Supplementary Appendix

This appendix has been provided by the authors to give readers additional information about their work.

Supplement to: Bhatraju PK, Ghassemieh BJ, Nichols M, et al. Covid-19 in critically ill patients in the Seattle region — case series. N Engl J Med. DOI: 10.1056/NEJMoa2004500

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Online video. Computed tomographic imaging of patient with acute respiratory distress syndrome due to COVID-19.

Methods:

Laboratory Testing

Initially, all clinical specimens were tested with the assay developed by the CDC, targeting the N1 and N2 genes,[1] which was run at the Washington Department of Health State Public Health Lab in Shoreline, Washington. On March 2nd, the University of Washington began using a test developed by the University of Washington clinical virology laboratory. The qRT-PCR based test uses a modified version of the World Health Organization's qRT-PCR for qualitative diagnosis of COVID-19 via detection SARS-CoV-2 RNA. The assay targets the SARS-CoV-2 E gene and RdRp gene.[2] Briefly, nasopharyngeal swabs are collected in 3mL of viral transport media and 200µL of viral media is extracted on a high-throughput Roche MP96 small volume extractor with spiked internal controls. Next, 5µL of eluate is used as template for a one-step qRT-PCR performed using 25µL total reactions with the AgPath-ID system on the ABI 7500 Real-Time PCR System. If both targets are detected, the assay is reported as positive; if one target is detected, the assay is reported as inconclusive and reflexively confirmed using the real-time RT-PCR assay developed by the CDC.

References:

1. CDC. Coronavirus Disease 2019 (COVID-19) [Internet]. Centers for Disease Control and Prevention. 2020 [cited 2020 Mar 14];Available from: https://www.cdc.gov/coronavirus/2019-ncov/lab/rt-pcr-detection-instructions.html

2. Corman VM, Landt O, Kaiser M, et al. Detection of 2019 novel coronavirus (2019-nCoV) by real-time RT-PCR. Euro Surveill 2020;25(3).

Table S1. List of viruses included on extended respiratory viral PCR

Respiratory Pathogen:	University of Washington Hospitals: [a]	Swedish Medical Center Hospitals: [b]	Virginia Mason Medical Center: [c]
Metapneumovirus	X	X	X
Parainfluenza	X		X
Parainfluenza 1		X	
Parainfluenza 2		X	
Parainfluenza 3		X	
Parainfluenza 4		X	
RSV	X	X	X
Influenza A	X	X	X
Influenza A H1		X	
Influenza A 2009 H1		X	
Influenza A H3		X	
Influenza B	X	X	X
Coronavirus (not SARS-CoV-2)	X		X
Coronavirus HKU1		X	
Coronavirus NL63		X	
Coronavirus 229E		X	
Coronavirus OC43		X	
Rhinovirus	X	X	X
Adenovirus	X	X	X
Bocavirus	X		
Bordetella pertussis		X	
Chlamydophila pneumonia		X	
Mycoplasma pneumoniae		X	

a: Testing performed on the UW Virology lab-developed test

b: Testing performed on Biomerieux Biofire Respiratory Pathogen Panel (note the endemic coronaviruses tested on this panel do not cross react with SARS-CoV-2)

c: Testing performed on the Virginia Mason Microbiology lab-developed test

Table S2. Individual patient data, demographics and prior medical history

Patient	Age (yrs)	Body Mass Index (kg/m^3)	Admission Location: Home, Skilled Nursing Facility or Transfer (SNF-Tx)	Number of Comorbid Conditions[a]
1.	60-70	22.6	Home	2
2.	> 80	-	SNF-Tx	1
3.	< 60	48.7	Home	2
4.	< 60	33.5	Home	4
5.	< 60	29.8	Home	1
6.	< 60	35.1	Home	1
7.	60-70	36.3	SNF-Tx	2
8.	> 80	29.2	SNF-Tx	2
9.	< 60	37.5	SNF-Tx	2
10.	60-70	25.8	Home	2
11.	70-80	41.1	Home	3
12.	60-70	38.4	SNF-Tx	1
13.	> 80	20.5	SNF-Tx	1
14.	60-70	33.8	Home	2
15	< 60	36.2	Home	0
16	60-70	28.5	Home	2
17.	60-70	34.0	Home	0
18.	70-80	28.9	Home	3
19.	70-80	45.2	Home	2
20.	70-80	28.2	Home	1
21	> 80	39.0	SNF-Tx	4
22.	60-70	28.4	Home	1
23.	> 80	23.5	SNF-Tx	0
24.	70-80	39.5	Home	1

a. Comorbid conditions include asthma, chronic obstructive pulmonary disease, obstructive sleep apnea, infection with human immunodeficiency virus, immunosuppression, diabetes mellitus, chronic kidney disease, and ischemic or hemorrhagic stroke

