

ORIGINAL ARTICLE - PUBLIC HEALTH

PREVENTION AND CONTROL STRATEGIES TO COUNTER THE DENGUE CYCLICAL TREND IN TAMIL NADU

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Abstract

INTRODUCTION : The most common vector-borne disease that is most prevalent is Dengue, which in its severe form can be fatal. Tamil Nadu has witnessed multiple epidemics in the past, with a cyclical trend occurring every five years. There are multivariou efforts to mitigate the dengue outbreak, which is endemic, by using a variety of preventive and control measures, which results in positive results and outcomes.

OBJECTIVE : The current study aims to assess the preventive and control methods used to combat Dengue and prevent the cyclical trend of outbreaks in Tamil Nadu.

METHODOLOGY : This retrospective study analyzed Dengue cases reported in Tamil Nadu from 2012 to 2023 and the control measures adopted to prevent and control the spread of Dengue infection. The data includes all the Dengue cases reported in the Sentinel Surveillance Hospitals (SSH) of Tamil Nadu under the National Vector Borne Disease Control (NVBDC) Program.

RESULTS : In Tamil Nadu, Dengue cases were identified throughout the year with an increase in incidence during monsoon (August). Since 2012, there are 2 peaks, one in 2012 with 13,204 cases and the other in 2017 with 23,294 cases. The commonly used anti-larval and anti-adult chemicals were Temephos 50% EC, Technical Malathion and Pyrethrum extract 2%. The number of positive mosquito pool for viral markers by RT PCR was highest in 2019 which was brought down in 2021 by preventive measures.

CONCLUSION : As the outbreak of the Dengue virus continues to prevail in today's world, the development of safe, cost-effective, and potential preventive and control measures, the development of new and improved techniques against dengue plays an important role in outbreak prevention. These multivariou efforts adopted by us prevented the expected outbreak and should be adopted by others to reduce the burden of Dengue.

KEYWORDS : Dengue, surveillance, outbreak, integrated vector control measures.

INTRODUCTION

In India, the first epidemic of clinical Dengue-like illness was recorded in Madras (now Chennai) in 1780. The epidemiology of Dengue in the Indian subcontinent has been very complex and has substantially changed over almost the past six decades in terms of prevalent strains, affected geographical locations, and severity of disease.¹ Dengue virus was isolated in India during 1945 for the first time. The first evidence of the occurrence of Dengue fever in the country was reported in 1956 from the Vellore district in Tamil Nadu.²

Dengue was once considered to be an arboviral disease of the urban environment infecting populations from municipalities, corporations, and cities. With rapidly increasing in urbanization, expanding travel patterns and climatic changes Dengue infection has spread to all geographical regions including both rural and urban areas. Dengue has been classified as the major re-emerging arboviral disease of public health importance by the World Health Organization (WHO) in the past decade affecting

more than 100 tropical and sub-tropical countries.³

Dengue epidemics tend to have seasonal patterns, with transmission often peaking during and after rainy seasons. Under optimal conditions, the life cycle of the aquatic stage of the *Aedes Aegypti* (the time taken from hatching to adult emergence) can be as short as seven days. At low temperatures, however, it may take several weeks for adults to emerge. During the rainy season, when survival is longer, the risk of virus transmission is greater. There are several factors contributing to this increase, and they include high mosquito population levels, susceptibility to circulating serotypes, favourable air temperatures, precipitation and humidity, all of which affect the reproduction and feeding patterns of mosquito populations as well as the Dengue virus incubation period.⁴



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Aedes aegypti is the main vector species of Dengue in India and is common in most of the urban areas on account of deficient water management, presence of non-degradable tyres and long-lasting plastic containers as well as increasing urban agglomerations and the inability of the public health community to mobilize the population to respond to the need to eliminate mosquito breeding sites.⁵ In India, every States experience outbreak of Dengue infection periodically. Some States encounter Dengue outbreaks once in every 3 years to 10 years. With stringent preventive and control measures the outbreak can be prevented.

