MONTHLY DENGUE UPDATE

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Ministry of Health, Sri Lanka

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Contents

DENGUE VECTOR MOSQUITO BREEDING HABITATS: CHARACTERISTICS AND DISTRIBUTION

Dengue fever is one of the urban illnesses that continues to grow in prevalence year after year. The rise and emergence of the disease are ascribed to population expansion and greater individual travel, urbanization, and a scarcity of financial and human resources. *Aedes aegypti* and *Aedes albopictus* are the two mosquito species that transmit dengue. Both species are often found in close proximity to human settlements. *Aedes* species are readily discovered in natural and man-made containers that contain clear, stagnant water and it's generally considered a clean water breeder. As a result, larval source reduction targeting these man-made habitats was considered the primary strategy for reducing dengue globally.

In Sri Lanka, most vector control programs are misguided owing to the lack of understanding of *Aedes* breeding habitats. Cleaning up drains, irrigation canals, and contaminated water bodies is the focus of most community-based cleanup campaigns and interventions. However, given on scientific knowledge gathered from entomological monitoring programs in Sri Lanka and across the world, these vector control interventions must specifically target man-made and natural breeding habitats including water storage containers and tanks, discarded receptacles, temporary removal items, covering items, tires, ponds, tube wells, and other wells, concrete slabs, ornamentals, blocked roof gutters, pet feeders as well as natural breeding sites such as leaf axils, tree holes, and bamboo stumps since these are the major breeding grounds for *Aedes* in Sri Lanka (Figure 1).

Water ecology, which encompasses the physical, biological, and chemical aspects of water, as well as the geographical and temporal distribution of mosquito breeding sites and larval habitat preferences, is critical for efficient vector control techniques. The size and shape of containers, location (indoors, outdoors, under vegetation), lid status (covered/uncovered), the container's material (plastic, metal, cement/clay), the colour of the container (dark, light), water physicochemical characteristics, food availability, and co-species competition, all have a role in its immature survival and

productivity (Clements,1992). Specific physicochemical characteristics, including the temperature of the water, dissolved oxygen (DO), pH, salinity, conductivity, total dissolved solids (TDS), turbidity, and total hardness, may all be important for mosquitoes' oviposition (Jorge et al., 2019). Knowledge of the dengue vector distribution and water quality may help to understand the severity of the dengue epidemic and better control can be achieved through different strategies targeting specific life-history stages.

Oviposition substrate preference

Typically, *Aedes* mosquitoes lay eggs in dark-colored containers with smooth surfaces. *Aedes* mosquitoes prefer black, red, brown-colored substrate for oviposition over other colours, according to Panigrahi *et al*., 2014. *Aedes aegypti* and *Aedes albopictus* have been seen to thrive in clear and stagnant water rich with organic matter and microorganisms. Organic detritus in larval habitat may serve as a source of food or a micro-habitat for hiding and escaping predators. It may influence physiological characteristics of the mosquito, like body size and wing length which determine adult mosquito competence. *Aedes* mosquitoes typically avoid oviposition in the presence of interspecific rivals, but they are drawn to locations with other mosquito larvae because the presence of conspecific larvae may serve as a reliable indicator that the site provides favourable circumstances for larval development. Mostly *Aedes* females select larger containers that hold water and have a greater surface area for oviposition because larger containers may offer large, sheltered, humid resting surfaces for females preparing for oviposition. Additionally, bigger containers have a lower risk of desiccation and are more likely to hold a greater quantity of food, increasing the likelihood of larval survival (Panigrahi *et al*., 2014).

