

AiroDoctor

STUDIES AND REPORTS

SCIENTIFIC VALIDATION

UVA LED PHOTOCATALYTIC AIR PURIFICATION SYSTEM

ELIMINATES >99% OF ALL TESTED VIRUSES AND BACTERIA



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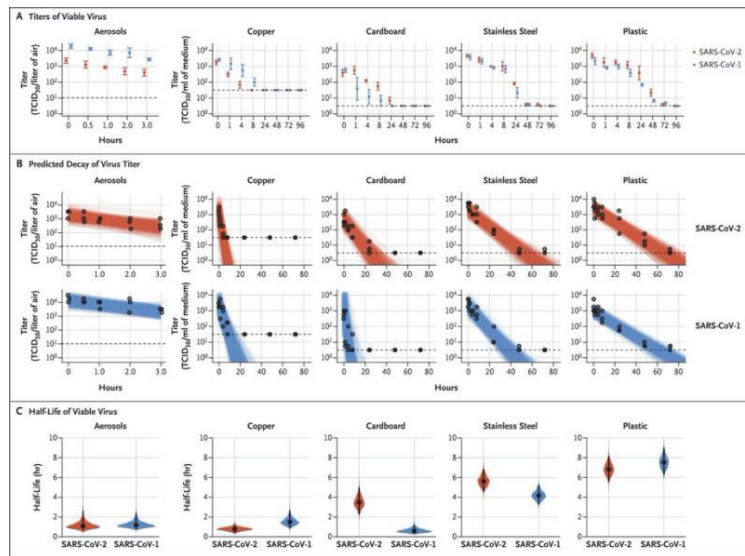
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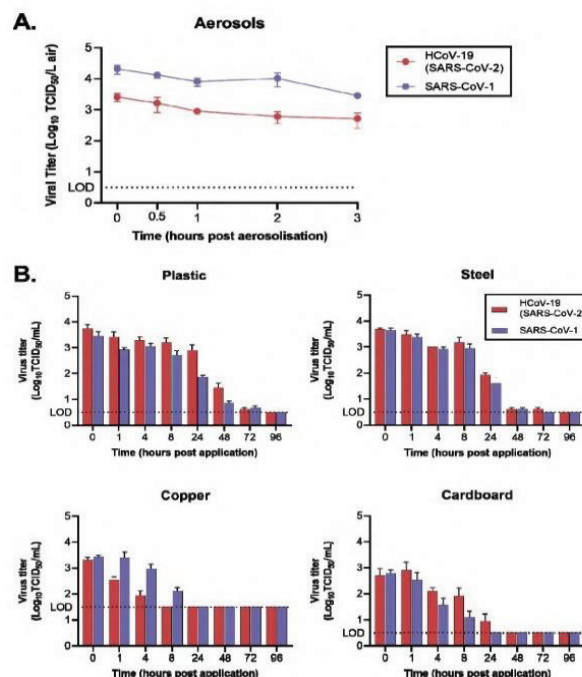
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UNDERSTANDING VIRUS AEROSOLS

Published in the New England Journal of Medicine, scientists at Princeton University, the University of California-Los Angeles, and the National Institutes of Health (NIH), et. al. indicated that the SARS-CoV-2 virus could remain viable in the air up to 3 hours post aerosolization, while detected on plastic and other surfaces for up to three days.⁽¹⁾



“Our results indicate that aerosol and fomite transmission of HCoV-19 is plausible, as the virus can remain viable in aerosols for multiple hours and on surfaces up to days,” reads the study abstract.⁽²⁾



<https://www.nejm.org/doi/full/10.1056/NEJMc2004973>⁽¹⁾
<https://www.medrxiv.org/content/10.1101/2020.03.09.20033217v1.full.pdf>⁽²⁾

