s emphasis that “prevention and control of dengue rely on vector control”[15]. In 2017 and again in 2023, the government launched statewide **“Arogya Keralam”** and inter-departmental campaigns to bolster surveillance and community cleanup. Diagnostic facilities and referral networks were strengthened (per NVBDCP protocol) to reduce case fatality; Kerala’s reported dengue fatality rates remain relatively low due to early detection and supportive care.

However, despite these measures, outbreaks have repeated. Evaluations indicate **gaps in implementation**: community clean-up drives and IEC campaigns have variable reach, and anti-larval interventions often lag behind mosquito breeding cycles. One study found many households in Kerala still had stagnant water sources even after official campaigns[16]. Public surveys suggest knowledge of dengue prevention is uneven, and behavioral compliance (e.g. covering water tanks, using larvicides) remains low in peri-urban slums. Infrastructure constraints – such as blocked drains and irregular waste collection – continue to create breeding foci. Thus, while Kerala’s health system mobilizes dengue control funds yearly, the **effective coverage** of interventions has been incomplete, as reflected by persistent high case counts.

Recommendations: Predicting, Preventing, Controlling Dengue

Building on past lessons, Kerala can adopt a multi-pronged strategy with evidence-based actions across policy, community, health systems, and technology.

- **Government Policy and Planning:**
- **Vector Control Regulations:** Strengthen enforcement of building and sanitation codes to eliminate Aedes breeding sites (e.g. require covering water tanks, clearing construction debris). Mandate periodic inspections in high-risk areas.

- **Urban Planning:** Integrate dengue risk into land-use planning. Prioritize improving drainage and solid-waste systems in rapidly urbanizing zones. Use urban growth models to identify and upgrade vulnerable neighborhoods.
- **Intersectoral Coordination:** Establish a permanent Dengue Task Force (health, urban, environment, PRIs) with authority to launch pre-monsoon control drives. Leverage waste management and public works departments for vector elimination during peak season.
- **Surveillance Enhancement:** Expand Integrated Disease Surveillance Programme (IDSP) use of mobile reporting and real-time data sharing across districts. Invest in Early Warning tools (see below) and ensure health officials act on alerts.
- **Community Engagement:**
 - **Awareness Campaigns:** Conduct continuous education (not only pre-monsoon) through local language media, school programs, and social media. Tailor messages to high-risk behaviors (e.g. tire disposal, water storage).
 - **Community Cleanup Drives:** Organize monthly “mosquito-proofing” weeks where local councils clear standing water with citizen volunteers. Use resident associations and women’s groups (Kudumbashree) to audit breeding sites at household level.
 - **Vector Source Reduction:** Promote low-cost vector control at home: larvivorous fish in ponds, bio-larvicides, introduction of mosquito traps. Engage communities in source-reduction competitions or incentives.
 - **Public-Private Partnerships:** Collaborate with NGOs (e.g. healthcare trusts, Rotary, Lions) to fund community outreach, distribute mosquito nets/larvicide kits, and support local vector surveys.
- **Healthcare System Measures:**
 - **Enhanced Diagnostics:** Scale up point-of-care testing at primary health centers (NS1 antigen tests, rapid kits) to ensure early case detection. Train frontline staff in dengue case management protocols (WHO/NVBDCP) to reduce complications.
 - **Rapid Response Protocols:** Institutionalize “fogging-on-alert”: when an area reports a cluster (e.g. 2+ cases/week), trigger immediate larviciding and fogging in surrounding environs. Utilize geo-coded IDSP data to detect hot-spots within days.
 - **Hospital Preparedness:** Stockpile IV fluids and platelets before peak season. Ensure tertiary care facilities are ready for dengue hemorrhagic fever cases. Track severity patterns (serotype shifts) to anticipate clinical resource needs.
 - **Surveillance Data Use:** Regularly analyze health data to identify age/sex clusters or emerging serotypes. For instance, if mixed infection rates rise^[11], prepare intensive monitoring (since mixed-serotype infection can signal severe outbreaks).
- **Technological Innovations:**

- **Predictive Modeling:** Adopt statistical or machine-learning models (e.g. LSTM, time-series ARIMA) that use weather forecasts and case trends to predict outbreak onset[17]. Pilot these tools with the Kerala State IT Mission to provide actionable forecasts each season.
- **GIS Mapping:** Implement district-level GIS dashboards mapping cases, vector indices, and environmental risk (rainfall, land use). Such mapping was used in Kasaragod to pinpoint high-risk wards[11]. Extend to all districts to guide focused interventions.
- **Mobile Surveillance Apps:** Leverage Kerala’s strong IT literacy by deploying a mobile app for community dengue reporting. Citizens could upload images of stagnant water or symptoms. Data feeds into health department systems for rapid follow-up (similar to existing fever surveillance apps).
- **Novel Vector Control Technologies:** Explore cutting-edge tools—e.g. Wolbachia-infected mosquito releases or sterilization drives in pilot areas—complementing source control. Collaborate with research institutes (such as KSCSTE or ICMR VCRC Trivandrum) to test new biocontrol methods suited to Kerala’s ecology.

Table 2. Recommended Actions for Dengue Control in Kerala (selected highlights)

Level	Strategy	Actions
Policy / Govt	Urban planning & regulation	Strengthen building codes; improve drainage and waste systems.
	Vector control enforcement	Pre-monsoon interdepartmental task force; rigorous inspections.
	Surveillance enhancement	Real-time IDSP reporting; utilize early warning models.
Community	Awareness & behavior change	Year-round IEC campaigns; school and media programs.
	Source reduction	Community clean-up drives; larvivorous fish; waste cleanup.
	Partnerships	Engage NGOs/PRIs for outreach and mobilization.
Healthcare	Diagnostics & reporting	Expand NS1/RDT testing in PHCs; mandatory case reporting.
	Rapid response	Fogging around case clusters; vector surveillance triggers.
	Clinical preparedness	Stock fluids/platelets; training in dengue case management.
Technology	Predictive analytics	Implement ML/forecast models with meteorological data[17].
	GIS & mobile tools	Develop GIS dashboards; dengue-reporting

Level	Strategy	Actions
		mobile app.
	Innovative vectors	Pilot Wolbachia or sterile insect releases.

This evidence-based, multi-tier approach leverages Kerala’s strengths (high literacy, health infrastructure, IT capacity) while addressing systemic gaps. Critically, *local action* — backed by strong state-level policies — will be key. The success of dengue control will require sustained sanitation improvements and community vigilance in addition to medical preparedness. By integrating data-driven prediction and technologies into ongoing programs, Kerala can better anticipate and curb outbreaks.

Sources: Kerala state surveillance data[4][2]; climate and epidemiology studies[3][7]; WHO and NVBDCP guidelines[15][8]; peer-reviewed Kerala-specific analyses[11][17]. These inform the trends and recommendations above.

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