SARS-CoV-2 droplet and airborne transmission heterogeneity

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Supplementary Materials

Table S1. Partial sequencing of the viral genome from aerosol-subgroup patients. These sequences were compared with the reference sequences of the main VOCs using Clustal Omega software (RRID: SCR_001591). All samples Variant of Concern Omicron BA.1 (OL672836). Patient 1´s sequence also present a silent mutation 21953 C>G

Patient 1	GTCTCTAGTCAGTGTGTTAATCTTACAACCAGAACTCAATTACCCCCTGCATACAC TAATTCTTTCACACGTGGTGTTTATTACCCTGACAAAGTTTTCAGATCCTCAGTTT- TACATTCACTCAGGACTTGTTCTTACCTTTCTTTTCCAATGTTACTTGGTTCCATGT- TATCTCTGGGACCAATGGTACTAAGAGGTTTGATAACCCTGTCCTACCATT- TAATGATGGTGTTTATTTTGCTTCCATTGAGAAGTCTAACATAATAAGAGGCTGGATTTTT- GGTACTACTTTAGATTCGAAGACCCAGTCCCTACTTATTGTTAATAACGCTACTAATGTT- GTTATTAAAGTCTGTGAATTTCAATTTTGTAATGATCCATTTTTGGACCACAAAAACAA- CAAAAGTTGGATGGAAAGTGAGTTCAGAGTTTATTCTAGTGCGAATAATTGCACTTTT- GAATATGTCTCTCAGCCTTTTCTTATGGACCTTGAAGGAAAACAGGGTAATTTCAA- AAATCTTAGGGAATTTGTGTTTAAGAATATTGATGGTTATTTTAAAATATATTCTAAGCA- CACGCCTATTATAGTGCGTGAGCCAGAAGATCTCCCTCAGGGTTTTTCGGCTTTAGAAC- CATTGGTAGATTTGCCAATAGGTATTAACATCACTAGGTTTCAAACTTTACTTGCTTTACA- TAGAAGTTATTTGACTCCTGGTGATTCTTCTTCAGG
Patient 2	CTCTAGTCAGTGTGTTAATCTTACAACCAGAACTCAATTACCCCCTGCATACAC- TAATTCTTTCACACGTGGTGTTTATTACCCTGACAAAGTTTTCAGATCCTCAGTTT- TACATTCAACTCAGGACTTGTTCTTACCTTTCTTTTCCAATGTTACTTGGTTCCATGT- TATCTCTGGGACCAATGGTACTAAGAGGTTTGATAACCCTGTCCTACCATT- TAATGATGGTGTTTATTTTGCTTCCATTGAGAAGTCTAACATAATAAGAGGCTGGATTTTT- GGTACTACTTTAGATTCGAAGACCCAGTCCCTACTTATTGTTAATAACGCTACTAATGTT- GTTATTAAAGTCTGTGAATTTCAATTTTGTAATGATCCATTTTTGGACCACAAAAACAA- CAAAAGTTGGATGGAAAGTGAGTTTAGAGTTTATTCTAGTGCGAATAATTGCACTTTT- GAATATGTCTCTCAGCCTTTTCTTATGGACCTTGAAGGAAAACAGGGTAATTTCAA- AAATCTTAGGGAATTTGTGTTTAAGAATATTGATGGTTATTTTAAAATATATTCTAAGCA- CACGCCTATTATAGTGCGTGAGCCAGAAGATCTCCCTCAGGGTTTTTCGGCTTTAGAAC- CATTGGTAGATTTGCCAATAGGTATTAACATCACTAGGTTTCAAACTTTACTTGCTTTACA- TAGAAGTTATTTGACTCCTGGTGATTCTTCTTCAG
Patient 3	TCTAGTCAGTGTGTTAATCTTACAACCAGAACTCAATTACCCCCTGCATACACTAA TTCTTTCACACGTGGTGTTTATTACCCTGACAAAGTTTTCAGATCCTCAGTTTTACATT- CAACTCAGGACTTGTTCTTACCTTTCTTTTCCAATGTTACTTGGTTCCATGTTATCTCTGG- GACCAATGGTACTAAGAGGTTTGATAACCCTGTCCTACCATTTAATGATGGTGTTTATTTT- GCTTCCATTGAGAAGTCTAACATAATAAGAGGCTGGATTTTTGGTACTACTTTA- GATTCGAAGACCCAGTCCCTACTTATTGTTAATAACGCTACTAATGTTGTTAT- TAAAGTCTGTGAATTTCAATTTTGTAATGATCCATTTTTGGACCACAAAAACAACAA-

