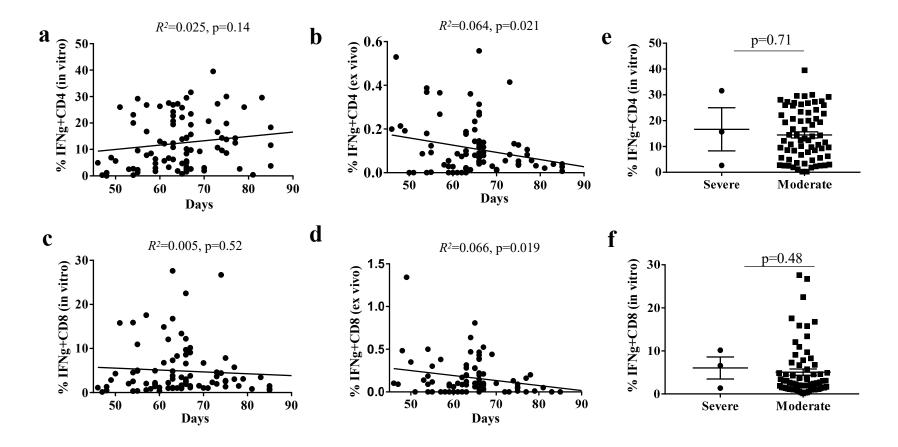
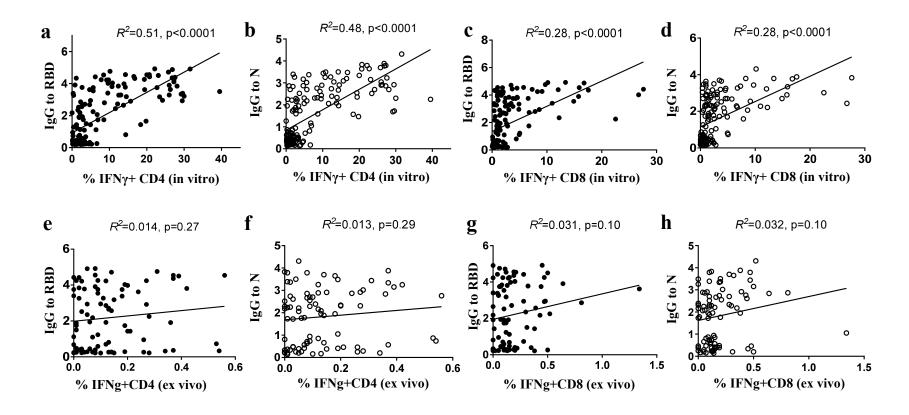


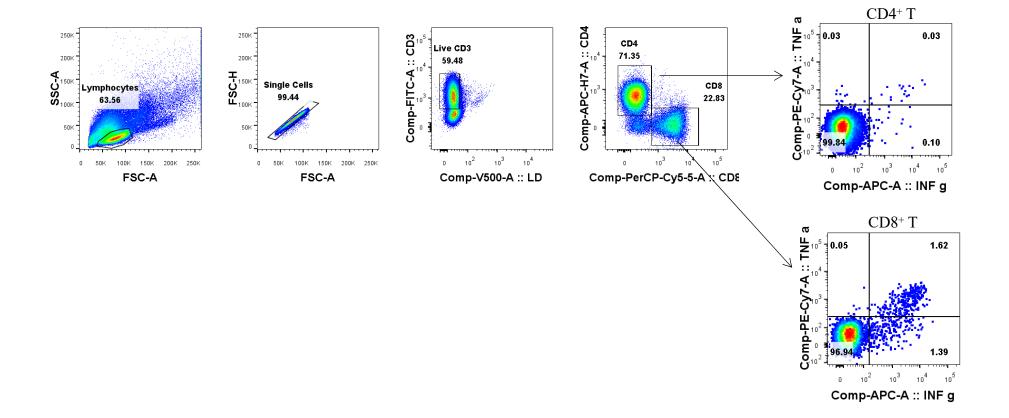
Supplementary Figure 1: Dual expression of IFN γ and TNF in SARS-CoV-2 peptide stimulated T cells in recovered COVID-19 patients, close contacts and unexposed healthy donors. Graphs show the frequency of IFN γ and TNF dual expressing cells in CD4+(a) and CD8+(c) T cells in PBMCs from 10-day culture after stimulation (n=90 for COVID-19, n=69 for close contacts and n=63 for healthy donors), and in CD4+(b) and CD8+(d) T cells in PBMCs stimulated overnight (n=89 for COVID-19, n=69 for close contacts and n=30 for healthy donors). Data are presented as mean frequencies of IFN γ +CD4+/CD8+ T cells +/- SEM. Student's t test was performed with two-sided p value as indicated.



Supplementary Figure 2: No change in IFN γ producing CD4+ or CD8+ T cells over time. PBMCs were stimulated overnight or expanded for 10 days with SARS-CoV-2 peptides and immuno-stained. IFN γ expressing cells were analyzed with FACS. Correlations of in vitro expansion (a, c) (n=90) and overnight stimulation (b, d) (n=89) of the IFN γ + CD4+ (a, b) and CD8+ (c, d) T cells with the days upon disease onset. (e, f) Comparison of in vitro CD4+ (e) and CD8+ (f) T cell expansion between patients after recovery from severe (n=3) or moderate disease (n=69). Statistical analysis was carried out with the linear regression method, with p values as indicated for a-d. Student's t test was performed with two-sided p values as indicated for e and f. Data are presented as mean frequencies of IFN γ +CD4+/CD8+ T cells +/- SEM.



