



WHO

Guidance from World Health Organization (WHO):
[Coronavirus disease \(COVID-19\) outbreak](#)

Scientific papers

Aerodynamic Characteristics and RNA Concentration of SARS-CoV-2 Aerosol in Wuhan Hospitals during COVID-19 Outbreak, Biorxiv, March 10, 2020.

Yuan Liu, Zhi Ning, Yu Chen, Ming Guo, Yingle Liu, Nirmal Kumar Gali, Li Sun, Yusen Duan, Jing Cai, Dane Westerdahl, Xinjin Liu, Kin-fai Ho, Haidong Kan, Qingyan Fu, Ke Lan

<https://www.biorxiv.org/content/10.1101/2020.03.08.982637v1>

Aerodynamic analysis of SARS-CoV-2 in two Wuhan hospitals, Nature, Published: 27 April 2020

Yuan Liu, Zhi Ning, Yu Chen, Ming Guo, Yingle Liu, Nirmal Kumar Gali, Li Sun, Yusen Duan, Jing Cai, Dane Westerdahl, Xinjin Liu, Ke Xu, Kin-fai Ho, Haidong Kan, Qingyan Fu & Ke Lan

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Aerosol transmission of SARS-CoV-2 Evidence for probable aerosol transmission of SARS-CoV-2 in a poorly ventilated restaurant, medRxiv, April 22, 2020

Yuguo Li^{1*†}, Ph.D.; Hua Qian^{2†}, Ph.D.; Jian Hang^{3†}, Ph.D.; Xuguang Chen⁴, M.Sc.; Ling Hong³, Ph.D.; Peng Liang⁵, M.Sc.; Jiansen Li⁴, M.Sc.; Shenglan Xiao¹, Ph.D.; Jianjian Wei⁶, Ph.D.; Li Liu⁷, Ph.D.; and Min Kang^{4†}, M.Sc.

<https://www.medrxiv.org/content/10.1101/2020.04.16.20067728v1.full.pdf>

COVID-19 Outbreak Associated with Air Conditioning in Restaurant, Guangzhou, China, center for disease control and prevention (CDC) 2020

Jianyun Lu¹, Jieni Gu¹, Kuibiao Li¹, Conghui Xu¹, Wenzhe Su, Zhisheng Lai, Deqian Zhou, Chao Yu, Bin Xu
Comments to Author, and Zhicong Yang
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Leslie Dietz,^a Patrick F. Horve,^a David A. Coil,^b Mark Fretz,^{a,c} Jonathan A. Eisen,^{d,e,f} Kevin Van Den Wymelenberga,

<https://msystems.asm.org/content/msys/5/2/e00245-20.full.pdf>

Air, Surface Environmental, and Personal Protective Equipment Contamination by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) From a Symptomatic Patient, JAMA 2020

Sean Wei Xiang Ong, MBBS1; Yian Kim Tan, PhD2; Po Ying Chia, MBBS1; et al



<https://jamanetwork.com/journals/jama/fullarticle/2762692>

Practical recommendations for critical care and anesthesiology teams caring for novel coronavirus (2019-nCoV) patients, Canadian Journal of Anesthesia, 2020

Randy S. Wax MD, MEd, FRCPC, FCCM & Michael D. Christian

<https://link.springer.com/article/10.1007%2Fs12630-020-01591-x>

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Joseph G. Allen and Linsey C. Marr

<https://www.preprints.org/manuscript/202005.0126/v1>

Stability of SARS-CoV-2 in different environmental conditions, medRxiv preprint doi, 15/03/2020

Alex W.H. Chin, Julie T.S. Chu, Mahen R.A. Perera, Kenrie P.Y. Hui, Hui-Ling Yen, Michael C.W. Chan, Malik Peiris, Leo L.M. Poon

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Neeltje vanDoremalen, Trenton Bushmaker, Dylan Morris, Myndi Holbrook, Amandine Gamble, Brandi Will iamson, Azaibi Tamin, Jennifer Harcourt, Natalie Thornburg, Susan Gerber, Jamie Lloyd-Smith, Emmie de Wit, Vincent Munster

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Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents, healthcare infection society , March 2020

G. Kampf, D. Todt, S. Pfaender, E. Steinmann

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Visualizing Speech-Generated Oral Fluid Droplets with Laser Light Scattering Professional Organization

Philip Anfinrud, Ph.D., Christina E. Bax, B.A., Adriaan Bax, Ph.D.

https://www.nejm.org/doi/full/10.1056/NEJMc2007800?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%20%20pubmed

The Airborne Lifetime of Small Speech Droplets and Their Potential Importance in SARS-CoV-2 Transmission

Valentyn Stadnytskyi 1, Christina E Bax 2, Adriaan Bax 3, Philip Anfinrud

<https://pubmed.ncbi.nlm.nih.gov/32404416/>

Estimation of Airborne Viral Emission: Quanta Emission Rate of SARS-CoV-2 for Infection Risk Assessment