Tamil Nadu has witnessed outbreaks of Dengue infection once in every 5 years in the past decades with the last outbreak occurring in 2017. With the expectation of an impending outbreak in 2022 - 23, The Directorate of Public Health and Preventive Medicine (DPH&PM) took several initiatives to prevent the spread of Dengue infection and other vector-borne diseases. With this knowledge, the above study was planned with the objectives of highlighting the comprehensive approaches of DPH&PM to prevent and control outbreaks of Dengue and to analyze the Dengue disease trend in Tamil Nadu.

METHODOLOGY

This descriptive retrospective study was conducted in Tamil Nadu with the data on Dengue cases reported in Tamil Nadu and the control measures adopted to prevent and control the spread of Dengue infection from 2012 to 2023. The data includes all the Dengue cases reported in the Sentinel Surveillance Hospitals (SSH) of Tamil Nadu under the National Vector Borne Disease Control (NVBDC) Program. Official permission to conduct the study was obtained from the Scientific Advisory Committee (SAC) of DPH&PM, Tamil Nadu.

The data was collected using Microsoft Excel and checked for validity and data cleaning done. The data was further analysed using IBM Statistical Package for the Social Sciences (SPSS) Version 19.

OPERATIONAL DEFINITION

Dengue case :

Probable case:

An acute febrile illness of 2-7 days duration with two or more of the following manifestations – headache, retro-orbital pain, myalgia, arthralgia, rash, haemorrhagic manifestation.⁶

Confirmed Dengue case:

A probable case of Dengue fever with IgM - ELISA positive with test done using National Institute of Virology (NIV)

testing kit or NS1 Ag – ELISA from Panbio Dengue Early ELISA kit from the SSH of the districts.^{6,7}

Dengue Surveillance :

Disease surveillance :

In order to take action to prevent or control a disease, epidemiological surveillance is vital. It is the continuous, systematic collection, recording, analysis, interpretation, and distribution of data representing the current health state of a community or population to stakeholders and public health specialists. Any dengue prevention and control program must include surveillance because it offers the data required for risk assessment, epidemic response, and program evaluation.^{4,8}

Entomological surveillance :

In order to ascertain shifts in the geographic distribution of vectors, to monitor and assess control programs, to acquire relative measurements of the vector population over time, and to enable pertinent and timely decisions regarding interventions, entomological surveillance is employed for both operational and research purposes. Identification of high-density infestation locations or times when the number of mosquitoes is rising may be accomplished through surveillance. The House index, Container index, Breteau index, and Mosquito pool are the commonly used entomological surveillance techniques.^{8,9}

Environmental surveillance :

There are a number of elements that have been shown to affect how susceptible a community is to dengue epidemics. When it comes to planning and determining the risk of dengue, factors such as population density and distribution, settlement features, land tenure, housing types, socioeconomic position, and education are all interconnected and crucial. Particularly pertinent information includes understanding how home water storage methods and solid waste disposal services have changed over time, as well as how the quality and dependability of water supply services have changed across time. This kind of data aids in the creation of ecological profiles, which are useful for organizing epidemic intervention strategies and planning focused source reduction or management initiatives.¹⁰

Dengue Prevention and Control measures :

Dengue preventive and control measures are multidimensional involving several stages of vector dynamics and activities. They are broadly classified as Integrated Vector Control measures (IVC).¹¹⁻¹³

a. Methods for Environmental Management and Source Reduction

Destruction of unused water storage containers or vessels,

detection and elimination of mosquito breeding grounds, proper management of sunshades, porticos, and roof tops, proper covering of stored water, keeping track of the weekly dry day once in a week.

b. Biological Control

Use of larvivores fishes (*Gambusia* / Mosquito fish) in ornamental tanks, fountains, etc., Use of biocides (*Bacillus thuringiensis*).

c. Chemical Control

Use of chemical larvicidal agents like abate (50% EC Temephos) in big breeding containers, indoor aerosol space spray during daytime using 2% Pyrethrum Extract, and outdoor aerosol air spray using Technical Malathion.

d. Personal Prophylactic Measures

Use of topical applicant mosquito repellent creams on exposed parts of the body, liquids, coils, mats etc., wearing of full sleeve shirts and full pants with socks to cover all the possible exposed parts of the body, Use of bed nets for sleeping infants and young children during daytime to prevent mosquito bite.