Supplementary Figure 3: Correlations between the T cell immunity and antibody responses against SARS-CoV-2. PBMCs were stimulated for overnight or expanded for 10 days after stimulation with SARS-CoV-2 peptides and immunostained as described in Figure 1 and the Methods section. Antibodies presence in the blood plasma were determined with ELISA. Top panel: Frequencies of IFNγ expressing CD4+ (a, b) and CD8+ (c, d) T cells are plotted against the antibody titers specific to SARS-CoV-2 RBD (a and c, closed circle) and N protein (c and d, open circle) after 10-day expansion (n=159). Bottom panel: Frequencies of IFNγ expressing CD4+ (e, f) and CD8+ (g, h) T cells are plotted against the antibody titers specific to SARS-CoV-2 RBD (e and g, closed circle) and N protein (f and h, open circle) after overnight stimulation (n=89). Statistical analysis was carried out with linear regression method, with two-sided p values as indicated. Data were pooled from multiple experiments.



Supplementary Figure 4: Gating strategy for our flow cytometry experiments. PBMCs were stimulated for overnight or expanded for 10 days after stimulation with SARS-CoV-2 peptides and then were immuno-stained for surface and intracellular. Live CD3 were gated from singlets derived from lymphocytes, based on live CD3, CD4 and CD8 were further gated on IFNγ and TNF. The gating strategy was applied to generation of data at Figure 1-3 and supplementary Figure 1-3.

Supplementary Table 1. Demographics and antibody titer of all subjects.

Subject No.	Symptoms	Age	Gender	days from disease onse	IgG (N+S)	IgG (N)	IgG (S RBD)	IgM (N+S)	nAb unit
co-015	A	59	F	48	41.6	1.3	2.2	4.0	309
co-038	A	16	M	66	152.2	2.1	2.9	1.0	161
co-051	A	13	F	57	97.6	2.2	2.4	3.5	287
co-086	A	32	M	67	91.7	2.9	3.9	25.9	655
co-089	A	71	F	49	21.9	1.1	1.7	0.9	136
co-090	A	56	F	67	131.3	2.9	3.6	3.3	1984
co-092	A	13	M	48	95.4	1.8	2.2	1.1	191
co-096	A	64	F	55	144.3	2.7	3.5	4.0	1038
co-097	A	66	M	55	27.3	0.7	1.2	0.7	236
co-102	A	51	F	66	77.7	2.1	2.7	5.5	289
co-107	A	31	F	83	5.0	0.5	0.4	0.5	
co-108	A	52	M	83	16.5	0.8	1.1	0.6	
co-109	A	52	F	83	30.5	1.7	2.5	6.1	
co-110	A	55	F	74	84.1	2.7	4.3	3.4	
co-137	A	16	F	85	72.3	1.7	1.5	5.9	
co-144	A	36	F	78	107.8	2.0	2.5	4.1	
co-155	A	11	F	77	101.5	2.3	3.3	11.0	
co-159	A	39	F	64	6.3	0.4	1.1	1.1	
00-137	А	Mean	%M	Mean	Mean	Mean	Mean	Mean	Mean
		41	28	67	72.5	1.8	2.4	4.6	569
co-001	M	39	F	64	118.9	2.8	1.9	7.9	190
co-002	M	53	M	66	71.2	3.0	2.3	6.7	1161
co-003	M	50	F	66	103.9	2.9	2.9	7.0	1209
co-005	M	60	M	63	107.8	3.8	4.9	4.5	294
co-006	M	52	M	63	145.8	3.4	4.4	3.3	726
co-007	M	52	F	65	102.6	2.3	4.0	1.0	1739
co-008	M	45	M	63	114.1	2.4	3.6	5.7	1045
co-008	M	40	M	60	114.1	3.0	3.3	6.5	635
co-011	M	33	F	62	143.8	3.2	4.4	6.6	862
co-011	M	62	F	57	139.9	3.9	4.4	29.7	839
co-012	M	36	F	55	77.4	1.7	3.3	3.3	340
co-013	M	36	M	54	65.5	1.6	2.6	1.1	697
co-014		52	F	54			4.5	26.9	935
	M	62	r F	54 54	116.0 96.7	3.2		4.6	
co-018	M					3.3	4.5		1175
co-022	M	65 53	F	51	100.6	2.9	3.9	5.6	1014
co-023	M	53	F	57	131.6	3.5	4.3	50.2	925
co-024	M	62 57	F	60	134.1	2.9	3.6	17.4	746
co-027	M	57	M	48	15.6	0.5	1.4	0.5	394
co-029	M	46	M	66	98.0	2.8	4.5	31.0	899
co-030	M	43	F	64	135.6	3.8	4.3	31.5	235
co-032	M	53	M	61	151.2	3.3	2.7	1.2	527
co-035	M	56	M	63	112.8	3.8	4.4	38.6	1227
co-036	M	71	M	50	76.9	2.2	3.8	2.1	415
co-037	M	48	M	66	86.7	2.2	1.9	0.9	311
co-039	M	70	F	66	129.6	3.4	4.8	1.1	1841
co-042	M	25	M	63	142.0	3.5	4.0	4.1	511
co-043	M	47	F	73	143.4	2.9	4.1	3.0	1176