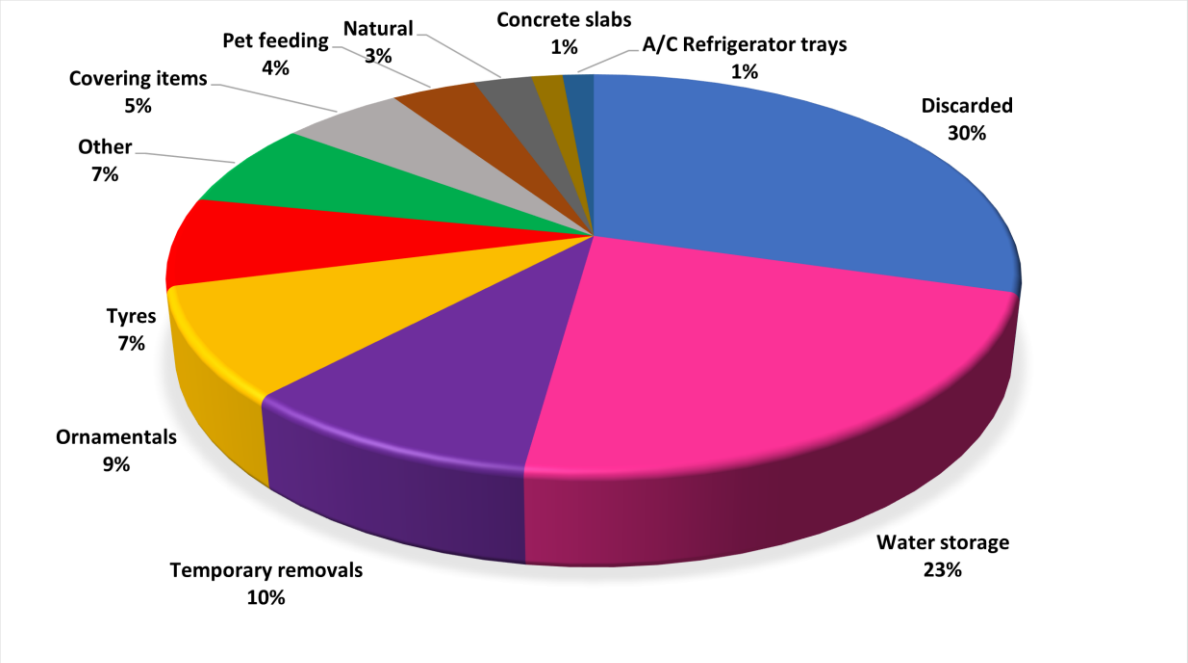

Figure 1. Distribution of Positive breeding habitats in Sri Lanka (Jan- Jun 2021)

Water quality characteristics of aquatic habitats of immature stages of *Aedes* mosquitoes

Aedes mosquitoes usually live in a wide temperature range of 18–35.9°C due to their greater environmental adaptation (Clark et al., 2004). Temperature is critical in the development of mosquito immatures because they are poikilothermic. Temperature, together with food and mineral concentrations, are the principal drivers of larval growth and development. An increase in water temperature may result in faster growth of mosquito larvae, but a reduction in adult size (Chatterjee *et al.,* 2015).

pH value is another critical determinant of the development and growth of mosquito larvae, in addition to temperature. Increasing pH, salinity, and alkalinity cause mosquito larvae to grow more rapidly and complete their life cycle within a very short time period increasing their vectorial capacity. Clark *et al*. 2004 revealed that *Aedes* mosquitos had a high level of adaptability and can breed in slightly acidic or alkaline water with a pH of 4.3–8. As a result, pH levels more than or equal to 8 or 9 and less than 4 might be used in mosquito control programs. Aquatic creatures will die if the pH of the water is too high or too low because their enzymes will denature.

Mosquito larvae are metapneustic, breathing by posterior spiracles and consuming largely ambient oxygen and in addition, they use dissolved oxygen (DO) opportunistically (Clements 1992). The dissolved oxygen level, on the other hand, also serves as an indication of the degree of pollution in the water, influencing the number, density, and habitat productivity of *Aedes* larvae. Because *Aedes* mosquitos are designed to dwell in clear water, they are normally inhabited in water with greater dissolved oxygen levels, and oxygen deficiency negatively affects larval abundance and productivity in *Aedes* breeding habitats. The quantity of oxygen dissolved in water changes depending on the presence of algae or plants and the temperature of the water. Despite the fact that algae produce oxygen via photosynthesis, increased algal abundance causes eutrophication, making it unsuitable for *Aedes* breeding.

Aedes mosquitoes, in general, breed in clean water. As a result, their larval population density declines as turbidity from organic debris and bacteria increases. *Aedes aegypti* favors clear water with low dissolved solids and turbidity, but *Aedes albopictus* prefers murky water with high organic matter dissolved solids and turbidity. So, they are highly abundant in natural breeding places such as tree holes, bamboo stums as well as gutters with higher organic matter. Since *Aedes aegypti* requires less food for oviposition than *Aedes albopictus*, it prefers to reproduce in aquatic habitats with less turbid water including water storage tanks, temporary removals, and discarded receptacles in urban settings. In addition to these physical parameters, TDS, total hardness, conductivity, fluoride, chloride, phosphate, sodium, and potassium concentrations, and dissolved oxygen content of water all play a role in mosquito breeding site selection.

