



International Journal of Health Systems Resilience

INJHSR
International Journal of
Health Systems Resilience

Original Research

ISSN 2950-7405



Way forward for Curative Care Management of Covid-19 patients in the 3rd wave in Sri Lanka

Fernando GHS¹, Gunasena BAHM², Yapa Bandara AS³, Dharmagunawardene D⁴, Lal Panapitiya⁵

1 Senior Registrar in Medical Administration, DDG (MS), Ministry of Health, 2 Senior Registrar in Medical Administration, DDG (MS), Ministry of Health, 3 Registrar in Medical Administration, DDG (MS)1, Ministry of Health, 4 Director medical services, 5 DDG medical services.

Correspondence: ghsfernando@gmail.com



<https://orcid.org/0000-0001-7356-6257>

Submitted: 07/07/2022

<https://doi.org/10.51595/INJHSR22/006>

Published: 01/10/2022

Abstract

Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) was first reported in Wuhan City, China in December 2019, and was named so by the International Committee for Taxonomy of Viruses. The first case in Sri Lanka was Chinese national detected on 27th January 2020 and first case from a local citizen was detected on 11th March 2021. Sri Lanka has since faced three waves of COVID 19 outbreaks. At the moment, 3396, 92341, 390185 cases were reported in three waves respectively. All positive symptomatic patients had to be treated under the care of trained health care professionals in COVID management centers; around 3000 oxygen dependent patient including 170 in ICUs and 800 in HDUs were managed within government hospitals daily. Asymptomatic and mild asymptomatic patient were treated at ICCs and the rest of eligible patients were quarantined at their residence under the observation of a medical team. As such, this study seeks to increase the treatment capacity of the Sri Lankan health system and methods to face the increasing demand to serve COVID 19 patients.

Key words: COVID 19, Covid Management, Ministry of Health, Sri Lanka

1. Introduction

Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) (henceforth referred to as Covid 19) was first reported in Wuhan City, China in December 2019 (1), and was named so by the International Committee for Taxonomy of Viruses (2). It was declared as a pandemic by the World Health Organization on March 11th, 2020, due to the speed and scale of the transmission of the disease (3). Globally, as of 16 July 2021, there had been 188,655,968 confirmed cases of COVID-19, including 4,067,517 deaths reported to World Health Organization (WHO) (4). The first case in Sri Lanka was a Chinese national detected on 27th January 2020 and first case from a local citizen was detected on 11th March 2021 (5). Sri Lanka has taken stronger measures to mitigate the spread of disease from the very beginning of the pandemic, through the actions of the Ministry of Health Sri Lanka and the support of security forces (5). However due to high infectivity, the disease spread all over the country requiring more curative and preventive measures.

The period between 27/01/2020 to 03/10/ 2020 was considered as the first wave of COVID 19. During this period, 3396 COVID 19 cases were reported (6) with only 13 deaths. The case fatality was 0.38 in this first Wave. All the patients were able to be managed within 11 government hospitals. They were National Institute of Infectious Diseases (IDH), Homagama Base Hospital (BH), Mulleriyawa (BH), Hambantota District General Hospital, BH Walikanda, BH Kathankudy, BH Minuwangoda, TH Anuradhapura, DGH Matara, BH Theldeniya and Iranawila Special COVID Hospital.

Second wave started on 04/10/2020, as the number of COVID 19 positive patients were increased gradually within a short period, thereby requiring more resources to manage the caseload. At the end of the second wave (14/04/2021) total number of COVID 19 positive cases were increased up to 92341 (6) with 591 deaths. In order to cater all positive patients, MOH decided to increase patient management centers with the help of PDHSs & RDHSs, converting more Divisional Hospitals and few Base Hospitals, and as well as non-medical institutions such as training centers. The Sri Lankan Army supported the said endeavor by providing some prepared Training Centers, which were already

functioning as Quarantine Centers. Those treatment centers were classified into 3 categories. The first category named as Intermediate Care Centers (ICC – Level I), wherein asymptomatic patients are managed. Non-medical institutions were most of which that were converted as these ICCs and the health staff of the nearby government hospitals served in those centers. An On-call consultant from the respective hospital allocated to each ICC. Furthermore, Hotels affiliated and managed by Private Hospitals were developed as more such ICCs.