co-045	M	40	M	66	133.2	2.9	3.2	19.4	546
co-046	M	45	F	66	156.7	3.5	3.8	3.3	360
co-049	M	34	F	55	161.4	3.3	2.9	7.7	1447
co-050	M	42	M	53	18.9	0.9	0.6	5.6	47
co-053	M	56	M	57	108.1	2.3	4.2	2.7	602
co-054	M	57	F	55	84.7	2.3	3.4	6.7	260
co-057	M	42	M	58	109.7	2.3	1.7	9.7	211
co-061	M	30	M	62	40.1	1.2	2.1	1.5	152
co-062	M	31	M	63	74.8	2.7	3.8	3.8	694
co-064	M	35	F	47	20.6	0.9	0.7	0.6	89
co-065	M	37	M	54	88.1	2.0	3.4	3.7	167
co-066	M	40	F	67	86.4	1.9	2.6	1.1	573

co-068	M	51	M	67	110.4	2.9	4.2	4.3	999	
co-072	M	37	F	63	162.0	3.7	3.8	38.6	437	
co-077	M	27	F	46	88.8	2.3	1.4	3.5	1105	
co-093	M	32	F	63	131.6	2.7	3.0	13.4	545	
co-100	M	16	M	75	70.5	1.6	2.8	5.9	452	
co-101	M	19	F	66	69.0	2.0	2.7	3.5	358	
co-104	M	50	M	59	142.4	3.2	2.7	5.5	290	
co-112	M	54	M	74	126.6	3.2	4.4	7.3		
co-113	M	52	F	75	108.0	2.4	4.0	2.7		
co-114	M	52	M	71	91.8	2.2	1.7	11.0		
co-115	M	53	M	70	87.3	2.6	4.2	26.8		
co-118	M	57	M	66	156.7	3.8	4.9	46.8		
co-119	M	77	F	66	155.9	3.7	4.7	120.6		
co-120	M	53	M	68	135.1	2.5	4.3	1.4		
co-121	M	52	F	58	126.5	2.5	3.2	26.6		
co-122	M	41	M	75	115.5	2.3	3.2	8.3		
co-126	M	48	M	77	102.4	2.4	3.3	12.0		
co-128	M	46	F	79	115.1	2.7	3.8	6.8		
co-133	M	37	M	79	151.8	3.0	3.3	2.8		
co-134	M	42	M	83	72.2	1.7	3.4	2.4		
co-135	M	41	F	86	85.4	1.6	1.4	5.1		
co-136	M	19	M	85	94.4	2.1	2.4	14.3		
co-138	M	32	M	75 73	70.1	1.5	1.7	4.9		
co-148	M	42	F	73	119.5	3.3	3.8	17.3		
co-152	M	39	M	77	126.8	2.7	4.6	13.6		
co-153	M	60	F	72 70	105.9	2.3	3.5	6.6		
co-156	M	51	M	70	127.2	3.4	1.9	6.7		
co-157	M	50	F	67	73.1	2.5	0.7	3.5		
co-158 co-069	M S	20 62	M M	65 67	98.5 50.1	1.8 3.1	1.9 2.9	1.9 116.3	1997	
co-085	S	59	M	67	135.5	4.3	4.9	15.1	523	
co-083	S	49	M	66	81.8	2.3	3.8	8.9	689	
00-077	5	Mean	%M	Mean	Mean	Mean	Mean	Mean	Mean	
		46	55.5	65	107.2	2.7	3.3	13.0	700	
		40	33.3	0.5	107.2	2.7	5.5	15.0	700	
co-004	н	37	М		0.8	0.4	0.2	0.6		
co-004	H H	37 64	M F		0.8 0.3	0.4 0.3	0.2 0.8	0.6 4.0		
co-010	H	64	F		0.3	0.3	0.8	4.0		
co-010 co-016	H H	64 61	F M		0.3 0.9	0.3 0.3	0.8 0.3	4.0 5.4		
co-010	H	64 61 61	F		0.3 0.9 1.6	0.3 0.3 0.3	0.8 0.3 0.4	4.0 5.4 0.5		
co-010 co-016 co-019 co-020	Н Н Н	64 61	F M M		0.3 0.9	0.3 0.3 0.3 0.3	0.8 0.3	4.0 5.4		
co-010 co-016 co-019 co-020 co-021	Н Н Н Н	64 61 61 66 39	F M M M		0.3 0.9 1.6 0.3 3.1	0.3 0.3 0.3 0.3	0.8 0.3 0.4 0.2 0.3	4.0 5.4 0.5 0.6 0.5		
co-010 co-016 co-019 co-020	H H H H	64 61 61 66	F M M M		0.3 0.9 1.6 0.3	0.3 0.3 0.3 0.3	0.8 0.3 0.4 0.2	4.0 5.4 0.5 0.6		
co-010 co-016 co-019 co-020 co-021 co-025	H H H H H	64 61 61 66 39 63	F M M M M		0.3 0.9 1.6 0.3 3.1 1.7	0.3 0.3 0.3 0.3 0.3	0.8 0.3 0.4 0.2 0.3	4.0 5.4 0.5 0.6 0.5 0.3		
co-010 co-016 co-019 co-020 co-021 co-025 co-026	H H H H H H	64 61 61 66 39 63 36	F M M M M M		0.3 0.9 1.6 0.3 3.1 1.7 0.9	0.3 0.3 0.3 0.3 0.3 0.7 0.5	0.8 0.3 0.4 0.2 0.3 0.3	4.0 5.4 0.5 0.6 0.5 0.3		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-028	H H H H H H	64 61 61 66 39 63 36 24	F M M M M M M		0.3 0.9 1.6 0.3 3.1 1.7 0.9	0.3 0.3 0.3 0.3 0.3 0.7 0.5	0.8 0.3 0.4 0.2 0.3 0.3 0.2	4.0 5.4 0.5 0.6 0.5 0.3 0.3		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-028 co-031	H H H H H H	64 61 61 66 39 63 36 24	F M M M M M M		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3	0.3 0.3 0.3 0.3 0.7 0.5 0.2 0.7	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3	4.0 5.4 0.5 0.6 0.5 0.3 0.3 0.4		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-028 co-031 co-033	H H H H H H H	64 61 61 66 39 63 36 24 45 56	F M M M M M M M		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3 