e. Health Education

To impart knowledge to the public regarding the disease and its presentation, transmission methods and vector dynamics through commonly used media sources like Television, Radio, Cinema slides, social gplatforms, etc. Information Education and Communication (IEC) and Behavioural Change Communication (BCC) about *Aedes* mosquito breeding sites are illustrated, and there are various audio Jingles as well as celebrity videos promoting Dos and Don'ts. All resources are provided in Tamil, and the public can get toll-free assistance via the 104, and 24 x 7 Public Health Control Room.

f. Community Participation

Organising rallies and marches for the community to sensitize them and involving the community for detection of mosquito breeding places and their elimination. Promoting a community representative or a leader to be a moderator of preventive and control measures actively.

RESULTS :

The Dengue infection is prevalent in Tamil Nadu for a while with frequent outbreaks once in every 5 years since the past two decades. With every outbreak the prevalence has increased since 2008.

First ever outbreak was noted in the year 2008 followed by 2012 and 2017.

Figure 1 explains the Dengue infection trend in Tamil Nadu since 2012 where there are 2 peaks, one in 2012 and the other in 2017 corresponding to the out breaks.

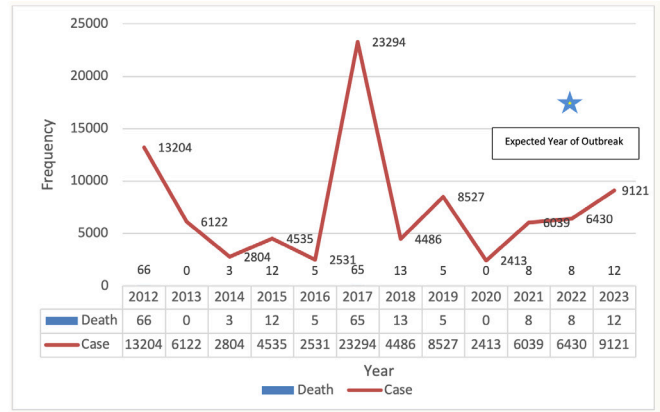


Figure 1: Dengue infection trend in Tamil Nadu from 2012 to 2023.

Figure 2 explains the month-wise distribution trend of Dengue cases in Tamil Nadu from 2017 to 2023. The incidence of Dengue cases increases with onset of monsoon in August. In the year 2017 witnessing the last outbreak in Tamil Nadu, the incidence of cases increased from June and peaked at October reporting 6,124 cases.

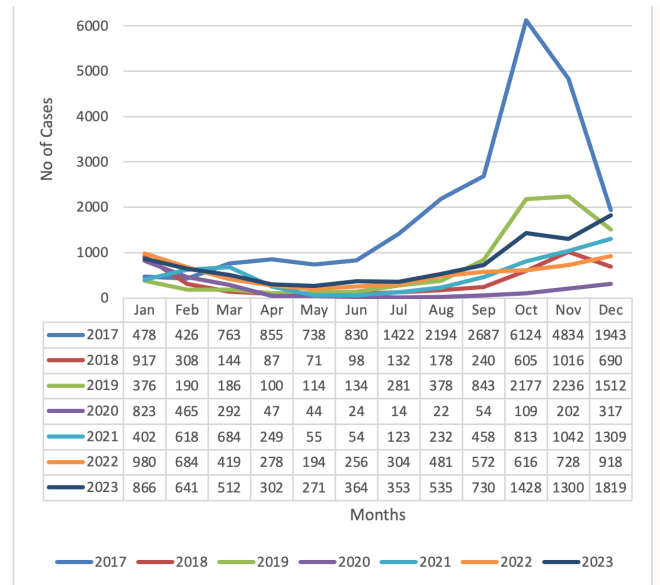


Figure 2 : Month-wise distribution of Dengue cases in Tamil Nadu from 2017 to 2023.

Table 1 illustrates the chemical control agents used in Tamil Nadu from 2019 to 2023. Temephos 50% EC and Pyrethrum extract 2% is commonly used for anti-larval measures and anti-adult measures. The procurement has been constant over the years.

Table 1 : Chemical control agents used in Tamil Nadu between 2019 and 2023.