The Second category Level II was established in Divisional Hospitals and in some Base Hospitals, which were served by health staff including consultants. Mild to moderate symptomatic patients and those with other co-morbidities were managed in these hospitals.

Third category – Level III hospitals with in-house consultants, were serving to symptomatic patients and those with other complications such as Surgical, Pediatric, Obstetric, Dialysis etc. Intensive Care Units (ICU) and High Dependency Units (HDU) dedicated for COVID patients were established in 15 hospitals such as IDH, Homagama Base Hospital and Mulleriyawa Base Hospital, TH Anuradhapura. BH Welikanda, DGH Hambantota, BH Kathankudy and BH Theldeniya etc. At the end of 2nd wave, there were 10 Level III hospitals with 1850 beds, 37 Level II hospitals with 2750 beds, 42 Intermediate Care Centers (ICC) with 10764 beds and 13 private hotels with 1677 beds (altogether nearly 16,000) to manage COVID 19 positive patients efficiently. All the patients were managed in treatment centers under supervision of medical staff and most of them were asymptomatic.

The 3rd wave started on 15/04/2021, wherein the transmission rate and contagion of the new virus strain was very high in comparison to the 2nd wave. As such, caseloads were rapidly increased presenting more than 2500 per day with more symptomatic patients. Percentage of the oxygen dependent patient were increased considerably and needed more Intensive care Unit (ICU) / High dependency Unit (HDU) facilities (7).

As such, several strategies were adapted by the Ministry of Health to face the 3rd Wave, as listed below.

1. Movement restrictions

2. Conversion of more government hospitals as COVID management centers
3. Preparation of all the government hospitals to manage COVID 19 positive patients.
4. Development of more Intermediate Care Centers to treat asymptomatic patients.
5. Provision of systematic on-line training programs for health staff
6. Empowerment of community on Health Education through media.

1.1 Outcomes of collective effort to face 3rd Wave.

Table 1. Establishment of different categories of COVID 19 Management centers

Level	Type	Explanation
Level 1	Intermediate care centers (ICC)	These are non-hospital places such as training centers, which were converted as COVID 19 management centers. The centers were affiliated to nearby government Hospitals. Health staff from that Hospital were attached to these centers on roster basis. Private Hotels were given the permission to run as ICCs by the recommendation of the regional health authorities. Asymptomatic COVID 19 positive patients were managed in such centers, wherein medical officers were the in-charge as no consultants were allocated. If patients developed symptoms, they were immediately transferred to the level 2 or 3 centers.
Level 2	Treatment centers	Existing primary and secondary care Government Hospitals were fully converted as COVID 19 management centers. Mild to moderate symptomatic patients were managed in these centers, as there were medical consultants to manage on a permanent or temporary basis. Facilities were improved in these centers to give oxygen to needed patients. Furthermore, the patients were transferred to level 3 COVID management centers if necessary.
Level 3	Treatment centers with HDU/ICU	A few secondary and tertiary care hospitals were converted as the level 3 COVID 19 management centers wherein severely ill patients were managed. Patients who needed HDU and ICU care were especially managed in these centers.

2. Objective

The objective of this project is to increase the treatment capacity and methods to face prevailing demand on COVID 19 patients.

3. Methodology

In order to face the situation, the Ministry of Health Sri Lanka upgraded existing Hospitals as level two and three COVID management centers, and non-health training centers and private hotels as level 1 (Intermediate care centers (ICC)) COVID management centers.