0.4 1.7 0.6 0.9	0.3 0.3 0.3 0.3 0.7 0.5 0.2 0.7 0.6	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3 0.3	4.0 5.4 0.5 0.6 0.5 0.3 0.3 0.4 0.8 1.1		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-028 co-031 co-033 co-034 co-040	H H H H H H H H	64 61 61 66 39 63 36 24 45 56 35 47 51	F M M M M M M M F M		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3 0.4 1.7 0.6 0.9	0.3 0.3 0.3 0.3 0.7 0.5 0.2 0.7 0.6 0.3 0.4 0.3	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3 0.3 0.2 0.3 0.3	4.0 5.4 0.5 0.6 0.5 0.3 0.3 0.4 0.8 1.1 0.6 15.8 1.3		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-028 co-031 co-033 co-034 co-040	H H H H H H H H H H	64 61 61 66 39 63 36 24 45 56 35 47 51 47	F M M M M M M M F M		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3 0.4 1.7 0.6 0.9 0.7 1.5	0.3 0.3 0.3 0.3 0.7 0.5 0.2 0.7 0.6 0.3 0.4 0.3 0.3	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3 0.3 0.2 0.3 0.2 0.2 0.2 0.3	4.0 5.4 0.5 0.6 0.5 0.3 0.3 0.4 0.8 1.1 0.6 15.8 1.3 2.1		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-028 co-031 co-033 co-034 co-040 co-041	H H H H H H H H H H	64 61 61 66 39 63 36 24 45 56 35 47 51 47	F M M M M M M M F M F M F M F M F		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3 0.4 1.7 0.6 0.9 0.7 1.5 0.2	0.3 0.3 0.3 0.3 0.7 0.5 0.2 0.7 0.6 0.3 0.4 0.3 0.3 0.6	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3 0.3 0.2 0.3 0.2 0.2 0.3 0.4	4.0 5.4 0.5 0.6 0.5 0.3 0.4 0.8 1.1 0.6 15.8 1.3 2.1 2.7		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-028 co-031 co-033 co-034 co-040 co-041 co-044	H H H H H H H H H H H	64 61 61 66 39 63 36 24 45 56 35 47 51 47 70 45	F M M M M M M M F M F M F M M		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3 0.4 1.7 0.6 0.9 0.7 1.5 0.2 0.2	0.3 0.3 0.3 0.3 0.7 0.5 0.2 0.7 0.6 0.3 0.4 0.3 0.6 0.6	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3 0.3 0.2 0.2 0.2 0.3 0.2 0.3 0.4 0.3	4.0 5.4 0.5 0.6 0.5 0.3 0.3 0.4 0.8 1.1 0.6 15.8 1.3 2.1 2.7		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-028 co-031 co-033 co-034 co-040 co-041 co-044 co-047	H H H H H H H H H H H H	64 61 61 66 39 63 36 24 45 56 35 47 51 47 70 45 12	F M M M M M M F M F M F M F M F F M F		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3 0.4 1.7 0.6 0.9 0.7 1.5 0.2 0.2 0.6	0.3 0.3 0.3 0.3 0.7 0.5 0.2 0.7 0.6 0.3 0.4 0.3 0.6 0.6 0.3	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3 0.2 0.2 0.2 0.3 0.2 0.3 0.4 0.3 0.4 0.3 0.3	4.0 5.4 0.5 0.6 0.5 0.3 0.4 0.8 1.1 0.6 15.8 1.3 2.1 2.7 0.6 0.8		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-028 co-031 co-033 co-034 co-040 co-041 co-044 co-047 co-048 co-052 co-055	H H H H H H H H H H H H	64 61 61 66 39 63 36 24 45 56 35 47 51 47 70 45 12 18	F M M M M M M F M F M F M M F M M F		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3 0.4 1.7 0.6 0.9 0.7 1.5 0.2 0.2 0.6 0.3	0.3 0.3 0.3 0.3 0.7 0.5 0.2 0.7 0.6 0.3 0.4 0.3 0.6 0.6 0.3 0.2	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3 0.2 0.3 0.2 0.2 0.3 0.4 0.3 0.2 0.3 0.4 0.3 0.3 0.2	4.0 5.4 0.5 0.6 0.5 0.3 0.4 0.8 1.1 0.6 15.8 1.3 2.1 2.7 0.6 0.8 2.3		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-031 co-033 co-034 co-040 co-041 co-044 co-047 co-048 co-052 co-055 co-056	H H H H H H H H H H H H H	64 61 61 66 39 63 36 24 45 56 35 47 51 47 70 45 12 18 23	F M M M M M M F M F M M M M F M M M M M		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3 0.4 1.7 0.6 0.9 0.7 1.5 0.2 0.2 0.6 0.3 0.9	0.3 0.3 0.3 0.3 0.7 0.5 0.2 