References

Chatterjee, S., Chakraborty, A., & Sinha, S. K. (2015). Spatial distribution & physicochemical characterization of the breeding habitats of *Aedes aegypti* in & around Kolkata, West Bengal, India. *The Indian journal of medical research*, *142 Suppl* (Suppl 1), S79–S86

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Clark, T. M., Flis, B. J., & Remold, S. K. (2004). pH tolerances and regulatory abilities of freshwater and euryhaline Aedine mosquito larvae. The Journal of experimental biology, 20(Pt 13), 2297–2304.

Panigrahi, S., Barik, T.K., Mohanty, S., & Tripathy, N.K. (2014). Laboratory Evaluation of Oviposition Behavior of Field Collected *Aedes* Mosquitoes.

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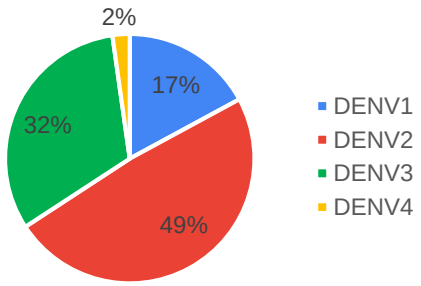
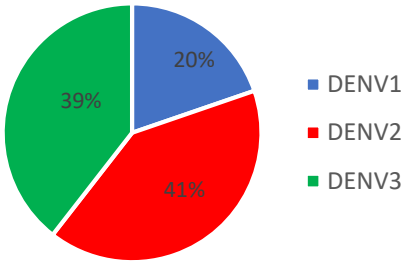
2. VIRUS SURVEILLANCE DATA

The Circulating Dengue Virus Serotypes in 2021 from major hospitals in Sri Lanka



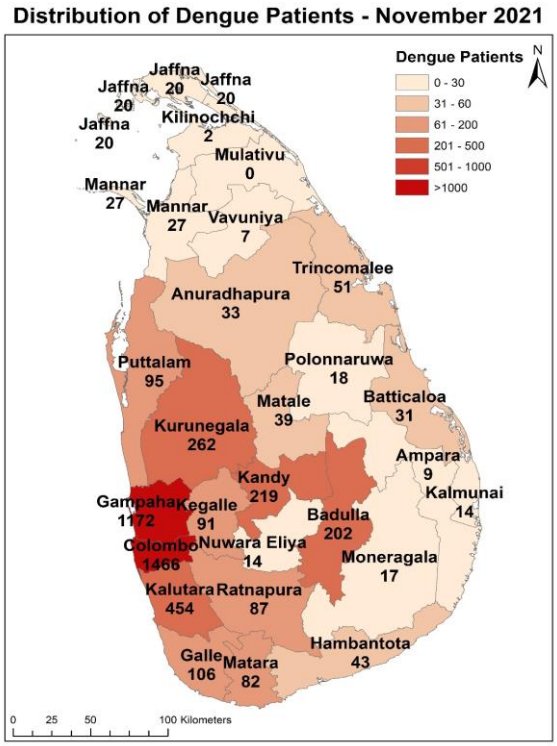
Cumulative from January to end of November 2021 (n = 269)



For the month of November (n=76)

Source: Department of Virology, MRI and Centre for Dengue Research, University of Sri Jayewardenepura

3. DISTRIBUTION OF DENGUE PATIENTS – NOVEMBER 2021



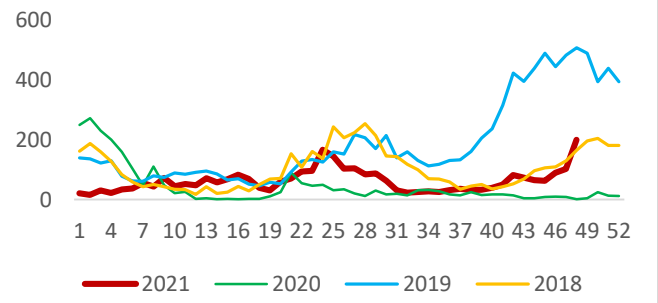
4. SUMMARY OF ENTOMOLOGICAL AND EPIDEMIOLOGICAL SURVEILLANCE DATA – November 2021