	AAGTTGGATGGAAAGTGAGTTCAGAGTTTATTCTAGTGCGAATAATTGCACTTTTGAATA- TGTCTCTCAGCCTTTTCTTATGGACCTTGAAGGAAAACAGGGTAATTTCAAAAATCT- TAGGGAATTTGTGTTTAAGAATATTGATGGTTATTTTAAAATATATTCTAAGCACACGCC- TATTATAGTGCGTGAGCCAGAAGATCTCCCTCAGGGTTTTTCGGCTTTAGAACCATTGGTA- GATTTGCCAATAGGTATTAACATCACTAGGTTTCAAACTTTACTTGCTTTACATAGAAGT- TATTTGACTCCTGGTGATTCTTCTTCAG
Patient 4	ATCTTACAACCAGAACTCAATTACCCCCTGCATACACTAATTCTTTCACACGTGG TGTT- TATTACCCTGACAAAGTTTTCAGATCCTCAGTTTTACATTCAACTCAGGACTTGTTCTTA CCTTTCTTTTCCAATGTTACTTGGTTCCATGTTATCTCTGGGACCAATGGTACTAAGA- GGTTTGATAACCCTGTCCTACCATTTAATGATGGTGTTTATTTTGCTTCCATTGAGAA- GTCTAACATAATAAGAGGCTGGATTTTTGGTACTACTTTAGATTCGAAGACCCA- GTCCCTACTTATTGTTAATAACGCTACTAATGTTGTTATTAAAGTCTGTGAATTTCAA- TTTTGTAATGATCCATTTTTGGACCACAAAAACAACAAAAGTTGGATGGAAAGTGAGTT- CAGAGTTTATTCTAGTGCGAATAATTGCACTTTTGAATATGTCTCTCAGCCTTTTCTTATG- GACCTTGAAGGAAAACAGGGTAATTTCAAAAATCTTAGGGAATTTGTGTTTAAGAATATT- GATGGTTATTTTAAAATATATTCTAAGCACACGCCTATTATAGTGCGTGAGCCAGAA- GATCTCCCTCAGGGTTTTTCGGCTTTAGAACCATTGGTAGATTTGCCAATAGGTATTAACA- TCACTAGGTTTCAAACTTTACTTGCTTTACATAGAAGTTATTT- GACTCCTGGTGATTCTTCTTCAGG
Patient 5	TAGTCAGTGTGTTAATCTTACAACCAGAACTCAATTACCCCCTGCATACACTAATTCTTT- CACACGTGGTGTTTATTACCCTGACAAAGTTTTCAGATCCTCAGTTTTACATTCAA CTCA- GGACTTGTTCTTACCTTTCTTTTCCAATGTTACTTGGTTCCATGTTATCTCTGGGACCAA- TGGTACTAAGAGGTTTGATAACCCTGTCCTACCATTTAATGATGGTGTTTATTTTGCTTC- CATTGAGAAGTCTAACATAATAAGAGGCTGGATTTTTGGTACTACTTTAGATTCGAAGAC- CCAGTCCCTACTTATTGTTAATAACGCTACTAATGTTGTTATTAAAGTCTGTGAATTTCAA- TTTTGTAATGATCCATTTTTGGACCACAAAAACAACAAAAGTTGGATGGAAAGTGAGTT- CAGAGTTTATTCTAGTGCGAATAATTGCACTTTTGAATATGTCTCTCAGCCTTTTCTTATG- GACCTTGAAGGAAAACAGGGTAATTTCAAAAATCTTAGGGAATTTGTGTTTAAGAATATT- GATGGTTATTTTAAAATATATTCTAAGCACACGCCTATTATAGTGCGTGAGCCAGAA- GATCTCCCTCAGGGTTTTTCGGCTTTAGAACCATTGGTAGATTTGCCAATAGGTATTAACA- TCACTAGGTTTCAAACTTTACTTGCTTTACATAGAAGTTATTT- GACTCCTGGTGATTCTTCTTCAG
Patient 20	GTCTCTAGTCAGTGTGTTAATCTTACAACCAGAACTCAATTACCCCCTGCATAC AC- TAATTCTTTCACACGTGGTGTTTATTACCCTGACAAAGTTTTCAGATCCTCAGTTT- TACATTCAACTCAGGACTTGTTCTTACCTTTCTTTTCCAATGTTACTTGGTTCCATGT- TATCTCTGGGACCAATGGTACTAAGAGGTTTGATAACCCTGTCCTACCATT- TAATGATGGTGTTTATTTTGCTTCCATTGAGAAGTCTAACATAATAAGAGGCTGGATTTTT- GGTACTACTTTAGATTCGAAGACCCAGTCCCTACTTATTGTTAATAACGCTACTAATGTT- GTTATTAAAGTCTGTGAATTTCAATTTTGTAATGATCCATTTTTGGACCACAAAAACAA- CAAAAGTTGGATGGAAAGTGAGTTCAGAGTTTATTCTAGTGCGAATAATTGCACTTTT- GAATATGTCTCTCAGCCTTTTCTTATGGACCTTGAAGGAAAACAGGGTAATTTCAA- AAATCTTAGGGAATTTGTGTTTAAGAATATTGATGGTTATTTTAAAATATATTCTAAGCA- CACGCCTATTATAGTGCGTGAGCCAGAAGATCTCCCTCAGGGTTTTTCGGCTTTAGAAC- CATTGGTAGATTTGCCAATAGGTATTAACATCACTAGGTTTCAAACTTTACTTGCTTTACA- TAGAAGTTATTTGACTCCTGGTGATTCTTCTTC
Patient 21	CTAGTCAGTGTGTTAATCTTACAACCAGAACTCAATTACCCCCTGCATACACTAAT TCTTTCACACGTGGTGTTTATTACCCTGACAAAGTTTTCAGATCCTCAGTTTTACATTCAA- CTCAGGACTTGTTCTTACCTTTCTTTTCCAATGTTACTTGGTTCCATGTTATCTCTGGGAC- CAATGGTACTAAGAGGTTTGATAACCCTGTCCTACCATTTAATGATGGTGTTTATTTT- GCTTCCATTGAGAAGTCTAACATAATAAGAGGCTGGATTTTTGGTACTACTTTA- GATTCGAAGACCCAGTCCCTACTTATTGTTAATAACGCTACTAATGTTGTTAT- TAAAGTCTGTGAATTTCAATTTTGTAATGATCCATTTTTGGACCACAAAAACAACAA- AAGTTGGATGGAAAGTGAGTTCAGAGTTTATTCTAGTGCGAATAATTGCACTTTTGAATA- TGTCTCTCAGCCTTTTCTTATGGACCTTGAAGGAAAACAGGGTAATTTCAAAAATCT- TAGGGAATTTGTGTTTAAGAATATTGATGGTTATTTTAAAATATATTCTAAGCACACGCC- TATTATAGTGCGTGAGCCAGAAGATCTCCCTCAGGGTTTTTCGGCTTTAGAACCATTGGTA-