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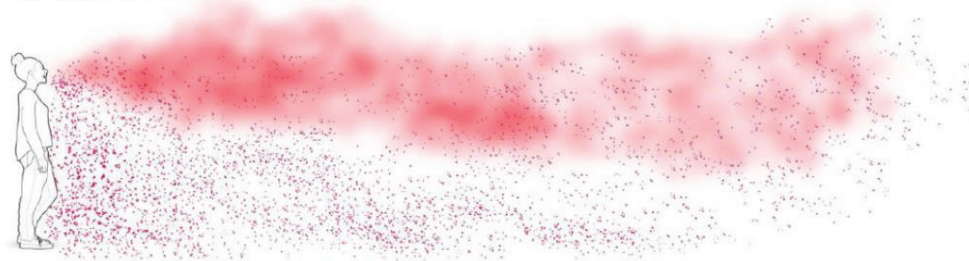
AIRBORNE TRANSMISSION OF THE HUMAN CORONAVIRUS

Some infections can be spread by exposure to virus in small droplets and particles that can linger in the air for minutes to hours. These viruses may be able to infect people who are further than 6 feet away from the person who is infected or after that person has left the space. This kind of spread is referred to as **airborne transmission** and is an important way that infections like tuberculosis, measles, and chicken pox are spread.

There is evidence that under certain conditions, people with COVID-19 seem to have infected others who were more than 6 feet away. These transmissions occurred within enclosed spaces that had inadequate ventilation. Sometimes the infected person was breathing heavily, for example while singing or exercising. Under these circumstances, scientists believe that the amount of infectious smaller droplet and particles produced by the people with COVID-19 became concentrated enough to spread the virus to other people. The people who were infected were in the same space during the same time or shortly after the person with COVID-19 had left.

Available data indicate that it is much more common for the virus that causes COVID-19 to spread through close contact with a person who has COVID-19 than through airborne transmission. ⁽³⁾

Emissions from a sneeze



The cloud may travel as far as almost 20 feet after a cough, and about six feet after exhalation, according to the MIT researcher.

Scientists emphasize there is no distinct size cut-off between droplets and aerosols. Some disagree about size ranges for each. Researchers are working to better understand the infectiousness of various-sized droplets and aerosols, and how it may change over time.

Large Droplet: **100 microns (diameter) or larger**

Small Droplets and Large Aerosols: **100 microns or smaller**

Small Aerosols: **3 microns or less**

These heavier droplets fall to the ground within seconds



Can linger in the air for 30 minutes or more



Can linger for hours



Source: WSJ research; Linsey Marr, Virginia Tech University; Lydia Bourouiba, Massachusetts Institute of Technology
Caitlin McCabe, Alberto Cevantes, Josh Ulick/THE WALL STREET JOURNAL

<https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-covid-spreads.html> ⁽³⁾
<https://www.wsj.com/articles/key-to-preventing-covid-19-indoors-ventilation-11598953607>

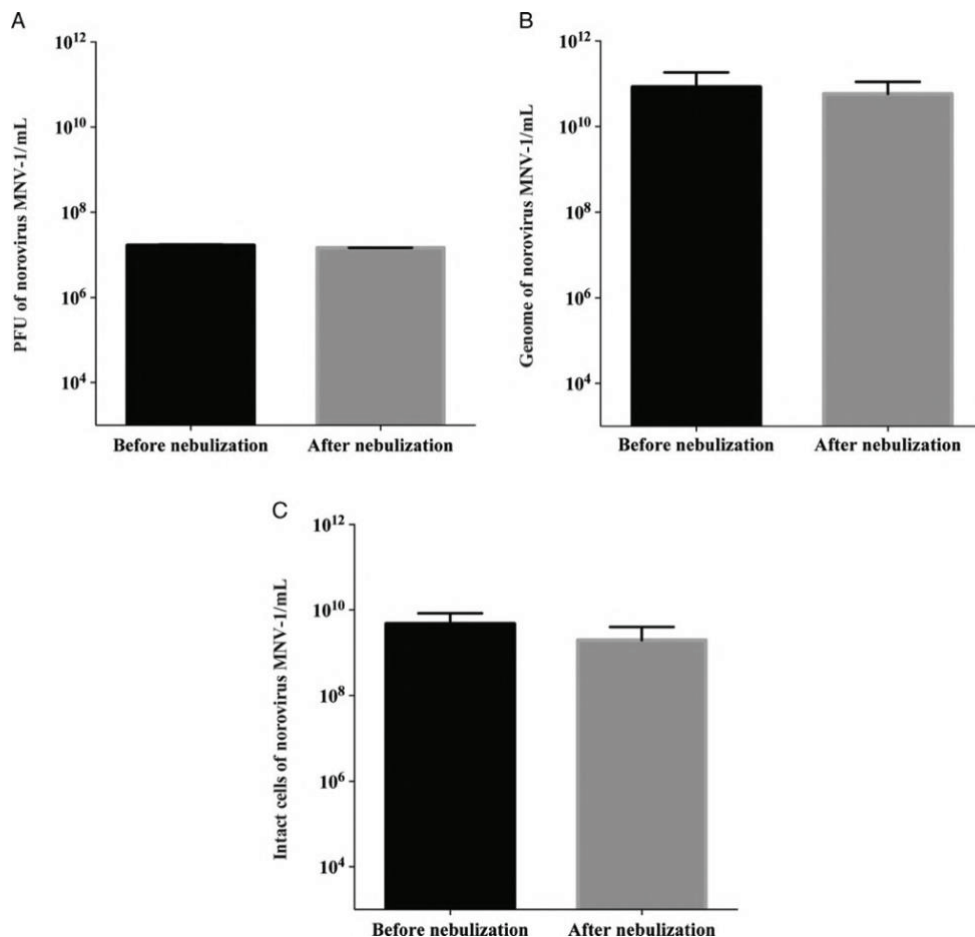
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DETECTION AND QUANTIFICATION OF AIRBORNE NOROVIRUSES DURING OUTBREAKS IN HEALTHCARE FACILITIES