4. Result

96 (22912 beds) level I (ICC), 74 (6033 beds) level II and 9 (1550 beds) level III centers were developed by the Ministry of Health Sri Lanka (Henceforth referred to as MOH). In order to manage oxygen dependent COVID positive patient by 09/09/2021, 204 ICU beds and 1033 HDU had been allocated in all government Hospitals.

Table 2: Number of COVID Management Centers according to the levels (8)

Level	2 nd Wave		3 rd Wave	
	Number of centers	Numbers of Beds	Number of centers	Numbers of Beds
Level 1	42	10764	96	22912
Level 2	37	2750	74	6033
Level 3	9	1550	9	1550
Private Hotels	13	1677	60	7162
Total	101	16741	239	37437

Table 3: COVID 19 Management Centers management by the Ministry of Health as of 15/07/2021

Province	District	Name of Functioning Care Centre	No of functioning Beds	Levels
Central	Kandy	BH Teldeniya (M+F)	126	3
		Kundasale Mahameunawa	850	1
		DH Katugastota	52	2
		Pallakale ICT (M)	20	1
		Panideniya (F) ICC Kandy	350	1
		Polgolla ITC (M)	350	1
		DH Waththegama	32	2
		DH Kadugannawa	60	2
		DH Pussellawa	60	2
		Gampola Youth centre ICC	100	1
		DH Akurana	60	2
		Kuruduwattha summer set	500	1
	Matale	DH.Pallegama	40	2
		BH Laggala Pallegama (M)	135	1
		Technical college Matale	260	1
		Hotel School Innamaluwa	100	1
		DH Ambana	100	2
		Technical college Dambulla	200	1
	Nuwaraeliya	DH Haguranketa	40	1

		Town hall Nuwaraeliya	500	1
		DH Walapane	120	1
		Kothmale cultural center	275	1
		Kandeala ICC	150	1
		Bagawantalawa	150	1
		Nawalapitiya	45	2
		Kotmale Tondaman Cultural center	275	1
Eastern	Ampara	DGH Ampara Rehabilitation	250	1
		DH Damana	60	2
		DH Padiyatalawa (M)	70	2
		Hardy University Ampara	400	1
		Dehiattakandiya ICC	100	1
	Ampara (Kalmunei)	DH Palamunei (M)	83	1
		BH.Akkrapatthu	100	2
		DH. Akkrapatthu	80	1
		DH. Marathamunei	108	1
		Aeddalachenai	40	1
	Batticaloa	BH Kattankudi (F)	120	3
		Kinya Ayurveda Hospital	40	1
		DH Karadiyanaru (M)	120	1
		DH Periya Kallar	140	1
		DH Vakara	60	2
		DH Navakadu	80	2
	Trincomalee	DH Eachchalampaththu	76	2
		Kappalturei Ayurvedic Hospital	50	1
		Nilaweli	120	1
		DH Kuchchiweli TC	80	2
		DH.Gomarankadwala	78	2
		BH. Kanthale TC	120	2
		DGH Trincomalee TC	50	2
		Nilaveli Samurdi Center	117	1
		Kapaltureic Aurvedic Hospital	50	1
		Kanthale Suger Factory	120	1
		Nadatiu Kinya Pradeshiya Saba Center	41	1