MONTH	2019		2020		2021		2022		2023	
	Temephos 50% EC	Pyrethrum Extract 2%	Temephos 50% EC	Pyrethrum Extract 2%	Temephos 50% EC	Pyrethrum Extract 2%	Temephos 50% EC	Pyrethrum Extract 2%	Temephos 50% EC	Pyrethrum Extract 2%
Jan	2923	1622	2582	1458	1514	1010	1786	1476	2082	1444
Feb	2615	1886	2207	1265	1871	1288	1446	818	1702	1181
Mar	3026	974	1761	1154	2272	2175	1548	596	1949	1357
Apr	2296	1790	1358	448	2401	1126	1083	449	1494	1275
May	1178	1054	1167	403	1137	1264	1160	587	2341	1003
Jun	1974	1481	1347	906	2113	1264	1906	938	1219	1217
Jul	1936	1738	1245	416	1985	1106	1596	983	1621	1256
Aug	2009	1875	1327	662	1835	785	1754	1065	1413	1013
Sep	2300	3374	2022	1248	2279	1351	1601	1156	1500	1175
Oct	3292	3292	1805	1364	1794	1151	1553	1444	1777	1440
Nov	2691	3362	2109	1496	2378	1746	1842	1600	1364	1208
Dec	3358	2623	2018	1402	2430	1963	1774	1394	1487	1312
TOTAL	29598	25071	20948	12222	24009	16229	19049	12506	19949	14881

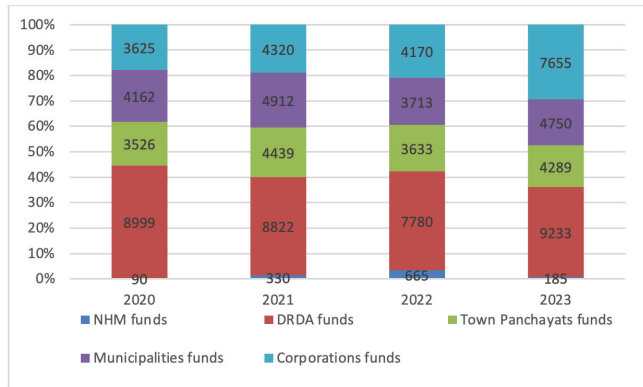


Figure 3 : Domestic breeding checkers deployed in Tamil Nadu from 2020 to 2023

Table 2: HUD wise Mosquito pool tested for Viral markers in Mosquito using RT-PCR test.