A study by the Université Laval in Québec (Clinical Infectious Diseases (2015; doi: 10.1093/cid/civ321), shows that the viruses are actually detectable in the air. The aims of this study were to investigate the presence of norovirus bioaerosols during gastroenteritis outbreaks in healthcare facilities and to study the in vitro effects of aerosolization and air sampling on the noroviruses.

“Norovirus genomes were detected in 6 of 8 healthcare centers. The concentrations ranged from 1.35×10^4 to 2.35×10^3 genomes/m³ in 47% of air samples. MNV-1 preserved its infectivity and integrity during in vitro aerosol studies.”

“Norovirus genomes are frequently detected in the air of healthcare facilities during outbreaks, even out- side patients’ rooms. In addition, in vitro models suggest that this virus may withstand aerosolization.”⁽⁴⁾



There is no significant difference between virus concentration at the beginning and at the end of aerosolization.

<https://academic.oup.com/cid/article/61/3/299/491373>⁽⁴⁾

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UVA LED PHOTOCATALYTIC AIR PURIFICATION SYSTEM

AiroDoctor air purifier with photocatalytic functionality completely breaks down harmful substances, such as viruses and pathogenic bacteria. This process is very efficient and safe for the environment as it produces no ozone or other chemical substances. The fine-pored structure of the photocatalytic system allows filtration of particles from PM2.5 classifications to less than 0.1µm.

Summary of Evaluation Results – UVA LED Photocatalytic System		
Testing Parameter	Microorganism	Percent Reduction
Virus	Human Coronavirus	>99.9%
Bacteria	E. coli	>99.9%
Bacteria	Salmonella	>99%
Virus	Rotavirus	>99%
Virus	Norovirus (Murine)	>99%
Virus	Influenza A	>99.9%
Bacteria	MRSA	>99.9%

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SCIENTIFIC DATA FOR AIRODOCTOR



The Korea Institute of Civil Engineering and Building Technology (KICT) is a Science & Technology government research institute. Since 1983, the institute has continuously operated to solve national and social issues, to create favorable, safe and high-quality environments in Korea. The KICT is a member of the research institute of the National Research Council of Science & Technology which operates together with the Ministry of Science and ICT. ⁽⁵⁾