North Central	Anuradhapura	BH Kabathigollawa	60	2
		Galkiriyagama	90	1
		DH Nochchiyagama (F)	45	2
		Galenbidunuwawa (ITC)M	60	1
		Methsirisewana	25	3
		DH Tammannawa	40	2
		Wahamalgollwa ICC	130	1
	Polonnaruwa	BH Hingurakgoda TC	200	2
		BH Welikanda TC	121	2
		Gallalla-Pulathisipura NCE(F)	500	1
		Kandakadu ICC(M)	555	1
		Punani Brandex ICC(M)	250	1
		Punani Campus ICC (M)	900	1
North Western	Kurunegala	Dambadeniya TC(M)	500	1
		DH.Alauwa	40	2
		DH Abanpola (M)	50	2
		DH Mawatagama	88	2
		DH Narammala (F)	60	2
		Giriulla TC (F)	400	1
		Kurunagala Ayurvedic Hospital	150	1
		Narammala Ayurveda center	60	1
		DH.Bingiriya TC	800	1
	Puttalam	BH Iranawila (M+F)	110	2
		DH Dankotuwa (M)	78	2
		BH.Marawila	8	2
		Madurakkuliya ICC	767	1
	Jaffna	Kopai TC(M) Jaffna	420	1
		Nawakkuli	200	1
		Periyapachchpalai	350	1
		Wachchukotte	215	1
	Kilinochchi	Krishnapuram TC (M+F)	160	2
		Bharathipuram ICC	230	1
		Murikandy ICC	375	1

Northern		Maruthankerny ICC preciners	300	1
	Mullativu			1
	Vauniya	Economic Center	200	1
		Vaunia Ayurvedic Hospital. Pampemaduwa	100	1
	Mannar	Turkey city	200	1
Sabaragamuwa	Kegalle	BH Warakapola (M+F)	202	2
		DH Beligala	69	2
		DH Kitulgala	64	2
		DH Rabukkana (M)	80	2
		DH Udugoda (M+F)	120	2
		Rabukkana TC (M)	313	1
		Abepussa Prisons	100	1
	Rathnapura	BH Embilipitiya YC (M+F)	200	1
		Sabaragamuwa University Hostels	600	1
		Chinchigune ICC	120	1
		Kalawana CEB	80	1
		BH Kahawatta TTC (F)	320	1
		DH Rakwana	50	2
		BH.Kolonna	50	2
		DH Batapola	50	2
	Galle			
		Boosasa Navy camp	200	1
		DH Arachchikanda (F)	244	1
		DH.Karandeniya TC (F) Galle	128	1
		Maliban ICC	50	1
		ITS Akmeemana ICC	300	1
		DH Habaraduwa	80	2
		DH. Bentota	50	2
		DH Polwatta	101	1
	Hambanthota	Angunakolapalassa ITC(F)	220	1
		DH. Ambalantota	80	2
		DGH Hambantota(M)	280	3
		Beliattha Ayurvedic Hospital	100	1

Southern Province		DH.Middeniya	100	1
	Matara	DGH Matara Kaburugamuwa (F)	234	2
		DH Weligama	160	2
		DH Akuressa	125	2
		DH Mawarala	35	2
		DH Dikwella	50	2
		DH.Gangodagama	48	2
		DH Morawaka	40	2
		DH Urubokka	20	2
		DH Deiyandara	20	2
		PMCU pallegama	40	1
Uva	Badulla	Bindunuwawa ICC	206	1
		CTB Badulla	280	1
		DH Bandarawela	62	2
		Kahagolla TC (M)	238	1
	Monaragala	DH Madagama	108	1
		Wallawaa Youth center	100	1
	Colombo	DH,Buttala	100	2
		BH Homagama (F)	234	3
		BH Mulleriyawa (F)	131	3
		Rathmalana Technical college	200	1
		NIMH Psychiatry	25	3
		DH Kosgama (M)	60	2
		ICC	50	
		DH Lunawa (F)	104	2
		DH Nawagamuwa	91	2
		DH Watara	60	2
		IDH (M+F)	189	3
		NFTH (F)	520	2
		Rajagiriya Aurvedic ITC (M+F)	325	1
		Moragasmulla	250	1
		DH. Maligawatta	10	2
		DH.Piliyandala	50	2
		BH Panagoda SL Army	100	1
		Bandaranayaka Memorial Ayurvedic Hospital	100	1