S. No	Name of the Health Unit District	2018		2019		2020		2021		2022		2023	
		Samples Tested	Positive	Samples Tested	Positive	Samples Tested	Positive	Samples Tested	Positive	Samples Tested	Positive	Samples Tested	Positive
1	Kancheepuram	27	1	39	15	160	5	223	8	262	13	241	10
2	Chengalpattu	14	0	25	11	103	11	456	16	530	17	348	15
3	Tiruvallur	33	1	49	17	182	6	287	9	320	14	319	6
4	Poonamallee	25	1	17	8	49	6	210	7	151	10	180	20
5	Vellore	93	4	101	30	209	11	342	24	405	8	285	3
6	Ranipet							174	5	290	8	234	11
7	Thirupathur	50	4	73	22	318	9	302	10	301	7	315	10
8	Tiruvannamalai	11	0	27	12	113	7	170	5	242	7	313	5
9	Cheyyar	60	3	53	21	129	9	265	11	289	7	318	9
10	Cuddalore	78	1	140	39	229	14	527	27	574	17	416	11
11	Villupuram	37	3	109	40	135	9	297	10	318	11	303	7
12	Kallakurichi	32	0	62	19	154	11	162	8	239	9	200	3
13	Thanjavur	67	2	154	29	191	5	471	8	395	20	394	10
14	Tiruvarur	32	0	63	16	96	1	159	4	237	10	283	12
15	Nagapattinam	29	0	51	14	125	2	211	1	170	8	168	6
16	Mayiladuthurai									161	8	156	2
17	Trichy	67	0	134	21	237	5	497	14	553	41	544	42
18	Karur	28	1	97	33	167	4	265	6	349	17	316	13
19	Ariyalur	12	1	34	8	57	1	131	1	131	4	146	3
20	Perambalur	18	2	48	5	80	1	122	2	120	7	196	3
21	Pudukottai	75	0	135	14	215	3	338	8	385	9	281	16
22	Aranthangi	20	1	50	9	65	0	118	1	84	1	76	3
23	Madurai	69	1	61	23	218	15	607	28	575	23	637	17
24	Theni	28	0	30	10	49	3	195	5	240	4	251	6
25	Dindigal	69	2	108	34	118	6	281	7	331	10	250	7
26	Palani	17	0	55	17	95	5	190	2	213	5	180	2
27	Ramnad	50	3	71	14	124	4	214	3	206	11	191	7
28	Paramakudi	18	0	89	15	124	2	264	7	260	11	274	17
29	Sivagangai	74	3	94	12	94	2	252	6	297	11	332	11
30	Virudhunagar	73	2	107	17	128	3	257	3	328	16	277	13
31	Sivakasi	56	2	95	22	93	2	254	4	269	13	177	6
32	Tirunelveli	43	1	56	10	64	1	228	13	271	17	340	14
33	Tenkasi	22	7	31	12	73	6	297	22	309	14	287	11
34	Thoothukudi	24	4	34	9	58	0	120	0	438	27	414	18
35	Kovilpatti	22	1	42	10	45	1	128	5	114	11	135	4
36	Kanyakumari	39	1	50	20	86	3	280	7	262	10	233	9
37	Salem	135	8	183	35	265	3	790	18	603	25	591	35
38	Attur									236	9	237	8
39	Namakkal	39	1	75	6	79	0	362	11	465	18	411	16
40	Dharmapuri	28	2	110	23	101	1	203	9	204	7	221	11
41	Krishnagiri	59	9	54	11	152	1	401	4	346	13	206	3
42	Coimbatore	56	1	102	36	91	7	232	15	504	18	287	22
43	Tirupur	77	8	88	28	95	7	509	19	540	22	558	9
44	Erode	15	0	54	15	142	9	309	16	408	16	412	26
45	Nilgiris	2	1	0	0	14	0	6	0	21	1	32	1
46	Chennai Corp	64	5	301	116	27	8	128	6	266	14	253	21
TOTAL		3905	87	5370	878	7369	209	14255	395	14212	579	13220	514

Table 2 explains the mosquito pool testing done to identify the presence of Dengue virus in the Aedes mosquito. Mosquito pooling has been effectively implemented in all districts and the testing has increased gradually since 2018 following the outbreak in 2017 when the guideline was framed.

Figure 3 explains the number of Domestic breeding checkers (DBC) deployed in Tamil Nadu from 2020 to 2023. Major contribution to the DBC deployment was from the Department of Rural development and the Panchayat Raj through DRDA at District level. DBC workers play a pivotal role in prevention and control of Dengue infection.

DISCUSSION

Dengue is an arboviral disease caused by Dengue virus through the bites of infected Aedes mosquito.

Dengue has become a major public health problem from being an urban disease to pan-geographic disease involving all terrains.

It has a potential to cause outbreaks at constant intervals. Tamil Nadu has experienced outbreaks at an interval of 5 years. With expected outbreak by 2022 the DPH&PM took several initiatives to prevent and control activities. The prevention and control activities involve various strategies.

Disease Surveillance :

Surveillance plays a major role in identifying the Dengue disease trend in the State of Tamil Nadu. It is carried out by the Integrated Disease Surveillance Program of the Integrated Health Information Platform (IHIP-IDSP) and through the NVBDC program. Daily samples tested and positives from the SSH are collected and assessed by the VBDC section of Communicable disease and appropriate field activities are planned with the team of Programme officers at the State level, District Health officers, District Entomologists / Regional entomologist team, various public health staffs and official in the field level and DBC workers with the help of mapping when the trend of disease increases. Similarly, the IHIP-IDSP section of the Communicable disease monitors the real-time reporting through the platform and initiates appropriate control measures with the help of State and District Surveillance officer, Epidemiologist and Rapid Response Team when the trend increases. The dual monitoring is an effective method of surveillance in prevention and control of Dengue outbreaks.¹⁴⁻¹⁶