	GATTTGCCAATAGGTATTAACATCACTAGGTTTCAAACTTTACTTGCTTTACATAGAAGT- TATTTGACTCCTGGTGATTCTTCTTCAGGTT
Patient 22	TCTAGTCAGTGTGTTAATCTTACAACCAGAACTCAATTACCCCCTGCATACACTAA TTCTTTCACACGTGGTGTTTATTACCCTGACAAAGTTTTCAGATCCTCAGTTTTACATT- CAACTCAGGACTTGTTCTTACCTTTCTTTTCCAATGTTACTTGGTTCCATGTTATCTCTGG- GACCAATGGTACTAAGAGGTTTGATAACCCTGTCCTACCATTTAATGATGGTGTTTATTTT- GCTTCCATTGAGAAGTCTAACATAATAAGAGGCTGGATTTTTGGTACTACTTTA- GATTCGAAGACCCAGTCCCTACTTATTGTTAATAACGCTACTAATGTTGTTAT- TAAAGTCTGTGAATTTCAATTTTGTAATGATCCATTTTTGGACCACAAAAACAACAA- AAGTTGGATGGAAAGTGAGTTCAGAGTTTATTCTAGTGCGAATAATTGCACTTTTGAATA- TGTCTCTCAGCCTTTTCTTATGGACCTTGAAGGAAAACAGGGTAATTTCAAAAATCT- TAGGGAATTTGTGTTTAAGAATATTGATGGTTATTTTAAAATATATTCTAAGCACACGCC- TATTATAGTGCGTGAGCCAGAAGATCTCCCTCAGGGTTTTCGGCTTTAGAACCATTGGTA- GATTTGCCAATAGGTATTAACATCACTAGGTTTCAAACTTTACTTGCTTTACATAGAAGT- TATTTGACTCCTGGTGATTCTTCTTCAGG

Table S2. Viral load detected in aerosols per m^3 of air using different methods.