0.7 0.6 0.3 0.4 0.3 0.6 0.6 0.3 0.2 0.6	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3 0.2 0.3 0.2 0.3 0.2 0.3 0.2 0.3 0.2 0.3 0.4 0.3 0.3 0.4 0.3 0.4 0.3 0.4	4.0 5.4 0.5 0.6 0.5 0.3 0.4 0.8 1.1 0.6 15.8 1.3 2.1 2.7 0.6 0.8 2.3 1.0		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-031 co-033 co-034 co-040 co-041 co-044 co-047 co-048 co-052 co-056 co-058	H H H H H H H H H H H H H H	64 61 61 66 39 63 36 24 45 56 35 47 51 47 70 45 12 18 23 18	F M M M M M M F M F M M F M F M F M F M		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3 0.4 1.7 0.6 0.9 0.7 1.5 0.2 0.2 0.6 0.3 0.9	0.3 0.3 0.3 0.3 0.3 0.7 0.5 0.2 0.7 0.6 0.3 0.4 0.3 0.6 0.6 0.3 0.2 0.6 0.5	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3 0.3 0.2 0.2 0.3 0.2 0.3 0.4 0.3 0.4 0.3 0.3 0.2 0.4 1.0	4.0 5.4 0.5 0.6 0.5 0.3 0.4 0.8 1.1 0.6 15.8 1.3 2.1 2.7 0.6 0.8 2.3 1.0 0.8		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-031 co-033 co-034 co-040 co-041 co-044 co-047 co-048 co-052 co-056 co-058 co-059	H H H H H H H H H H H H H H H	64 61 61 66 39 63 36 24 45 56 35 47 51 47 70 45 12 18 23 18	F M M M M M M M F M F M M F M F F F F		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3 0.4 1.7 0.6 0.9 0.7 1.5 0.2 0.2 0.6 0.3 0.9	0.3 0.3 0.3 0.3 0.3 0.7 0.5 0.2 0.7 0.6 0.3 0.4 0.3 0.6 0.6 0.3 0.2 0.6 0.5 0.5	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3 0.3 0.2 0.2 0.3 0.2 0.3 0.4 0.3 0.4 0.3 0.2 0.4 1.0 0.3	4.0 5.4 0.5 0.6 0.5 0.3 0.3 0.4 0.8 1.1 0.6 15.8 1.3 2.1 2.7 0.6 0.8 2.3 1.0 0.8 0.3		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-028 co-031 co-033 co-034 co-040 co-041 co-044 co-047 co-048 co-052 co-055 co-056 co-058 co-059 co-060	H H H H H H H H H H H H H H H H	64 61 61 66 39 63 36 24 45 56 35 47 51 47 70 45 12 18 23 18 38 17	F M M M M M M M F M F M M F F F F		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3 0.4 1.7 0.6 0.9 0.7 1.5 0.2 0.2 0.6 0.3 0.9	0.3 0.3 0.3 0.3 0.3 0.7 0.5 0.2 0.7 0.6 0.3 0.4 0.3 0.6 0.6 0.3 0.2 0.6 0.5 0.5 0.5 0.5	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3 0.2 0.3 0.2 0.2 0.3 0.2 0.3 0.2 0.3 0.4 1.0 0.3 0.3 0.3	4.0 5.4 0.5 0.6 0.5 0.3 0.3 0.4 0.8 1.1 0.6 15.8 1.3 2.1 2.7 0.6 0.8 2.3 1.0 0.8 0.3 0.8		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-028 co-031 co-033 co-034 co-040 co-041 co-044 co-047 co-048 co-052 co-056 co-058 co-059 co-060 co-063	H H H H H H H H H H H H H H H H H H H	64 61 61 66 39 63 36 24 45 56 35 47 51 47 70 45 12 18 23 18 38 17 31	F M M M M M M M F M F M M F F F F F		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3 0.4 1.7 0.6 0.9 0.7 1.5 0.2 0.2 0.6 0.3 0.9 0.5 1.7	0.3 0.3 0.3 0.3 0.3 0.7 0.5 0.2 0.7 0.6 0.3 0.4 0.3 0.6 0.6 0.3 0.2 0.6 0.5 0.5 0.5 0.5 0.5	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3 0.2 0.3 0.2 0.2 0.3 0.2 0.3 0.4 0.3 0.3 0.2 0.4 1.0 0.3 0.3 0.3 0.2	4.0 5.4 0.5 0.6 0.5 0.3 0.3 0.4 0.8 1.1 0.6 15.8 1.3 2.1 2.7 0.6 0.8 2.3 1.0 0.8 0.3 0.8 0.8		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-028 co-031 co-033 co-034 co-040 co-041 co-044 co-047 co-048 co-052 co-055 co-056 co-058 co-059 co-060 co-063 co-070	H H H H H H H H H H H H H H H H H H H	64 61 61 66 39 63 36 24 45 56 35 47 51 47 70 45 12 18 23 18 38 17 31 24	F M M M M M M M F M F M M F M F M F M M F M M F M M F M M F M M F M M M F M		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3 0.4 1.7 0.6 0.9 0.7 1.5 0.2 0.2 0.6 0.3 0.9 0.5 1.7 0.3 0.5 0.2	0.3 0.3 0.3 0.3 0.3 0.7 0.5 0.2 0.7 0.6 0.3 0.4 0.3 0.6 0.6 0.3 0.2 0.6 0.5 0.5 0.5 0.5 0.5 0.5 0.2	