Entomological Surveillance :

Entomological surveillance is carried out by the team of Regional Entomologists (RE), District Entomologists (DE), Health Inspectors (HI) and DBC workers in the field to study the vector dynamics and the presence of Dengue virus in the Aedes mosquito. The team periodically performs mosquito pooling which collects samples of the mosquito and larva from the field, and they are tested for the presence of virus by RT-PCR testing in the Apex laboratory at State Public Health Laboratory (SPHL), Chennai, and Institute of Vector Control and Zoonoses (IVCZ), Hosur. When the samples are found positive for Dengue virus field activities to reduce the vector density is initiated with fogging, source reduction, and indoor and outdoor spraying of insecticides.^{17,18}

In addition to the mosquito pool, the major step in entomological surveillance is calculation of House Index, Container Index and Breteau Index. They are monitored by the HI and DBC workers on every week by house to house visit and recorded in the register. Analysis of these data helps to predict and impending outbreak when there is rise in the index. Efficient and timely deployment of the HI and DBC workers has helped to monitor the vector density and kept the Dengue disease under control preventing outbreaks.^{9,13}

Environmental Surveillance :

Environmental surveillance is carried out by the team of DE, HI and DBC workers in the field. They look for the

possible sites for breeding which involves water collection sites, temporary and permanent water collection bodies in houses, farmlands, abandoned buildings, Government and private institutions, and other possible environmental sites which could pose a possible risk factor. The unplanned urbanisation has led to increased burden of Dengue disease which is checked and controlled by the environmental surveillance which targets the root cause for the disease by controlling the vectors.

Integrated vector control measures :

Integrated vector control measures are multi-dimensional and is highly effective in prevention and control of dengue. These measures are closely monitored in Tamil Nadu at the highest levels to prevent any outbreaks of Dengue disease.

a. Source reduction: It is performed by the HI and DBC workers in the field. They destroy or provide alternate measures to all the possible sites which could potentially contain the vectors in breeding. Several activities are involved in it. One such activity is the tyre removal campaign which is conducted on a fixed day in a week to remove all the unused tyres stored in shops and abandoned in the field. Similarly, during regular visits unused and abandoned tanks are destroyed with a chisel and hammer which is available in the kit which they carry. Household empty flowerpot and accessories are stored upside down to prevent water collection which could help vectors breed. Coconut shells, bottles, etc are collected and destroyed.^{9,11,18}

b. Biological control: Biological control is by introducing larvivores fish *Gambusia* in large water bodies in which Aedes larvae could not be destroyed or by chemical control measures. The DPH&PM has introduced *Gambusia* fish in several waterbodies in the State with the help of HI and DBC workers. These fishes have a strong appetite for mosquito larva leading to control of the vector density and prevention of Dengue disease.^{11,18}

c. Chemical control: Chemical control is done by using chemical agents like Pyrethrum extract 2%, Technical Malathion and Temephos EC 50% through the HI and DBC workers monitored by the entomological team. Temephos EC 50% is used in small to medium water storage units in the households which is a larvicidal agent. DBC workers and HI carry it with them during their daily field visit and use them. Similarly, Pyrethrum extract 2% is used for indoor fogging and Technical Malathion for outdoor fogging which acts on adult mosquito and kills them. Fogging is done during 8 to 11 am and by 3 to 5 pm.^{5,18}

d. Personal prophylaxis: Every household in the high vector

density area are advised to use mosquito nets. People are advised to wear full sleeves to prevent the public being susceptible to the mosquito bites.¹⁸

e. Health education and Community participation: The DPH&PM has initiated several measures to provide awareness to the public in prevention and control of Dengue. Several IEC materials have been prepared in the form of pamphlets, short videos involving celebrities and political leaders for dissemination to the public to provide awareness. The DPH&PM has designated multimedia links (Nalam Youtube channel, X handle, TNDPHPM website) where information is shared to the general population to adopt preventive measures. Similarly, guidelines for prevention, control and management are shared to all levels of health care providers including private practitioners through IMA and IAP. These initiatives have had a major impact on the reduction of cases and prevention of outbreaks.^{3,19}

Best practices and innovations in Dengue controls :