Evaluation Results of Antibacterial - Antiviral Performace of Photocatalyst															AiroDoctor KICT			
Test method	Photocatalytic material		Bacteria · virus		UV inspection · measurement time									Analysis method	Virus elimination rate	Remarks		
	Type	Concentration	Type	Concentration	0.25 ^m	0.5 ^m	0.75 ^m	1.0 ^h	1.25 ^h	1.5 ^h	2.0 ^h	3.0 ^h	4.0 ^h					
Coating	P-25 NP400	-	Bacteriophage Qβ	1 × 10 ⁷ pfu/ml		⊙	○				○	○	○	Plaque Assay	99.99%	CEVI		
			Bacteriophage MS-2	2 × 10 ⁴ pfu/ml		○	○		⊙	○					Pour Plate Method		99.8%	
			<i>E. coli</i>			○	○		⊙	○					Spreading Plate Method		99% ↑	
			<i>Salmonella</i>			○	○		⊙	○							Spreading Plate Method	99% ↑
			Norovirus(Murine)			○	○		⊙	○							Plaque Assay	99% ↑
			Rotavirus			○	○		⊙	○							Plaque Assay	99% ↑
			Influenza		6.7 × 10 ⁶ TCID ₅₀ /ml											⊙	TCID ₅₀	99.99%
Suspension	P-25	0.0005%	Bacteriophage Qβ	5 × 10 ⁷ pfu/ml	○	○		⊙						Plaque Assay	99.99%	PIRC		
			<i>E. coli</i>		○	○		⊙							Spreading Plate Method		99.99%	
	P-25 NP400	0.1%	Bacteriophage MS-2	2 × 10 ⁴ pfu/ml	○	○		⊙	○						Pour Plate Method	99.9%	CEVI	
			<i>E. coli</i>	2 × 10 ⁴ cfu/ml	○	○		⊙	○						Spreading Plate Method	99% ↑		
			<i>Salmonella</i>		○	○		⊙	○						Spreading Plate Method	99% ↑		
			Norovirus(Murine)		○	○		⊙	○						Plaque Assay	99% ↑		
	Rotavirus	○	○			⊙	○						Plaque Assay	99% ↑				
	P-25	0.1%	HCoV	2 × 10 ⁴ pfu/ml	○	○	○	⊙						RT-qPCR	99% ↑			
P-25	0.05%	HCoV	2 × 10 ⁴ pfu/ml									⊙	RT-qPCR, TCID ₅₀	99.96%				

Table 1: Antiviral and antimicrobial performance evaluation of photocatalytic materials

Test condition ISO 16000-36:2018, Indoor air — Standard method for assessing the reduction rate of culturable airborne bacteria by air purifiers using a test chamber

<https://www.kict.re.kr/> ⁽⁵⁾

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TEST REPORT: KOREA INSTITUTE OF CIVIL ENGINEERING AND BUILDING TECHNOLOGY



>99.9% Elimination of Human Coronavirus

*HCoV-OC43 is an RNA Virus that is the same structure and size as SARS-CoV-2

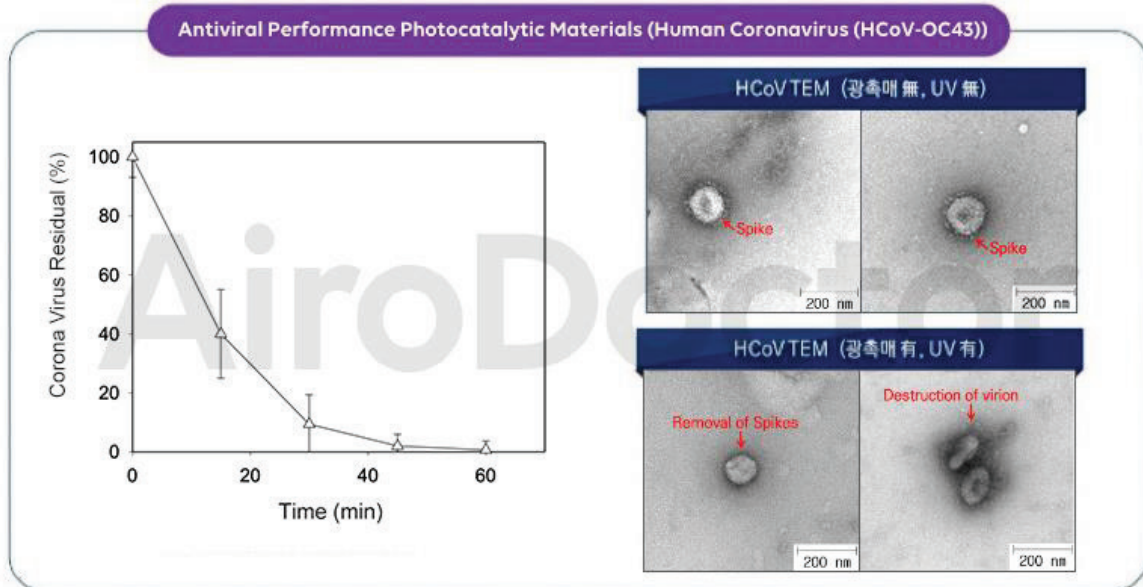


Table 2: Antiviral performance evaluation of photocatalytic materials using the Human Corona Virus HCoV-OC43