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3 0.2 0.3 0.2 0.2 0.3 0.2 0.3 0.4 0.3 0.3 0.2 0.4 1.0 0.3 0.3 0.2 0.4 1.0 0.3 0.3 0.2 0.2 0.2	4.0 5.4 0.5 0.6 0.5 0.3 0.3 0.4 0.8 1.1 0.6 15.8 1.3 2.1 2.7 0.6 0.8 2.3 1.0 0.8 0.3 0.8 0.8 0.8		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-028 co-031 co-033 co-034 co-040 co-041 co-044 co-047 co-048 co-052 co-056 co-058 co-059 co-060 co-063 co-070 co-071	H H H H H H H H H H H H H H H H H H H	64 61 61 66 39 63 36 24 45 56 35 47 51 47 70 45 12 18 23 18 38 17 31 24 37	F M M M M M M F M F M F M F M M F M M F M		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3 0.4 1.7 0.6 0.9 0.7 1.5 0.2 0.2 0.6 0.3 0.9 0.5 1.7 0.3 0.5 0.2 0.3	0.3 0.3 0.3 0.3 0.3 0.7 0.5 0.2 0.7 0.6 0.3 0.4 0.3 0.6 0.6 0.3 0.2 0.6 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3 0.3 0.2 0.2 0.3 0.2 0.3 0.4 0.3 0.4 0.3 0.2 0.4 1.0 0.3 0.3 0.2 0.4 1.0 0.3 0.3 0.2 0.3	4.0 5.4 0.5 0.6 0.5 0.3 0.3 0.4 0.8 1.1 0.6 15.8 1.3 2.1 2.7 0.6 0.8 2.3 1.0 0.8 0.3 0.8 0.3 0.8 0.4 0.3		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-028 co-031 co-033 co-034 co-040 co-041 co-044 co-047 co-048 co-052 co-056 co-058 co-059 co-060 co-063 co-070 co-071 co-073	H H H H H H H H H H H H H H H H H H H	64 61 61 66 39 63 36 24 45 56 35 47 51 47 70 45 12 18 23 18 38 17 31 24 37 8	F M M M M M M F M F M F M F M M F M M F M M M M H M M M M		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3 0.4 1.7 0.6 0.9 0.7 1.5 0.2 0.2 0.6 0.3 0.9 0.5 1.7 0.3 0.5 0.2 0.3 1.0	0.3 0.3 0.3 0.3 0.3 0.5 0.5 0.2 0.7 0.6 0.3 0.4 0.3 0.6 0.6 0.3 0.2 0.6 0.5 0.5 0.5 0.5 0.5 0.5 0.2 0.5 0.2 0.5 0.2	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3 0.3 0.2 0.2 0.3 0.2 0.3 0.4 0.3 0.4 0.3 0.2 0.4 1.0 0.3 0.3 0.2 0.4 1.0 0.3 0.3 0.3 0.2 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3	4.0 5.4 0.5 0.6 0.5 0.3 0.3 0.4 0.8 1.1 0.6 15.8 1.3 2.1 2.7 0.6 0.8 2.3 1.0 0.8 0.3 0.8 0.4 0.8 0.3 0.4 0.8 0.3 0.4 0.8 0.3 0.8		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-028 co-031 co-033 co-034 co-040 co-041 co-044 co-047 co-048 co-052 co-056 co-058 co-059 co-060 co-063 co-070 co-071 co-073 co-074	H H H H H H H H H H H H H H H H H H H	64 61 61 66 39 63 36 24 45 56 35 47 51 47 70 45 12 18 23 18 38 17 31 24 37 8	F M M M M M M F M F M F M F M M F M M F M M M M F M		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3 0.4 1.7 0.6 0.9 0.7 1.5 0.2 0.2 0.6 0.3 0.9 0.5 1.7 0.3 0.5 0.2 0.3 1.0 34.9	0.3 0.3 0.3 0.3 0.3 0.5 0.5 0.2 0.7 0.6 0.3 0.4 0.3 0.6 0.6 0.3 0.2 0.6 0.5 0.5 0.5 0.5 0.5 0.2 0.5 0.9	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3 0.2 0.3 0.2 0.2 0.3 0.4 0.3 0.4 0.3 0.2 0.4 1.0 0.3 0.3 0.2 0.4 1.0 0.3 0.3 0.2 0.3 0.3 0.7	4.0 5.4 0.5 0.6 0.5 0.3 0.3 0.4 0.8 1.1 0.6 15.8 1.3 2.1 2.7 0.6 0.8 2.3 1.0 0.8 0.3 0.8 0.4 0.3 0.4 1.6		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-028 co-031 co-033 co-034 co-040 co-041 co-044 co-047 co-048 co-052 co-056 co-058 co-059 co-060 co-063 co-070 co-071 co-073 co-074 co-075	H H H H H H H H H H H H H H H H H H H	64 61 61 66 39 63 36 24 45 56 35 47 51 47 70 45 12 18 23 18 38 17 31 24 37 8 42 53	F M M M M M M F M F M F M M F M M F M M M M M M M M M M M M M M M		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3 0.4 1.7 0.6 0.9 0.7 1.5 0.2 0.2 0.6 0.3 0.9 0.5 1.7 0.3 0.5 0.2 0.3 1.0 34.9 0.8	0.3 0.3 0.3 0.3 0.3 0.3 0.7 0.5 0.2 0.7 0.6 0.3 0.4 0.3 0.6 0.6 0.3 0.2 0.6 0.5 0.5 0.5 0.5 0.2 0.5 0.2 0.7 0.6 0.7 0.7 0.6 0.7	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3 