Province	District	Entomological surveillance data (Source - returns of entomology surveys received by NDCU)				Epidemiological surveillance (Source-DenSys)	
		No. of Premises				Month	
		Inspected	Positive Found	Positive %	Main type of containers positive for larvae and percentage positivity	November	Cumulative
WP	Colombo	1410	249	17.6	Discarded items (25.9%), Temporary Removed items (22.9%), Ornamental items (10.2%)	1466	8780
	Colombo MC				Data not Received by NDCU		
	Gampaha	1471	155	10.5	Discarded items (26.3%), Temporary Removed items (22 %), Ornamental items (10.8%)	1172	4513
	Kalutara	1473	209	14.2	Discarded items (30.7%), Temporary Removed items (20.5%), Tyres(12.9%)	454	2030
	NIHS	710	145	20.4	Temporary Removed items (38.7%), Discarded items (17.6%), Covering Items (13.1%)		
CP	Kandy	2602	196	7.5	Discarded items (28.8%), Temporary Removed items (17.2%) Ornamental item (15.5%)	219	1175
	Matale	700	35	5	Discarded items (41.9%), Covering Items (14%), Tyres(11.6%)	39	246
	Nuwara Eliya				Data not Received by NDCU	14	84
SP	Galle	1900	255	13.4	Discarded items (32.5%), Ornamental item (14.3%), Water storage other items (13.2%)	106	539
	Hambantota	1324	181	13.7	Discarded items (21.2%), Ornamental item (15.7%), Temporary Removed items (15.4%),	43	396
	Matara	1501	144	9.6	Discarded items (29.2%), Ornamental items (13.9%), Water storage other item (12.9%)	82	653
NP	Jaffna	551	90	16.3	Ornamental items (23.5%), Water storage other items (22.6%), Pet feeding (15.7%)	20	59
	Kilinochchi				Data not Received by NDCU	2	16
	Mannar	360	76	21.1	Discarded items (21.2%), Water storage barrels (21.7%) Water storage barrels (20%)	27	54
	Vavuniya	1479	188	12.7	Discarded items (36.7%), Ornamental items (22.1%) Water storage other items (13.5%)	7	44
	Mullativu				Data not Received by NDCU	0	1
EP	Ampara	373	75	20.1	Discarded items (30.9%), Tyres (20.7%), Water storage item (13.5%)	9	83
	Batticaloa	1223	138	11.3	Discarded items (27.1%), Other items (23.7%) Temporary Removed items (16.3%)	31	3439
	Trincomalee	1079	138	12.8	Temporary removed items (26%), Discarded items (19.5%), Water storage other items (13%)	51	204
	Kalmunai	1194	215	18	Discarded items (22%), Ornamental item (18.3%) Temporary Removed items (17.2%)	14	258
NWP	Kurunegala	2004	317	15.8	Discarded items (29.2%), Ornamental items (11.8%), Covering items (11%)	262	1416
	Puttalam	613	38	6.2	Discarded items (26.3%) Water Storage other (21%), Ponds (14%)	95	473
NCP	Anuradhapur				Data not Received by NDCU	33	331
	Polonnaruwa	765	96	12.6	Discarded items (48.8%), Temporary Removed items (15.2%) Ornamental item (11.2%)	18	97
UP	Badulla	24	3	12.5	Other items (38.2%), Discarded items (38.2%), Covering items (8.8%)	202	558
	Monaragala	1986	323	16.3	Discarded items (41.1%), Water Storage barrels (14.2%), Covering items (12%)	17	163
SGP	Rathnapura	1204	163	13.54	Discarded items (35.8%), natural items (12.8%) Water Storage barrels (8.3%),	87	754
	Kegalle	2344	249	10.62	Water Storage barrels (30%), Discarded items (23.3.8%), Ornamental item (20.8%)	91	592
Sri Lanka		**30294**	**3678**	**12.14**	**Discarded items (28.9%), Temporary Removed items (12.8%), Ornamental items (11.8%)**	**4561**	**26958**