>99% Elimination of E. coli, Salmonella, Rotavirus, Norovirus, Bacteriophage MS-2, Influenza A

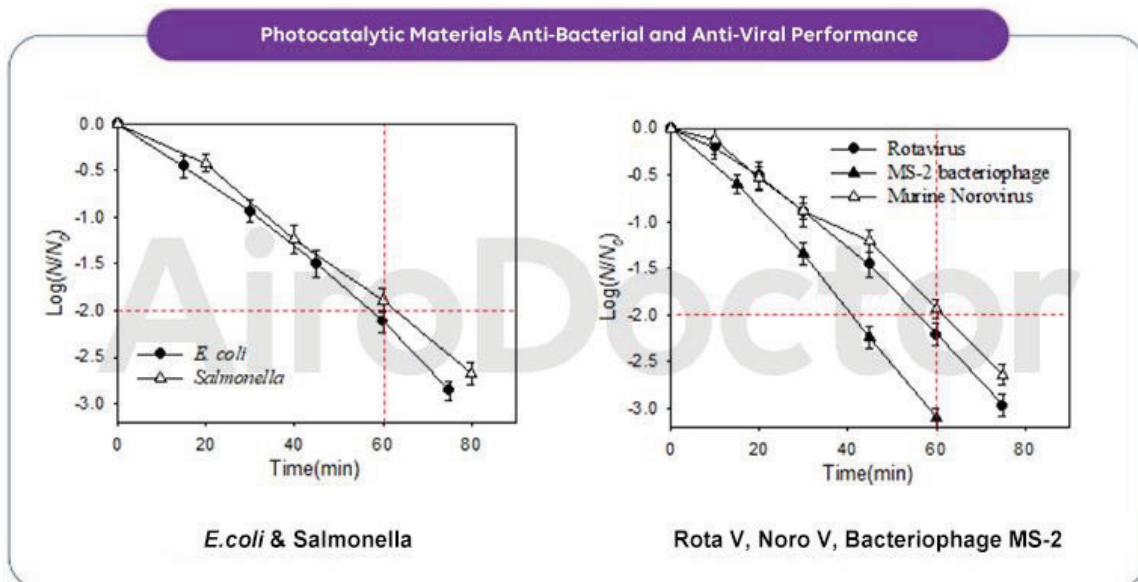


Table 3: Antimicrobial and antiviral performance of photocatalytic material

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TEST REPORT: THE KITASATO INSTITUTE OF MEDICAL RESEARCH



北里大学
KITASATO UNIVERSITY



学校法人
北里研究所
THE KITASATO INSTITUTE

The Kitasato Institute, Japan's first private medical research facility, was established in 1914. Together with the scientific discovery of life phenomena, the Institute takes as its mission the cultivation of preeminent researchers, educators, and other professionals in the Life Sciences and related fields and continues to play an active role in education, research, and medicine. Underlying all this is the indomitable spirit of the Institute's founder, Shibasaburo Kitasato, who devoted his life to preventive medicine and was a groundbreaker in the study of Life Sciences, never wavering in his efforts to apply medicine in a practical way to benefit society.