0.2 0.3 0.2 0.2 0.3 0.4 0.3 0.4 0.3 0.2 0.4 1.0 0.3 0.3 0.2 0.2 0.4 1.0 0.3 0.3 0.7 0.3	4.0 5.4 0.5 0.6 0.5 0.3 0.3 0.4 0.8 1.1 0.6 15.8 1.3 2.1 2.7 0.6 0.8 2.3 1.0 0.8 0.3 0.8 0.4 0.3 0.4 1.6 1.2		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-028 co-031 co-033 co-034 co-040 co-041 co-044 co-047 co-048 co-052 co-056 co-058 co-059 co-060 co-063 co-070 co-071 co-073 co-074 co-075 co-076	H H H H H H H H H H H H H H H H H H H	64 61 61 66 39 63 36 24 45 56 35 47 51 47 70 45 12 18 23 18 38 17 31 24 37 8 42 53 71	F M M M M M M F M F M F M M F M M F M M M M M M M M M M M M M M M		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3 0.4 1.7 0.6 0.9 0.7 1.5 0.2 0.2 0.6 0.3 0.9 0.5 1.7 0.3 0.5 0.2 0.3 1.0 34.9 0.8 0.4	0.3 0.3 0.3 0.3 0.3 0.3 0.7 0.5 0.2 0.7 0.6 0.3 0.4 0.3 0.6 0.6 0.3 0.2 0.6 0.5 0.5 0.5 0.5 0.2 0.5 0.2 0.7 0.6 0.6 0.7 0.6 0.7 0.6 0.7 0.6	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3 0.2 0.3 0.2 0.2 0.3 0.4 0.3 0.4 0.3 0.2 0.4 1.0 0.3 0.3 0.2 0.2 0.4 1.0 0.3 0.3 0.2 0.4 1.0 0.3 0.3 0.3 0.2 0.4 1.0 0.3 0.3 0.3 0.4	4.0 5.4 0.5 0.6 0.5 0.3 0.3 0.4 0.8 1.1 0.6 15.8 1.3 2.1 2.7 0.6 0.8 2.3 1.0 0.8 0.3 0.8 0.4 0.3 0.4 1.6 1.2 0.6		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-028 co-031 co-033 co-034 co-040 co-041 co-044 co-047 co-048 co-052 co-056 co-058 co-059 co-060 co-063 co-070 co-071 co-073 co-074 co-075 co-076 co-078	H H H H H H H H H H H H H H H H H H H	64 61 61 66 39 63 36 24 45 56 35 47 51 47 70 45 12 18 23 18 38 17 31 24 37 8 42 53 71 58	F M M M M M M F M F M F M M F M M M M M		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3 0.4 1.7 0.6 0.9 0.7 1.5 0.2 0.2 0.6 0.3 0.9 0.5 1.7 0.3 0.5 0.2 0.3 1.0 34.9 0.8 0.4 1.5	0.3 0.3 0.3 0.3 0.3 0.3 0.7 0.5 0.2 0.7 0.6 0.3 0.4 0.3 0.6 0.6 0.3 0.2 0.6 0.5 0.5 0.5 0.5 0.2 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.7 0.6 0.2	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3 0.2 0.3 0.2 0.2 0.3 0.4 0.3 0.2 0.4 1.0 0.3 0.3 0.2 0.4 1.0 0.3 0.3 0.2 0.4 1.0 0.3 0.3 0.2 0.4 1.0 0.3 0.3 0.3 0.4 0.3 0.3 0.3 0.3 0.3 0.4 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3	4.0 5.4 0.5 0.6 0.5 0.3 0.3 0.4 0.8 1.1 0.6 15.8 1.3 2.1 2.7 0.6 0.8 2.3 1.0 0.8 0.3 0.8 0.4 0.3 0.4 1.6 1.2 0.6 0.5		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-028 co-031 co-033 co-034 co-040 co-041 co-044 co-047 co-048 co-052 co-056 co-058 co-059 co-060 co-063 co-070 co-071 co-073 co-074 co-075 co-076 co-078 co-079	H H H H H H H H H H H H H H H H H H H	64 61 61 66 39 63 36 24 45 56 35 47 51 47 70 45 12 18 23 18 38 17 31 24 37 8 42 53 71 58 12	F M M M M M M F M F M F M M F M M F M		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3 0.4 1.7 0.6 0.9 0.7 1.5 0.2 0.2 0.6 0.3 0.9 0.5 1.7 0.3 0.5 0.2 0.3 1.0 34.9 0.8 0.4 1.5 0.8	0.3 0.3 0.3 0.3 0.3 0.3 0.7 0.5 0.2 0.7 0.6 0.3 0.4 0.3 0.6 0.6 0.5 0.5 0.5 0.5 0.2 0.5 0.2 0.7 0.6 0.3 0.5 0.2 0.6 0.5 0.5 0.3 0.5 0.2 0.6 0.5 0.3 0.5 0.2 0.6 0.5 0.3 0.5 0.2 0.6 0.5 0.3 0.5 0.2 0.6 0.5 0.3 0.5 0.2 0.6 0.5 0.3 0.5 0.2 0.5 0.3 0.5 0.2 0.5 0.3 0.5 0.2 0.5 0.3 0.5 0.2 0.5 0.3 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3 0.2 0.3 0.2 0.2 0.3 0.4 0.3 0.2 0.4 1.0 0.3 0.3 0.2 0.4 1.0 0.3 0.3 0.2 0.4 1.0 0.3 0.3 0.2 0.4 1.0 0.3 0.3 0.2 0.4 1.0 0.3 0.3 0.2 0.2 0.3 0.3 0.2 0.2 0.3 0.3 0.3 0.2 0.2 0.3 0.3 0.3 0.3 0.3 0.2 0.2 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3	4.0 5.4 0.5 0.6 0.5 0.3 0.3 0.4 0.8 1.1 0.6 15.8 1.3 2.1 2.7 0.6 0.8 2.3 1.0 0.8 0.3 0.8 0.4 0.3 0.4 1.6 1.2 0.6 0.5 0.5		