In Tamil Nadu various best practices from past experiences and innovations are being followed up to prevent and control Dengue. They involve multilevel approach and multisectoral coordination like reporting of clustering of any fever cases to the relevant authorities, Timely referral of Dengue cases through 108 Ambulances, State & District level epidemic co-ordination committee meeting, Nomination of Block Nodal Officers by the District administration during outbreaks/ monsoon season, Special Fever camps / MMU & RBSK teams deployment for medical camps, ORS Corners in all Health facilities to hydrate the patients, 24 Hours Fever Clinic in Community health centers, Government Hospitals and Medical college Hospitals. All Block PHCs and UGPHC having Cell counters to screen the patients haematological status (CBC, Platelet, Haematocrit, etc.) and exclusive fever wards with mosquito proofing and adequate beds, drugs and laboratory logistics and availability of blood components.¹⁸

Capacity building for Govt and Private Medical practitioners, Involvement of AYUSH Department for distribution of Nila Vembu Kudineer, provision under The Tamil Nadu Public Health Act 1939, Madras Municipal Corporation act, Involvement of resident welfare associations, Raid on Quack practitioners, Effective inter-departmental coordination with Municipal administration and water supply department, Rural development and Panchayat Raj institutions, Education department, Revenue department, and Department of ICDS. Certification of Aedes Free campus activities on every Thursday in Government offices and educational institutions, Detection of Dengue virus from the Aedes mosquito by RT-PCR method, Genomic

surveillance – whole genomic sequencing (WGS) of Dengue virus to identify the mutation and emergence of new variants and types of mosquitoes (under process), GIS mapping of Dengue hotspots and Xeno mapping.^{11,18}

The above activities have been followed by the DPH&PM ever since Dengue was notified. Adopting the best practices from the experience gained during previous outbreaks these activities are implemented with strict monitoring and evaluation at all levels. These have helped the State of Tamil Nadu to prevent the outbreak of Dengue disease in 2022 - 23 which was expected based on the previous cyclical trend of outbreak once in every 5 years. Continuation of these activities/ best practices/ innovations to prevent outbreak in the future which should be adopted in other States where outbreaks are highly prevalent are recommended.^{11,18}

CONCLUSION

Dengue must be viewed as an emerging and serious public health concern that calls for coordinated, multifaceted, and all-encompassing responses. As the Dengue infection outbreak persists in the modern world, the creation of secure, affordable, and effective preventive and control strategies promises a decrease in Dengue viral infection. Advanced combinations have also anticipated attenuation of vector population as tactics expand and are employed in conjunction with other approaches. The above-multifaceted approach followed in Tamil Nadu to the anticipated epidemic prevented the major events and burden of the disease. The mosquito pool is to be strengthened to identify the presence of Dengue virus in Mosquito in all states where Dengue is a major burden to identify the hotspots and initiate Integrated vector control measures to prevent impending outbreaks. Future generations may benefit from improved control and protective immunity if new approaches and techniques are further investigated and tested.

REFERENCES

1. Dengue in India : Indian Journal of Medical Research [Internet]. [cited 2024 Mar 21]. Available from: <https://journals.lww.com/ijmr/pages/articleviewer.aspx?year=2012&issue=36030&article=00006&type=Fulltext>
2. National Guideline for Clinical Management of Dengue 2022 [Internet]. [cited 2024 Mar 21]. Available from: <https://www.who.int/timorleste/publications/national-guideline-for-clinical-management-of-dengue-2022>