	Gampaha	TH. Ragama	190	2
		Yakkala warallawatta	600	1
		Seduwa Brandrix	1200	1
		BH.Gampaha	138	2
		Dompe Ulawitiwala	230	1
		BH Minuwangoda (F)	104	2
		DH Divlapitiya (M)	99	2
		DH Dompe (M)	42	2
		DH Radawana (M)	52	2
		NHRD Welisara (F)	70	2
		Watupitiwala TC (F)	141	1
		Yakkala TC (Gampaha)	126	1
		Kadana DH	80	1
		BH Katunayaka Air Force	50	1
		BH Pimbura (M+F)	60	2
	Kalutara	DH Bandaragama (M)	38	2
		DH Ingiriya (M)	63	2
		DH Itthapana (M)	35	2
		DH Matugama (M)	65	2
		Dharga Town ICC	166	1
		DH Haltota	50	2
		Gorakana	150	1
		Beruwala Jamiah Naleemia ICC	270	1
		Sripali Horana ITC	300	1
		Naleemia school ICC	250	1
		Police Training School Kalutara	100	1
		Pasdun Rata TC (F)	350	1
Private Hotels		Hotels (60)	7162	1
Total			37437	

5. Discussion

In order to treat the increase numbers of COVID 19 positive cases, Director General of Health Services (DGHS) instructed all the head of the institutions, to establish a “COVID Coordinating Cell” in each Hospital (9). The implementation and the preparation of COVID Management Centers were coordinated by the Deputy Director General

Medical Services 1 (DDG(MS)1, Dr. Lal Pannipitiya. During the 2nd Wave, COVID 19 Management Centers were developed and coordinated largely by the central Ministry of Health. However, due to the high caseload during the 3rd Wave, all Provincial Director of Health Services (PDHS) & Regional Health Services (RDHS) were advised by the Ministry of Health to open up new level 1 and 2 COVID Management

Centers to accommodate positive patients in the provincial level (10). The tri-forces in Sri Lanka volunteered to develop many places as ICCs, based on the decision taken at COVID Task Force and as well as movements in the political structure.

As per the leadership of Hon Health Minister, guidance from the Secretary of Health and the direction of the DGHS and Additional Secretaries and the technical committee, it was very helpful to perform duties of DDG MS 1 as the coordinator of all the curative sector operational level strategies. All the DDGs and Directors and other relevant officials were given a strong support to implement preventive and curative measures to face the 3rd Wave. Meanwhile the political authority and higher authorities with the support of COVID Task Force co-chaired by DGHS and Army Commander General Shavendra Silva were able to get the approval and guidance from HE. President Gotabhaya Rajapaksha for COVID patient management modalities such as “Integrated Home-Based Care until patients are mobilized to Treatment Centers” and also for “Active monitoring of such patients through a Call Centre”

As the main coordinator of COVID Management Centers, DDG MS I with his team was doing remarkable endeavor in managing Treatment Centers and mobilizing patients. Contribution of all DDGs, Directors and their teams in Medical Supplies Division, Laboratory Services, Non-Communicable Diseases Unit and Public Health Services have become very much important in managing such centers. Supervision of DDG MS II, Directorate of Medical Services and Nursing Medical Services Divisions in mobilizing of staff is to be highly appreciated, including the coordination and guidance by the Additional Secretary (Medical Services).

All Provincial and Regional Directors of Health Services have speeded up the process of development of new COVID 19 management centers. Up to 19/07/2021, 189195 cases were reported in the 3rd wave with more than 3000 number of cases are presenting per day in peak period (11). During the 3rd wave, COVID Management Centers were increased by 37 Treatment Centers, 54 Intermediate Care C and 47 private hospitals compared to the 2nd wave (Table 2). There were 239 COVID 19 Management Centers coordinated by the Ministry of Health. The total bed

capacity was increased up to 37437 in 3rd wave. In addition to the above treatment centers, all the other hospitals had allocated nearly 6055 patients' beds, 181 ICU beds and 630 HDU beds to manage COVID 19 positive patients (12). Furthermore, new 28 ICCs (8584 beds), 18 treatment centers (1254 beds) were added to manage COVID patients.