co-010 co-016 co-019 co-020 co-021 co-025 co-026 co-028 co-031 co-033 co-034 co-040 co-041 co-044 co-047 co-048 co-052 co-056 co-058 co-059 co-060 co-063 co-070 co-071 co-073 co-074 co-075 co-076 co-078	H H H H H H H H H H H H H H H H H H H	64 61 61 66 39 63 36 24 45 56 35 47 51 47 70 45 12 18 23 18 38 17 31 24 37 8 42 53 71 58	F M M M M M M F M F M F M M F M M M M M		0.3 0.9 1.6 0.3 3.1 1.7 0.9 0.3 0.4 1.7 0.6 0.9 0.7 1.5 0.2 0.2 0.6 0.3 0.9 0.5 1.7 0.3 0.5 0.2 0.3 1.0 34.9 0.8 0.4 1.5	0.3 0.3 0.3 0.3 0.3 0.3 0.7 0.5 0.2 0.7 0.6 0.3 0.4 0.3 0.6 0.6 0.3 0.2 0.6 0.5 0.5 0.5 0.5 0.2 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.5 0.2 0.6 0.7 0.6 0.2	0.8 0.3 0.4 0.2 0.3 0.3 0.2 0.3 0.2 0.3 0.2 0.2 0.3 0.4 0.3 0.2 0.4 1.0 0.3 0.3 0.2 0.4 1.0 0.3 0.3 0.2 0.4 1.0 0.3 0.3 0.2 0.4 1.0 0.3 0.3 0.3 0.4 0.3 0.3 0.3 0.3 0.3 0.4 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3	4.0 5.4 0.5 0.6 0.5 0.3 0.3 0.4 0.8 1.1 0.6 15.8 1.3 2.1 2.7 0.6 0.8 2.3 1.0 0.8 0.3 0.8 0.4 0.3 0.4 1.6 1.2 0.6 0.5		

co-081	Н	40	F	0.2	0.2	0.2	1.0	
co-081	Н	32	F	0.5	0.2	0.2	1.0	
co-082	Н	10	F	0.5	0.7	0.2	0.8	
co-084	Н	56	F	0.3	0.3	0.3	0.8	
co-087	Н	47	M	0.2	0.2	0.3	0.5	
co-088	Н	50	M	0.2	0.1	0.3	1.1	
co-088	Н	34	F	0.3	0.2	0.2	1.3	
co-091	Н	34	M	0.1	0.2	0.2	0.9	
co-094	Н	7	F	0.1	0.2	1.1	0.4	
co-093	Н	35	M	0.1	0.2	0.2	0.5	
co-103	Н	48	M	0.4	0.5	1.3	1.2	
co-105	Н	49	F	0.3	0.3	0.2	0.6	
co-105	Н	48	F	0.3	0.6	0.2	0.5	
co-100	Н	42	M	0.5	0.0	0.2	0.3	
co-111	Н	12	F	0.7	0.4	0.4	0.7	
co-110	Н	50	F	0.7	0.3	0.4	0.8	
co-117	Н	20	M	0.3	0.3	0.4	0.6	
co-123	Н	12	F	1.4	0.3	0.3	3.5	
co-124	Н	43	F	0.3	0.5	0.3	0.5	
co-123	Н	70	M	1.1	0.6	0.3	0.4	
co-127	Н	22	F	0.3	0.4	0.5	1.5	
co-129	Н	52	M	1.3	0.5	0.5	0.6	
co-131	Н	35	F	0.5	0.5	0.4	1.2	
co-132	Н	58	F	0.3	0.4	0.2	0.5	
co-139	Н	58	M	0.2	0.2	0.3	1.1	
co-140	Н	31	F	0.2	0.2	0.3	2.2	
co-141	Н	55	F	0.5	0.5	0.2	0.5	
co-142	Н	54	F	0.2	0.2	0.3	0.8	
co-143	Н	9	M	0.4	0.2	0.3	0.6	
co-145	Н	41	M	0.2	0.2	0.2	2.3	
co-146	Н	14	M	0.2	0.1	0.2	0.5	
co-147	Н	75	M	1.4	0.4	0.2	0.3	
co-149	Н	7	M	6.6	0.3	0.3	0.7	
co-150	Н	60	M	0.3	0.2	0.3	0.4	
co-151	Н	32	M	0.4	0.4	0.3	0.3	
co-154	Н	36	F	1.3	0.2	0.3	1.1	
		Mean	%M	Mean	Mean	Mean	Mean	
		39	57.9	1.2	0.2	0.3	1.2	

A; asymptomatic: M: mild-moderate; S: severe, H; healthy (NAT-Ab-). nAb: neutralizing antibody titer. NA: not applicable; ND: not detectable.

Supplementary Table 2. Validation of three Ab assays

	Assa	•		say 2		say 3
	immunochron	~ 1		omatographic	EL	ISA
	IgG N+S	IgM* N+S	IgG N+S	IgM* N+S	IgG N	IgG sRBD
Number of negative controls for method validation	284	286	188	188	403	269
Minimum	0.00	0.00	0.29	0.17	0.11	0.09
25% Percentile	0.08	0.14	1.23	0.81	0.24	0.18
Median	0.18	0.24	1.87	1.46	0.35	0.21
75% Percentile	0.43	0.38	3.20	3.01	0.47	0.26
Maximum	1.79	1.91	18.73	11.60	0.97	0.62
Mean	0.26	0.30	2.67	2.19	0.38	0.23
Std. Deviation	0.23	0.26	2.49	2.03	0.19	0.09
Std. Error of Mean	0.01	0.02	0.18	0.15	0.01	0.01
Establishment of statistic par	ameters used th	is study with	the 79 confirm	ned covid-19 pa	tients	
Theoretical cut off (Mean+3SD)	0.95	1.08	10.15	8.27	0.95	0.55
Cut off used in test	1	1.1	11	10	1	1
False positive (%)	0.70	3.85	1.06	1.06	0	0
Specificity: Consistency with NAT result (% of 79 confirmed cases)	93.6	53.1 [¶]	97.4	26.5¶	91.1	94.9

^{*:} Reliable serum IgM titer is only detected within the first 3 weeks from disease onset (Fig. 3c)

^{¶:} It was 48-86 days between their hospitalisation and the date of IgM assay for these 79 confirmed covid-19 patients.