The Kitasato Institute, founded by Shibasaburo Kitasato who also started the National Institute of Infectious Diseases, is a joint venture with the Institute of Research for Biologicals and operates the University School of Medicine. ⁽⁶⁾

>99.9% Elimination of *E. coli*

Table 1. Bacteria elimination effectiveness of equipment for the elimination of virus/bacteria in suspension when *E. coli* used as indicator

Measurement No.	Concentration of <i>E. coli</i> injected ($\times 10^9$ CFU/ml)	Ultraviolet light source: OFF			Ultraviolet light source: ON		
		Concentration of <i>E. coli</i> collected upstream	Concentration of <i>E. coli</i> collected downstream	Elimination rate of <i>E. coli</i> (%)	Concentration of <i>E. coli</i> collected upstream	Concentration of <i>E. coli</i> collected downstream	Elimination rate of <i>E. coli</i> (%)
		($\times 10^5$ CFU/ml)	($\times 10^5$ CFU/ml)		($\times 10^5$ CFU/ml)	($\times 10^5$ CFU/ml)	
1	1.905	110 \pm 1.6	80 \pm 0.5	27.27	115 \pm 1.5	<0.0001*	>99.999**
2	1.905	122 \pm 2.0	72 \pm 1.0	40.98	120 \pm 2.0	<0.0001*	>99.999**
3	1.905	126 \pm 1.5	84 \pm 1.0	33.33	126 \pm 1.4	<0.0001*	>99.999**

*Shown below measurable limit (10 CFU/ml) because *E. coli* was detected.

** Calculated based on the concentration of *E. coli* collected downstream and measurable limit (10 CFU/ml)

THE KITASATO INSTITUTE
Medical Environment Research Center

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TEST REPORT: THE KITASATO INSTITUTE OF MEDICAL RESEARCH

>99.9% Elimination of MRSA

Table 2. Bacteria elimination effectiveness of equipment for the elimination of virus/bacteria in suspension when MRSA used as indicator

Measurement No.	Concentration of MRSA injected ($\times 10^9$ CFU/ml)	Ultraviolet light source: OFF			Ultraviolet light source: ON		
		Concentration of MRSA collected upstream	Concentration of MRSA collected downstream	Elimination rate of MRSA (%)	Concentration of MRSA collected upstream	Concentration of MRSA collected downstream	Elimination rate of MRSA (%)
		($\times 10^5$ CFU/ml)	($\times 10^5$ CFU/ml)	(%)	($\times 10^5$ CFU/ml)	($\times 10^5$ CFU/ml)	(%)
1	1.605	120 \pm 1.5	86 \pm 0.5	27.27	115 \pm 1.5	<0.0001*	>99.999**
2	1.605	1232 \pm 2.2	70 \pm 2.0	40.98	120 \pm 2.0	<0.0001*	>99.999**
3	1.605	126 \pm 1.8	80 \pm 1.0	33.33	126 \pm 1.4	<0.0001*	>99.999**

*Shown below measurable limit (10 CFU/ml) because MRSA was detected.

** Calculated based on the concentration of MRSA collected downstream and measurable limit (10 CFU/ml)

THE KITASATO INSTITUTE,
Medical Environment Research Center

>99.9% Elimination of Influenza A

Table 3. Virus elimination effectiveness of equipment for the elimination of virus/bacteria in suspension when Influenza virus A used as indicator

Measurement No.	Concentration of Influenza virus A injected (TCID ₅₀ /ml)	Ultraviolet light source: OFF			Ultra Violet light source: ON		
		Concentration of Influenza virus A collected upstream	Concentration of Influenza virus A collected downstream	Elimination rate of Influenza virus A (%)	Concentration of Influenza virus A collected upstream	Concentration of Influenza virus A collected downstream	Elimination rate of Influenza virus A (%)
		(TCID ₅₀ /ml)	(TCID ₅₀ /ml)	(%)	(TCID ₅₀ /ml)	(TCID ₅₀ /ml)	(%)
1	1.0 ^{7.5}	10 ⁵²	10 ⁴⁸	60.19	10 ⁴⁴	10 ^{<0.5*}	>99.987**
2	1.0 ^{7.5}	10 ⁴⁸	10 ⁴²	74.88	10 ⁵²	10 ^{<0.5*}	>99.998**
3	1.0 ^{7.5}	10 ⁴⁶	10 ⁴³	49.88	10 ⁴⁸	10 ^{<0.5*}	>99.995**

* Shown below measurable limit (10^{<0.5} TCID₅₀/ml) because Influenza virus A was detected.

** Calculated based on the concentration of Influenza virus A collected downstream and measurable limit (10^{<0.5} TCID₅₀/ml)

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