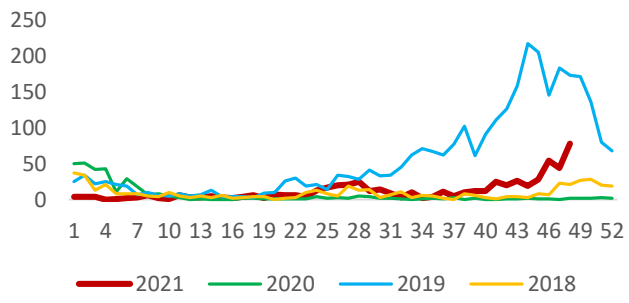
Summary of Adult Surveys				
District	**MOH**	**GN area**	**Findings**	
Colombo	Kolonnawa	Vijayapura	Outdoor findings (8.00 am-1.00 pm)	*Aedes albopictus* - 08 Female (all were unfed female)
Colombo	Dehiwala	Colombo South Teaching Hospital (Doctors', nurses', MLT quarters)	Indoor findings (8.00 am - 1.00 pm)	*Aedes aegypti* – 04 male, 02 female
Colombo	Dehiwala	Dewala Road	Indoor findings (8.00 am - 1.00 pm)	*Aedes albopictus* – 01 female
Matara	Matara MC	Sunanda Mawatha	Outdoor findings (8.00 am – 1.00 pm)	*Aedes albopictus* - 06 female (blood fed 05, unfed 01), 18 male
Kalmunai	Akkaraipattu	Kathiriya	Indoor findings (8.35 am -12.40 pm)	*Aedes aegypti* - 14 female (unfed 3, blood fed 3, semi gravid 4, gravid 4)
Kalutara	Horana	Wewala West	Outdoor finding (8.10 am -2.35 pm)	*Aedes albopictus* - female 03 (gravid 02, semi gravid 01)

Current high risk MOH AREAS - Epidemiological trends (Source: DenSys)

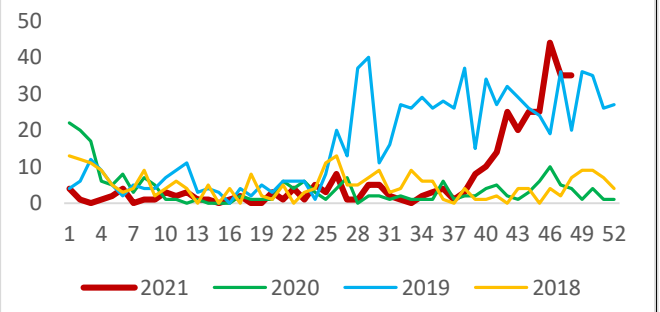
MOH MC Colombo



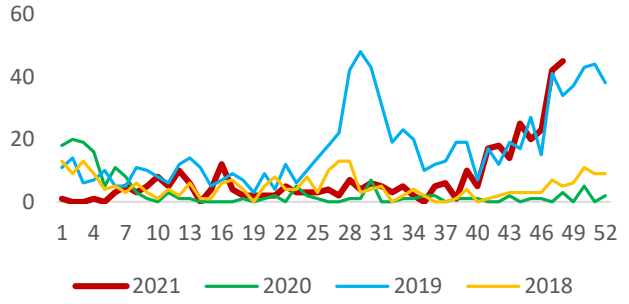
MOH MC Negombo



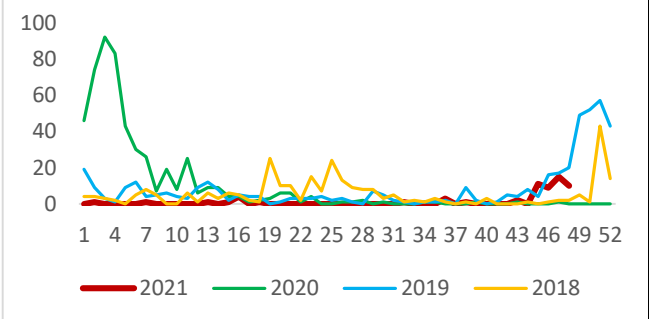
MOH Seeduwa



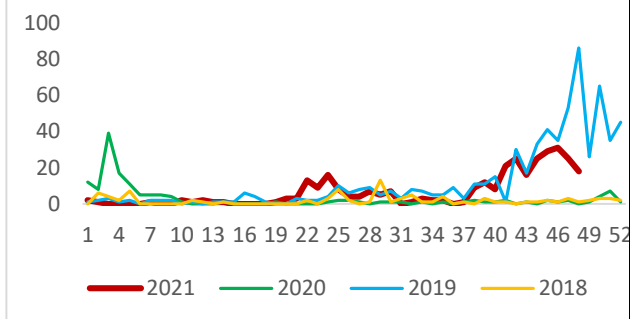
MOH Kalutara (NIHS)