G Buonanno 1, L Stabile 2, L Morawska 3



<https://pubmed.ncbi.nlm.nih.gov/32416374/>

The Airborne Lifetime of Small Speech Droplets and Their Potential Importance in SARS-CoV-2 Transmission

Valentyn Stadnytskyi 1, Christina E Bax 2, Adriaan Bax 3, Philip Anfinrud 3

<https://pubmed.ncbi.nlm.nih.gov/32404416/>

Airborne Transmission Route of COVID-19: Why 2 Meters/6 Feet of Inter-Personal Distance Could Not Be Enough

Leonardo Setti 1,* , Fabrizio Passarini 2, Gianluigi De Gennaro 3, Pierluigi Barbieri 4, Maria Grazia Perrone 5, , Massimo Borelli 6, Jolanda Palmisani 3, Alessia Di Gilio3, Prisco Piscitelli7,8 and Alessandro Miani 8,9

https://www.researchgate.net/publication/340876488_Airborne_Transmission_Route_of_COVID-19_Why_2_Meters6_Feet_of_Inter-Personal_Distance_Could_Not_Be_Enough

Identifying airborne transmission as the dominant route for the spread of COVID-19

Renyi Zhang, View ORCID ProfileYixin Li, Annie L. Zhang, View ORCID ProfileYuan Wang, and Mario J. Molina

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Professional Organization

ASHRAE Position Document on Infectious Aerosols, Approved by ASHRAE Board of Directors, April 14, 2020

https://www.ashrae.org/file%20library/about/position%20documents/pd_infectiousaerosols_2020.pdf

REHVA, Federation of European Heating, Ventilation and air conditioning Association of designers and building services engineers , April 3, 2020

https://www.rehva.eu/fileadmin/user_upload/REHVA_COVID-19_guidance_document_ver2_20200403_1.pdf

Eurovent : European industry association for indoor climate, process cooling and food cold chain technologies , April 2, 2020

<https://eurovent.eu/?q=articles/covid-19-regular-and-correct-maintenance-ventilation-systems-gen-110500>

ASHRAE Offers COVID-19 Building Readiness/Reopening Guidance

<https://www.ashrae.org/about/news/2020/ashrae-offers-covid-19-building-readiness-reopening-guidance>

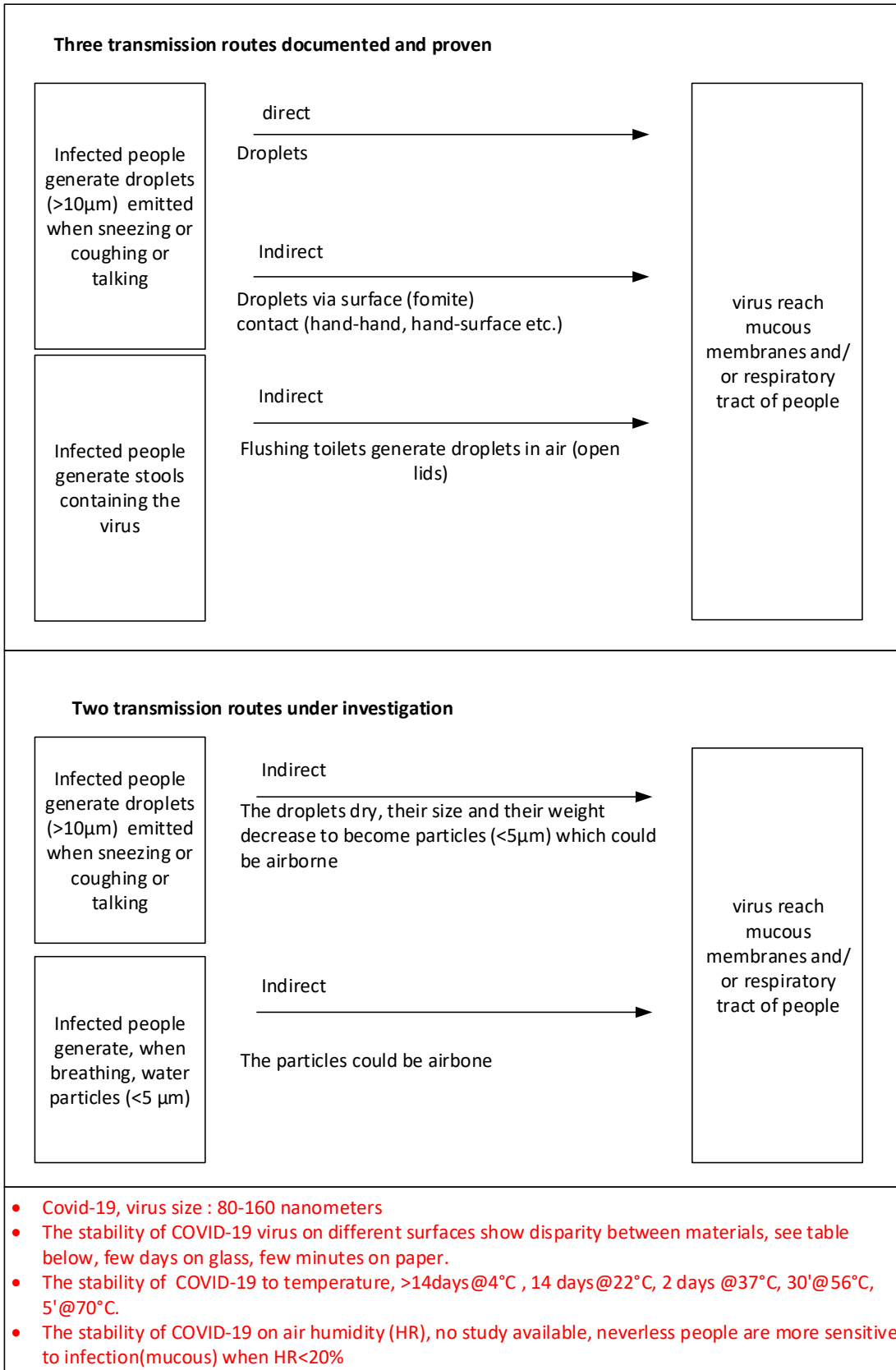
EPEE COVID-19 Transmission and Air Conditioning, June 2020