Table S3. Individual patient data, presenting symptoms at hospital admission

Patient	Symptoms Prior to Hospital admission (days)	Known Sick Contact	Max Temp within 24 hrs of hospital admission (°C)	Max Temp Day 2 (°C)	Max Temp Day 3 (°C)	Respiratory Rate (breaths/min)	Heart rate (beats/min)	Cough	Sputum Production	Shortness of Breath
1.	9	No	39.4	38.7	38.1	16	99	Yes	Yes	Yes
2.	1	Yes	36	-	-	33	125	No	No	Yes
3.	7	Yes	39.3	37.7	38.7	20	110	Yes	Yes	Yes
4.	7	Yes	38.1	38.3	38.5	20	72	Yes	No	Yes
5.	8	No	37.8	36.9	36.8	28	124	Yes	Yes	Yes
6.	13	Yes	36.1	36	-	20	147	Yes	Yes	Yes
7.	5	No	37.2	37.6	37.9	22	106	Yes	No	Yes
8.	14	Yes	38.1	38.1	38.1	24	92	Yes	Yes	Yes
9.	7	Yes	40.7	39.9	-	34	124	Yes	Yes	Yes
10.	14	No	38.2	38.2	38.5	30	96	Yes	Yes	Yes
11.	7	No	38.8	38.7	38.9	29	83	Yes	No	Yes
12.	14	Yes	36.7	36.5	36.7	18	63	Yes	Yes	Yes
13.	1	Yes	37.9	36.9	36.0	20	69	Yes	No	No
14.	14	No	37.5	37.2	36.7	24	101	No	Yes	Yes
15	6	No	39.6	39.6	38.9	44	104	Yes	No	Yes
16	10	Yes	39.4	39.5	38.2	18	92	Yes	No	No
17.	3	Yes	39.2	39	39.6	21	109	Yes	No	Yes
18.	3	Yes	38.2	38	38.9	20	80	Yes	No	Yes
19.	4	No	39.6	39.4	38.0	20	69	Yes	No	Yes
20.	10	Yes	38.3	37.6	37.4	-	-	Yes	No	Yes
21	3	No	38	37.3	36.9	22	100	Yes	Yes	Yes
22.	6	No	38.9	37.5	37.6	28	101	Yes	No	No
23.	2	Yes	38.6	38.6	38.2	18	127	Yes	No	Yes
24.	4	No	38.1	38.3	38.9	36	89	No	No	Yes

Table S4. Individual patient data, hospital admission laboratory data and laboratory data during first 3 days of ICU admission