Meanwhile, Hon. State Minister of Indigenous Medicine Promotion has agreed to convert all Ayurveda hospitals in the country as COVID Treatment Centers. This will add another 50 COVID Management Ayurveda Centers with more than 3500 beds at the end of August 2021. At present, with the strong support of the HE the President and the government, the entire health care team led by the Hon Minister of Health with assistance of two State Ministers as well as the Secretary of Health and the DGHS and military forces led by COVID Task Force, donors and other non-governmental organizations, Sri Lankan health system is successfully managing the COVID 19 patient care services.

Because of the interprovincial movement restrictions, the daily case load was gradually reducing from 3000 cases per day between 1000 to 1500 per day. According to the Ministry of Health, 25 to 30 cases of new Delta variant was detected in Western Province in Sri Lanka (13). Based on the global data submitted to GISAID, the estimated effective reproductive number for the Delta variant is 55% (95% CI 43-68%), which is noted to be higher than the Alpha variant (14,15,16).

Therefore, Delta variant was the dominant variant present by the end of the August (17) and hospital admissions was increased compared to the Alpha variant (18). As such, the demand for hospital beds were increased by exceeding the available capacity. There was a risk of a 4th wave attack due the presence of new Delta variant (19). If the delta variants are 60% more virulent than the current variants, more than 5000 positive patients were expected to be reported. Since a positive patient was kept for 10 days in the treatment centers, bed capacity needed to be increased up to 50,000 for additional COVID patients. As such, 181 ICU beds and 630 HDU beds had been allocated for COVID positive patient in Government Hospitals (20). However, 113 (62.4%) ICU beds and 376 (59.6%) HDU beds were occupied by the COVID positive patients as per 03/07/2021. With the presence of

delta variant, the requirement of ICU beds and HDU beds was estimated to be increased by 60%. According to the present ICU and HDU capacity, ICU and HDU beds capacity must be increased up to 280 and 1000 respectively as proactive response.

However, Ministry of Health has instructed all the heads of health care institutions to increase their bed capacity including ICU beds and HDU beds, in parallel to the continuation of health education programs, systematic staff training programs, community empowerment programs, strategies of movement restrictions, vaccination programs and regional lockdowns of highly suspected areas as preventive measures.

6. Conclusion and Recommendations

Threat of COVID 19 continued in Sri Lanka, paroral to other countries in the world. The Ministry of Health managed the situation in both preventive and curative aspects, thereby treating COVID 19 positive patient presented in 3rd wave. There was a risk of having a 4th wave due to Delta variant and the increased number of COVID positive patients, with a necessity to increase the number of beds in COVID-19 Management Centers, ICUs and HDUs and the escalation of “Integrated Home-Based Care” for asymptomatic patients. Moreover, it was recommended to continue the health education programs and community empowerment programs, staff training programs, movement restriction strategies with increase coverage of vaccination combined with strategies to increase bed capacity including ICU and HDU as mentioned above, to control the threat of COVID 19 escalation