News paper

how air conditioners should be used to avoid getting coronavirus

<https://www.elmundo.es/ciencia-y-salud/salud/2020/06/23/5ef1d43d21efa0c22c8b460a.html>





Time vs material

Time	Virus titre (Log TCID ₅₀ /ml)									
	Paper		Tissue paper		Wood		Cloth		Glass	
	Mean	±SD	Mean	±SD	Mean	±SD	Mean	±SD	Mean	±SD
0 min	4.76	0.10	5.48	0.10	5.66	0.39	4.84	0.17	5.83	0.04
30 mins	2.18	0.05	2.19	0.17	3.84	0.39	2.84	0.24	5.81	0.27
3 hrs	U	-	U	-	3.41	0.26	2.21 ^a	-	5.34	0.05
6 hrs	U	-	U	-	2.47	0.23	2.25	0.08	5.06	0.31
1 day	U	-	U	-	2.07 ^a	-	2.07 ^a	-	3.48	0.37
2 days	U	-	U	-	U	-	U	-	2.44	0.19
4 days	U	-	U	-	U	-	U	-	U	-
7 days	U	-	U	-	U	-	U	-	U	-

Time	Banknote		Stainless steel		Plastic		Mask, inner layer		Mask, outer layer	
	Mean	±SD	Mean	±SD	Mean	±SD	Mean	±SD	Mean	±SD
	0 min	6.05	0.34	5.80	0.02	5.81	0.03	5.88	0.69	5.78
30 mins	5.83	0.29	5.23	0.05	5.83	0.04	5.84	0.18	5.75	0.08
3 hrs	4.77	0.07	5.09	0.04	5.33	0.22	5.24	0.08	5.11	0.29
6 hrs	4.04	0.29	5.24	0.08	4.68	0.10	5.01	0.50	4.97	0.51
1 day	3.29	0.60	4.85	0.20	3.89	0.33	4.21	0.08	4.73	0.05
2 days	2.47	0.23	4.44	0.20	2.76	0.10	3.16	0.07	4.20	0.07
4 days	U	-	3.26	0.10	2.27	0.09	2.47	0.28	3.71	0.50
7 days	U	-	U	-	U	-	U	-	2.79	0.46

Reference: Stability of SARS-CoV-2 in different environmental conditions,
<https://www.medrxiv.org/content/10.1101/2020.03.15.20036673v2.full.pdf>

Practical recommendation to maintain building Indoor air quality through two mains HVAC systems
https://www.rehva.eu/fileadmin/user_upload/REHVA_COVID-19_guidance_document_ver2_20200403_1.pdf

- AHU/RTU (air handling unit/ roof top unit)
 - Increase air supply and exhaust ventilation, stop air recirculation & switch recirculation to 100% outdoor air as much as possible
 - Use more window airing as possible
 - Safe use of heat recovery sections, Inspect heat recovery equipment to be sure that leakages are under control
 - Switch ventilation to nominal speed at least 2 hours before the building usage time and switch to lower speed 2 hours after the building usage time
 - At nights and weekends, do not switch ventilation off, but keep systems running at lower speed
 - Do not change heating, cooling and possible humidification setpoints
 - Replace central outdoor air and extract air filters as usually, according to maintenance schedule
 - Regular filter replacement and maintenance works shall be performed with common protective measures including respiratory protection
 - Do not plan duct cleaning for this period

- VRF/FC (variable refrigerant flow / fan coils)
 - Switch fan coils either off or operate so that fans are continuously on
 - Use more window airing as possible
 - Keep system running 7/24, even if it is low speed.
 - Do not change heating, cooling and possible humidification setpoints
 - Replace air filters as usually, according to maintenance schedule
 - Regular filter replacement and maintenance works shall be performed with common protective measures including respiratory protection

In addition:

- Keep toilet ventilation 24/7 in operation
- Avoid open windows in toilets to assure the right direction of ventilation