Method	*Viral load (copies/m³) by RT-qPCR*	*Patients*	*Particle diameter*	*Ref.*
NIOSH BC 251 Ciclon Time: 4 hours Flow: 3.5 L/min Volume: 5040 L Medium: 15 mL (n/d)	$1.84 E^3$ - $3.38 E^3$ Detection: 2/3 samples	2 patients (Ct 33.22; 18.45 and 20.11)	>4 µm 1–4 µm (Not detected in <1 µm samples)	[1]
SASS 2300 Wetted Wall Cyclone Time: 30 min Flow: 300 L/min Volume: 9000 L Medium: n/d (n/d)	$5.2 E^2$ - $1.4 E^3$ Detection: UCI: 54/124 samples GW: 9/114 samples	ICU 15 pat. GW 24 pat.	n/d	[2]
Sartorius MD8 Time: 15 min Flow: 50 L/min Volume: 750 L Medium: gelatin filter	$2.42 E^3$ Detection: 121/163 samples	3 patients and quarantin unit spaces	n/d	[3]
Coriolis µ Time: 10 min Flow: 100 L/min Volume: 1000 L Medium: 5 mL (DMEM)	$5.05 E^2$ – $5.15 E^2$ Detection: 14/31 samples	Tracheostomy procedures, admissions ward, ICU and general area	n/d	[4]
VIVAS (condensation method) Time: 1 hour Flow: 6.5 L/min Volume: 390 L Medium: 1.5 mL (PBS)	$8.7 E^3$ Detection: 1/2 samples	Respiratory infection evaluation area	n/d	[5]
SKC biosampler Time: 3 hours Flow: 12 L/min Volume: 2160 L Medium: 15 mL (DMEM)	n/d Detection: 2/14 samples, only in ICU areas	ICU areas (10 patients), hospital entrance and hall	0.25 and 32 µm particle size detection with aerosol spectrometer	[6]
Cascade impactor Time: 48 hours Flow: 5 L/min Volume: 14400 L	5 - $5.1 E^1$ Detection: 9/90 samples	COVID areas, close to ICU, nursing and workers workstations	≤ 2.5 µm, 2.5-10.0 µm and > 10 µm	[7]
NIOSH W-15 cyclone Time: 30 min Flow: 3.5 L/min Volume: 210 L	n/d	ICU and isolation ward	n/d	[8]

Medium: 15 mL (>4.0 µm), 1.5 mL (1.0-4.0 µm) and PTFE filter (<1.0 µm) DingBlue sampler Time: 30 min Flow: 14 L/min Volume: 420 L Medium: 3 mL (VTM)	Detection: UCI: 1/218 samples IW: 9/182			
Coriolis µ Time: 10 min Flow: 300 L/min Volume: 3000 L Medium: 15 mL (PBS) Sartorius MD8 Time: 10 min Flow: 50 L/min Volume: 500 L Medium: gelatin filter	<10 – 4.6 E^2 Detection: 4/55 samples	ICU and non-ICU COVID settings	n/d	[9]
Coriolis µ Time: 10 min Flow: 100 L/min Volume: 1000 L Medium: 4 mL (PBS)	6.36 E^3 – 6.66 E^3 Detection: 2/44 samples	4 COVID areas and 7 non-COVID areas from an Hospital	n/d	[10]
Coriolis µ Time: 10 min Flow: 100 L/min Volume: 1000 L Medium: 5 mL (DMEM)	1.31 E^2 – 7.05 E^3 Detection: 2/31 samples	Emergency Department and hospital public areas	n/d	[11]
Coriolis µ Time: 10 min Flow: 150 L/min Volume: 1500 L Medium: 5 mL (VTM)	0.64 E^2 – 11.94 E^3 Detection: ICU: 4/23 samples WR: 7/92 samples LTCR: 3/15 FR: 1/8	COVID rooms (WR), ICU areas and rooms in long-term care homes (LTCT) and facility rooms (FR)	n/d	[12]
Coriolis µ Time: 10 min Flow: 300 L/min Volume: 3000 L Medium: 15 mL (PBS)	n/d Detection: 4/90 samples	COVID rooms	n/d	[13]
SKC biosampler impigner Time: 30 min Flow: 12.5 L/min Volume: 375 L Medium: 10 mL (PBS)	2.6 E^2 – 7.1 E^2 Detection: 16/86 samples	COVID rooms and other hospital areas	n/d	[14]
PM2.5 Filters Time: 10 hours Flow: 10 L/min Volume: 6000 L	9.89 E^2 – 9.50 E^3 Detection: 3/12 samples	Public transport	n/d	[15]
Sartorius MD8 Time: 4, 6 and 18 hours Flow: 10 L/min Volume: 240, 260 and 1080 L Medium: gelatin filter	<2.5 E^1 – 5.1 E^2 Detection: 11/100 samples	COVID patient rooms	n/d	[16]
WA-400 DingBlue Centrifugal Time: 30 min Flow: 400 L/min Volume: 12000 L Medium: 2 mL (PBS)	1.11 E^3 – 1.12 E^4 Detection: ICU: 8/38 samples TAC: 1/6 samples	ICU places and TAC rooms	n/d	[17]
Derenda PNS 16T-3.1 Time: 1.5 hours Flow: 16.7 L/min	5.5 E^1 – 3.15 E^3 Detection:	AIIR	n/d	[18]