	Hospital Admission						First 3 days of ICU admission							Hospitalization
Patient	Lactate (mmol/L)	Pro-calcitonin[a] (ng/mL)	ALT[b] (U/L)	AST[c] (U/L)	WBC[d] (per mm^3)	Lymphocyte Count (per mm^3)	WBC[d] Day 2 (per mm^3)	WBC[d] Day 3 (per mm^3)	SCr[e] (mg/dL)	Troponin (ng/mL)	Platelets (per mm^3)	Bilirubin (mg/dL)	CK[f] (U/L)	Max CRP[g] mg/L
1.	1.3	0.13	19	42	7.0	0.70	11.0	9.0	1.0	0.03	105, 000	0.6	-	-
2.	16.0	-	864	4904	27.3	4.92	-	-	2.3	-	298, 000	0.5	-	-
3.	-	-	77	49	10.5	1.24	6.63	8.37	1.0	0.03	291, 000	0.9	174	42.5
4.	1.7	0.13	118	80	12.8	0.38	13.27	12.75	0.9	-	275, 000	0.7	-	-
5.	-	-	14	27	3.3	0.23	2.43	2.41	1.2	0.03	98, 000	0.7	-	-
6.	10.7	-	17	21	12.5	0.70	13.67	-	1.4	0.03	155, 000	0.5	35	-
7.	1.6	-	7	16	8.6	1.62	7.05	6.72	1.9	0.04	208, 000	0.9	30	-
8.	-	-	10	19	5.5	0.66	4.95	4.73	1.1	-	84, 000	0.3	-	-
9.	1.0	-	29	25	16.2	0.90	-	-	1.0	-	230, 000	0.6	-	-
10.	1.2	-	17	20	9.0	1.74	14.4	12.53	3.8	0.06	332, 000	0.5	-	-
11.	2.8	-	101	87	13.6	0.31	10.65	14.67	3.8	0.06	260, 000	0.5	-	-
12.	-	-	-	-	7.4	1.71	-	7.27	0.8	-	176, 000	-	-	-
13.	-	-	16	36	5.1	1.27	6.57	6.2	0.8	0.03	113, 000	0.5	-	-
14.	3.1	0.34	104	123	12.4	0.59	11.82	9.98	1.4	0.03	359, 000	1	-	174.8
15	-	0.59	25	24	8.3	1.30	9.5	8.9	0.6	0.02	233, 000	0.6	-	101.8
16	-	0.18	52	62	6.3	0.50	5.8	5.2	1.1	-	147, 000	0.6	308	269.7
17.	0.4	0.20	-	-	10.0	2.90	8.3	8.6	0.7	-	184, 000	0.2	-	367.9
18.	-	0.28	42	43	4.5	0.18	3.3	-	1.8	-	93, 000	0.5	54	302
19.	0.7	0.07	16	22	5.8	1.45	6.5	6.1	0.8	-	104, 000	0.7	-	97
20.	-	0.18	21	39	6.7	0.54	10.3	7.8	0.5	-	152, 000	0.4	-	196
21	1.2	-	20	24	14.2	0.57	14.2	14.6	3.4	0.06	57, 000	0.6	-	-
22.	1.6	0.88	20	34	5.4	0.74	5.6	6.6	2.2	-	220, 000	0.7	-	-
23.	2.3	0.24	10	12	10.5	1.14	12.9	22.4	0.8	0.79	254, 000	0.6	-	95
24.	1.5	0.12	33	61	4.7	0.25	9.4	-	2.0	0.17	115, 000	0.8	1915	219

a. Procalcitonin represents the maximum value within in the first 48hrs
b. Alanine aminotransferase
c. Aspartate aminotransferase
d. White Blood Cell Count
e. Serum Creatinine
f. Creatinine Kinase
g. C-reactive Protein

Table S5. Individual patient data, ventilator settings and vasopressors

Patient	Mechanical Ventilation	Highest Static Pressure (cm H_2O) Day 1	Highest PEEP (cm H_2O) Day 1	Highest F_I0_2 Day 1	Lowest Static Compliance (ml/cmH_2O) Day 1	Highest Static Pressure (cm H_2O) Day 2	Highest PEEP (cm H_2O) Day 2	Highest F_I0_2 Day 2	Lowest Static Compliance (ml/cmH20) Day 2	Highest Static Pressure (cm H_2O) Day 3	Highest PEEP (cm H_2O) Day 3	Highest F_I0_2 Day 3	Lowest Static Compliance (ml/cmH20) Day 3
1.	Yes	22	8	0.7	36	23	10	0.8	36	24	12	0.6	39
2.	No	-	-	-	-	-	-	-	-	-	-	-	-
3.	Yes	27	10	0.8	29	33	14	0.55	23	28	14	0.5	29
4.	Yes	25	12	0.7	31	24	12	0.80	33	22	12	0.6	40
5.	No	-	-	-	-	-	-	-	-	-	-	-	-
6.	Yes	30	12	1.0	21	33	12	1.0	18	-	-	-	-
7.	Yes	-	-	0.6	-	27	10	0.7	25	26	12	0.9	35
8.	No	-	-	-	-	-	-	-	-	-	-	-	-
9.	No	-	-	-	-	-	-	-	-	-	-	-	-
10.	Yes	19	8	1.0	35.7	20	8	0.7	35	19	10	0.5	42
11.	Yes	22	12	1.0	42	26	18	0.5	52.5	19	10	0.5	46.7
12.	No	-	-	-	-	-	-	-	-	-	-	-	-
13.	No	-	-	-	-	-	-	-	-	-	-	-	-
14.	Yes	28	18	0.9	26	29	12	0.8	26	30	12	0.7	25
15	Yes	-	5	0.4	-	-	5	0.4	-	-	5	0.4	-
16	Yes	-	10	1.0	-	-	12	0.9	-	-	8	0.6	-
17.	Yes	27	7	1.0	16	23	7	0.7	20	34	8	0.7	11
18.	Yes	-	10	1.0	-	-	8	0.6	-	-	8	0.6	-
19.	Yes	20	8	0.4	25	21	8	0.5	19	22	10	0.7	23
20.	Yes	14	10	1.0	-	-	18	1.0	-	-	14	0.7	-
21	Yes	-	10	0.8	-	-	10	0.5	-	18	10	0.5	58
22.	Yes	28	15	0.9	-	21	8	0.6	-	18	5	0.4	-
23.	Yes	18	5	0.5	-	17	5	0.4	-	15	5	0.4	-
24.	Yes	30	12	1.0	-	29	12	0.7	-	28	12	0.8	-