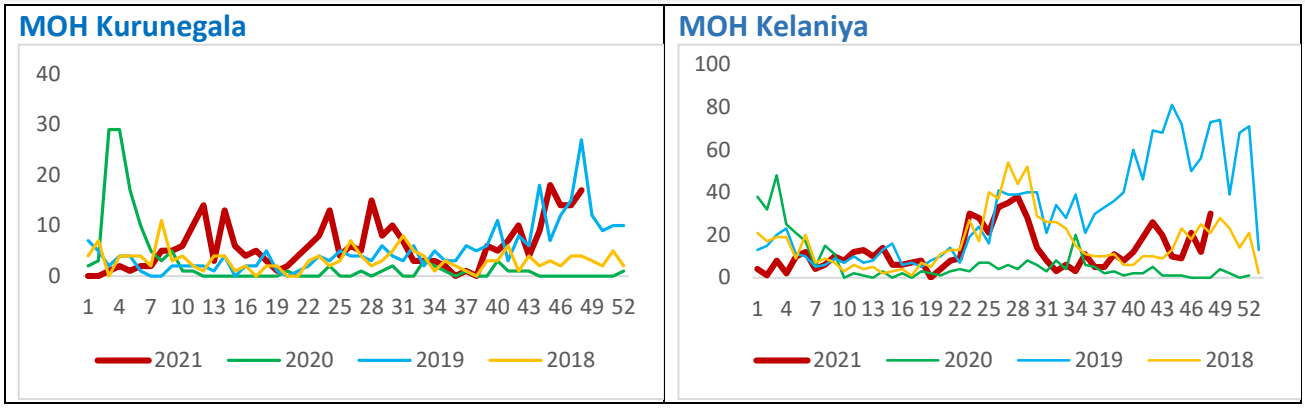


MOH Mutur



MOH Badulla



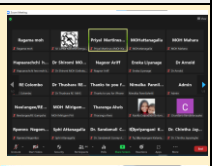
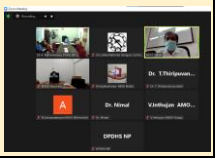


5. DENGUE FORECAST

Entomological forecast of high-risk areas		
District	**MOH Area**	**GN Division**
Colombo	Dehiwala	Nadimala
	Gothatuwa	Isuru Pedesa, Manigamulla
	Kolonnawa	Gajabapura
	Moratuwa	Moratumulla North
	Moratuwa	Lakshapathiya South
Gampaha	Gampaha	Madagama
	Negambo	Kurana
	Negambo	Periyamulla
Kalutara	Beruwela	757
	Beruwala	727D
	802-Bopitiya East	802-Bopitiya East
Kandy	Werellagama	Polwatte
Puttalama	Chillaw	Chilawwella
	Chillaw	Aluthwatta
Kurunagala	Kurunagala	Thittawella
Jaffna	Nallur	J/110 (Thalaiyadi lane)
Mannar	Mannar	Pannakadukodi
	Mannar	Thoddaweli
	Mannar	Periyakadi
Rathnapura	Embilipitiya	Moraketiya
Matara	Weligama	Kapparatota
Galle	Galle	Katugoda

Dengue vector surveys were conducted in 340 GN areas inspecting 31164 premises in November.
Here, the Entomological forecasting has been done by considering the districts currently recording a high number of Dengue cases that are also recorded high values for Entomological indices against their conventional threshold values.

6. SPECIAL ACTIVITIES AND EVENTS CONDUCTED BY THE NATIONAL DENGUE CONTROL UNIT

Technical Support Group Meeting (Hybrid) - 02.11.2021	Preparatory meeting for Mosquito Control Week - 03.11.2021	Outbreak prepairedness meeting with disrict teams – 04 & 05.11.2021
 	  	   

Knowledge Sharing Sessions – 19.11.2021	Debriefing of Mosquito Control Week – 23.11.2021
Speakers - **Prof. Indika Karunathilaka**, Professor in Medical Education, Department of Medical Education, Faculty of Medicine, Colombo **Dr. Inoka Suraweera,** Consultant Community Physician, Environment and Occupation Health Unit, Ministry of Health, Colombo **Dr. Chandana Siriwardana**, Senior Lecturer, Department of Civil Engineering, University of Moratuwa   	 

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Any comments, suggestions, and contributions for the MDU Sri Lanka are welcome.

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