Volume: 1500 L Medium: membrane filter	25/1544 samples			

Where, ICU = Intensive Care Unit; GW = General Ward; AIIR = Airborne Infectious Isolation Rooms.

Table S3. Some superspreading events. Modified from [19].

Setting	Number of sites	Total infected	Reference
Religious	2	4531	[20]
	3	150	[21]
	1	102	[22]
	2	33	[23]
	1	19	[24]
Worker dormitories	17	1690	[23]
Food processing plant	1	1029	[25]
	3	779	[26]
	1	534	[27]
	4	469	[28]
Work	2	34	[23]
	3	25	[29]
School	1	133	[30]
	1	130	[31]
	1	96	[32]
	1	26	[33]
Shopping	3	122	[23]
	3	44	[34]
Hospital	1	118	[20]
	1	54	[35]
	2	20	[36]
Bar	6	100	[36]
	1	6	[37]
	1	77	[38]
	1	16	[39]
	1	15	[40]
	4	106	[24]
Building Site	3	90	[23]
Conference	1	89	[41]
Meal	2	55	[23]
	2	19	[42]
Aircraft	1	26	[43]
Skiing	1	11	[44]
Bus	1	30	[45]

Table S4. Dose-response characterization using animal models. Modified from Karimzadeh et al.[46]

Host	*Dose (copies)*	*Infection rate*	*Inoculation method*	*Ref*
Ferret	221,359	6/6	Intranasal	[47]
Ferret	500	1/6	Intranasal	[48]
	50,000	6/6		
	500,000	6/6		
Ferret	420,000	4/4	Intranasal	[49]
Mice (hACE2)	70,000	7/19	Intranasal	[50]
Mice (hACE2)	400,000	3/3	Intranasal	[51]
	4,000,000	1/3	Intragastric	
Mice (hACE2)	630	2/2	Aerosols	[52]
Mice (hACE2)	21,000	24/24	Intranasal	[53]
Mice (hACE2)	100,000	11	Intranasal	[54]
Cynomolgus macaque	700,000	4/4	Intranasal, intratraqueal	[55]

Rhesus macaque	700,000	2/2	Intraocular	[56]
		1/1	Intrathecal	
		0/2	Intragastric	
Rhesus macaque	1,820,000	8/8	Intranasal, intrathecal, intraocular, oral	[57]
Rhesus macaque	11,000	3/3	Intranasal, intrathecal	[58]
	110,000	3/3	Intranasal, intrathecal	
	1,100,000	3/3	Intranasal, intrathecal	
Cynomolgus macaque	48,600	4/4	Aerosols	[59]
Rhesus macaque	28,700	4/4		
African Green Monkeys	38,000	3/3		
African Green Monkeys	500,000	6/6	Intranasal, intrathecal	[60]
African Green Monkeys	3,000,000	6/6	Intranasal	[61]
African Green Monkeys	2,000	2/2	Aerosols	[62]
	3,610,000	2/2	Intranasal, intrathecal intraocular, oral	
Syrian hamster	398,107	4/4	Intranasal, intraocular	[63]
	1,000		Intranasal, intraocular	
Syrian hamster	56,000	3/3	Intranasal	[64]
Syrian hamster	100,000	24/36	Intranasal	[65]
Syrian hamster	70,000	7/9	Intranasal	[66]

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