3. Pilot E, Nittas V, Murthy GVS. The Organization, Implementation, and Functioning of Dengue Surveillance in India—A Systematic Scoping Review. *Int J Environ Res Public Health* [Internet]. 2019 Feb 2 [cited 2024 Mar 21];16(4). Available from: [/pmc/articles/PMC6407027/](https://pmc/articles/PMC6407027/)
4. Guidelines :: National Center for Vector Borne Diseases Control (NCVBDC) [Internet]. [cited 2024 Mar 21]. Available from: <https://ncvbdc.mohfw.gov.in/index1.php?lang=1&level=1&sublinkid=5899&lid=3686>
5. Kularatne SA, Dalugama C. Dengue infection: Global importance, immunopathology and management. *Clin Med (Northfield Il)* [Internet]. 2022 Jan 1 [cited 2024 Mar 21];22(1):9. Available from: [/pmc/articles/PMC8813012/](https://pmc/articles/PMC8813012/)
6. SIGNS & SYMPTOMS OF DENGUE FEVER :: National Center for Vector Borne Diseases Control (NCVBDC) [Internet]. [cited 2024 Mar 22]. Available from: <https://ncvbdc.mohfw.gov.in/index4.php?lang=1&level=0&linkid=436&lid=3711>
7. LABORATORY DIAGNOSIS :: National Center for Vector Borne Diseases Control (NCVBDC) [Internet]. [cited 2024 Mar 22]. Available from: <https://ncvbdc.mohfw.gov.in/index4.php?lang=1&level=0&linkid=445&lid=3725>
8. GOI INITIATIVES FOR DENGUE AND CHIKUNGUNYA :: National Center for Vector Borne Diseases Control (NCVBDC) [Internet]. [cited 2024 Mar 22]. Available from: <https://ncvbdc.mohfw.gov.in/index4.php?lang=1&level=0&linkid=444&lid=3726>
9. Chin J, American Public Health Association. SURVEILLANCE, EMERGENCY PREPAREDNESS AND RESPONSE. 2009 [cited 2024 Mar 21];624. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK143158/>
10. Rather IA, Parray HA, Lone JB, Paek WK, Lim J, Bajpai VK, et al. Prevention and Control Strategies to Counter Dengue Virus Infection. *Front Cell Infect Microbiol* [Internet]. 2017 Jul 25 [cited 2024 Mar 21];7(JUL):336. Available from: [/pmc/articles/PMC5524668/](https://pmc/articles/PMC5524668/)
11. Health & Family Welfare Department, Government of Tamil Nadu [Internet]. [cited 2024 Mar 22]. Available from: <https://tnhealth.tn.gov.in/tngovin/dph/dphdbdengue.php>
12. DENGUE SITUATION IN INDIA :: National Center for Vector Borne Diseases Control (NCVBDC) [Internet]. [cited 2024 Mar 22]. Available from: <https://ncvbdc.mohfw.gov.in/index4.php?lang=1&level=0&linkid=431&lid=3715>
13. VECTOR CONTROL MEASURES :: National Center for Vector Borne Diseases Control (NCVBDC) [Internet]. [cited 2024 Mar 22]. Available from: <https://ncvbdc.mohfw.gov.in/index4.php?lang=1&level=0&linkid=448&lid=3722>
14. Chandy S, Ramanathan K, Manoharan A, Mathai D, Baruah K. Assessing effect of climate on the incidence of dengue in Tamil Nadu. *Indian J Med Microbiol*. 2013 Jul 1;31(3):283–6.
15. Over 3,000 DBC Workers May be Engaged as Multi-Tasking Staff in Delhi - Oneindia News [Internet]. [cited 2024 Mar 28]. Available from: <https://www.oneindia.com/india/over-3000-dbc-workers-may-be-engaged-as-multi-tasking-staff-in-delhi-gen-3667093.html>
16. Goel K, Chaudhuri S, Saxena A. India's strategy on surveillance system- A paradigm shift from an Integrated Disease Surveillance Programme (IDSP) to an Integrated Health Information Platform (IHIP). *Clin Epidemiol Glob Heal* [Internet]. 2022 May 1 [cited 2023 Oct 12];15:101030. Available from: <http://www.ceghonline.com/article/S2213398422000720/fulltext>
17. TNDPHPM [Internet]. [cited 2024 Mar 28]. Available from: <https://www.tndphpm.com/#/IVCZ>
18. TNDPHPM [Internet]. [cited 2024 Mar 28]. Available from: <https://www.tndphpm.com/#/Dengue>
19. Mone FH, Hossain S, Hasan MT, Tajkia G, Ahmed F. Sustainable actions needed to mitigate dengue outbreak in Bangladesh. *Lancet Infect Dis* [Internet]. 2019 Nov 1 [cited 2024 Mar 21];19(11):1166–7. Available from: <http://www.thelancet.com/article/S1473309919305419/fulltext>