Positive end expiratory pressure, PEEP

Table S6. Individual patient data, ARDS strategies, vasopressor use and outcomes

Patient	MV [a]	P_aO_2/F_IO_2 Day 1[b]	P_aO_2/F_IO_2 Day 2[b]	P_aO_2/F_IO_2 Day 3[b]	Days Prone[c]	Days of Neuro-muscular blockade[c]	Days of Inhaled Pulmonary Vasodilator[c]	Duration of MV[a] (days)	Pressors[d]	Extubated	Length of Hospital Stay (days)	Length of ICU Stay (days)	Discharged from the hospital	Death
1.	Yes	90	89	108	Day 3-5	Day 3-5	-	11	Yes	Yes	25	16	No	No
2.	No	-	-	-	-	-	-	0	Yes	-	1	1	-	Yes
3.	Yes	145	-	-	-	-	-	12	Yes	Yes	16	15	Yes	No
4.	Yes	-	-	-	-	-	Days 2-8	16	Yes	Yes	21	18	Yes	No
5.	No	-	-	-	-	-	-	0	No	-	7	1	Yes	No
6.	Yes	58	133	-	-	-	-	2	Yes	-	2	2	-	Yes
7.	Yes	-	118	117	-	Days 2-4	Days 2-7	8	Yes	No	9	9	No	Yes
8.	No	-	-	-	-	-	-	0	No	-	17	1	No	No
9.	No	-	-	-	-	-	-	0	No	-	3	3	-	Yes
10.	Yes	98	145	167	-	-	-	15	Yes	-	15	15	No	No
11.	Yes	148	167	134	-	-	-	8	Yes	No	10	10	-	Yes
12.	No	-	-	-	-	-	-	0	No	-	17	1	No	No
13.	No	-	-	-	-	-	-	0	No	-	4	4	-	Yes
14.	Yes	155	-	-	Day 5	Day 5-7+	Day 5-7+	20	Yes	No	28	20	No	No
15	Yes	242.5	247.5	242.5	-	-	-	6	No	Yes	14	7	Yes	No
16	Yes	117	-	-	-	Day 1-7	-	12	No	No	19	17	No	No
17.	Yes	139	107	-	Day 7+	Day 3-7+	-	11	Yes	No	18	11	-	Yes
18.	Yes	188	151	245	-	-	-	3	Yes	-	9	4	-	Yes
19.	Yes	227.5	230	-	-	-	-	9	Yes	No	9	9	-	Yes
20.	Yes	86	117.5	106	Day 1-7	Day 5-7	Day 1-7	10	Yes	No	10	10	-	Yes
21	Yes	116	-	-	-	-	-	6	Yes	No	6	6	-	Yes
22.	Yes	192.51	-	-	-	-	-	7	Yes	Yes	31	13	Yes	No
23.	Yes	166	175	79	-	-	-	11	Yes	Yes	17	12	No	No
24.	Yes	76.25	66.25	171	Day 3-7+	Day 4-7+	Day 4-7+	8	Yes	No	8	8	-	Yes

a. Mechanical Ventilation
b. Limited to patients on mechanical ventilation
c. Prone on mechanical ventilation within first 7 days of mechanical ventilation
d. Use of vasopressor medications at any time during hospitalization