References

1. N. Zhu, D. Zhang, W. Wang, X. Li, B. Yang, J. Song, X. Zhao, B. Huang, W. Shi, R. Lu, P. Niu, F. Zhan, X. Ma, D. Wang, W. Xu, G. Wu, G.F. Gao, W. Tan(2019) China Novel Coronavirus Investigating and Research Team A novel coronavirus from patients with pneumonia in China, 2019 N. Engl. J. Med., 382 (8) (2020), pp. 727-733, 10.1056/NEJMoa2001017 CrossRefView Record in Scopus Google Scholar
2. World Health Organization (2019). Naming the Coronavirus Disease (COVID-19) and the Virus That Causes It (2020). Retrieved on 15/07/2021.Available at <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance>. Google Scholar.
3. World Health Organization (2020). WHO Director-General's opening remarks at the mission briefing on COVID-19.Retrieved on 16/07/2021. Available at: <https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-mission-briefing-on-covid-19>. (accessed May 16, 2020). Google Scholar.
4. WHO. (2021). WHO COVID 19 Dashboard.Retrieved on 17/06/2021 Available at: <https://covid19.who.int/>.
5. Wickramarachchi W.P.T.M, Perera I.S.S.N, Jayasinghe S (2020). COVID-19 Epidemic in Sri Lanka: A Mathematical and Computational Modelling Approach to Control. Open access. Retrieved on 16/07/2021.Available at: <https://www.hindawi.com/journals/cm/2020/4045064/>.Volume 2020 |Article ID 4045064 | <https://doi.org/10.1155/2020/4045064>.
6. Epidemiology Unit Ministry of Health (2021) COVID-19 Epidemiology Sri Lanka. Retrieved on 05/06/2021. Available at: https://www.epid.gov.lk/web/images/pdf/Circulars/Corona_virus/esummary.pdf.
7. Asia and the Pacific COVID 19(2021). Sri Lanka struggles to respond effectively to Covid-19 third wave. Retrieved on 19/07/2021. Available at: <https://www.amnesty.org/en/documents>

- /asa37/4262/2021/en/. Index number: ASA 37/4262/2021
8. Ministry of Health (2021). Updated COVID 19 Management centers. Daily report to COVID management meeting held at ministry Auditorium on 15.07.2021.
 9. Ministry of Health (2021) Arrangement of the COVID 19 patient care management within the Health care Institutions. DGHS/COVID 19347/2021. Issued on 29/04/2021.
 10. Ministry of Health (2021). Zoon meeting conducted by the DGHS with the provincial health leaders on
 11. Epidemiology Unit (2021). COVID 19 National epidemiology report. Retrieved on 19/07/2021. Available at: <https://www.epid.gov.lk/web/>.
 12. Ministry of Health (2021). HIUS update. DDG MS 1. Presented to COVID 19 management committee meeting held at Ministry of Health on 19/07/2021.
 13. World News. (2021). Delta Variant of Covid-19 Spreading Fast in Sri Lanka. Retrieved on 20/07/2021. Available at: <https://www.news18.com/news/world/delta-variant-of-covid-19-spreading-fast-in-sri-lanka-3980435.html>.
 14. WHO (2021). COVID-19 Weekly Epidemiological Update. Retrieved on 20/07/2021. Available at: https://reliefweb.int/sites/reliefweb.int/files/resources/20210706_Weekly_Epi_Update_47.pdf.
 15. Cherian S, Potdar V, Jadhav S, et al (2021). Convergent evolution of SARS-CoV-2 spike mutations, L452R, E484Q and P681R, in the second wave of COVID-19 in Maharashtra, India. BioRxiv. Published online January 1, 2021:2021.04.22.440932. doi:10.1101/2021.04.22.44093216.
 16. Public Health England (2021). SARS-CoV-2 Variants of Concern and Variants under Investigation in England Technical Briefing 16.; 2021. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/994839/Variants_of_Concern_VOC_Technical_Briefing_16.pdf.
 17. Campbell F, Archer B, Laurenson-Schafer H, et al (2021). Increased transmissibility and global spread of SARS-CoV-2 variants of concern as at June 2021. Eurosurveillance. 2021;26(24):2100509. <https://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2021.26.24.2100509>.
 18. Public Health England (2021). SARS-CoV-2 Variants of Concern and Variants under Investigation in England Technical Briefing 14.; 2021. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/991343/Variants_of_Concern_VOC_Technical_Briefing_14.pdf.
 19. Sri Lanka Medical Association (2021). Press conference conducted by the Sri Lanka Medical Association conducted at on 20/07/2021,
 20. Ministry of Health (2021). HIUS updated (MS) 1. Daily report presented to COVID management meeting on 18/07/2021.