Leids Universitair Medisch Centrum

Prevention of SARS-CoV-2 transmission by aerosols in hospitals.

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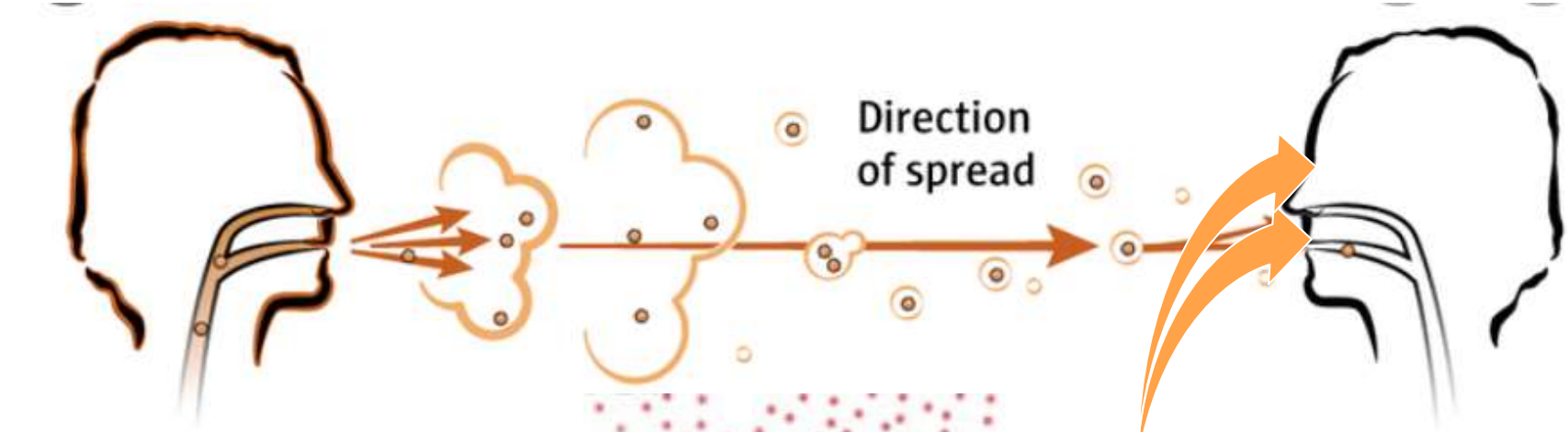
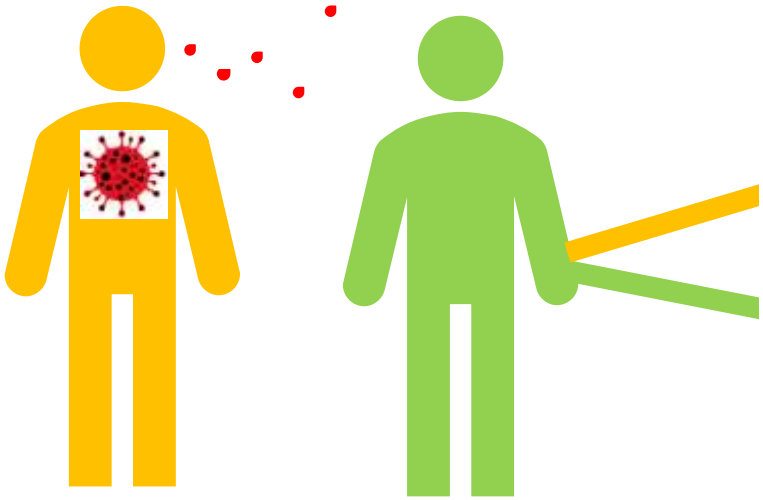
Transmission of SARS-CoV-2 by droplets & contact

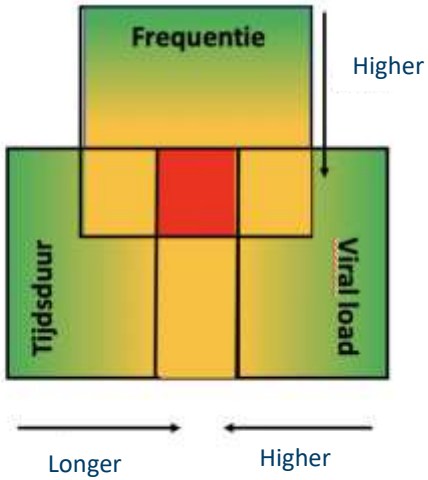


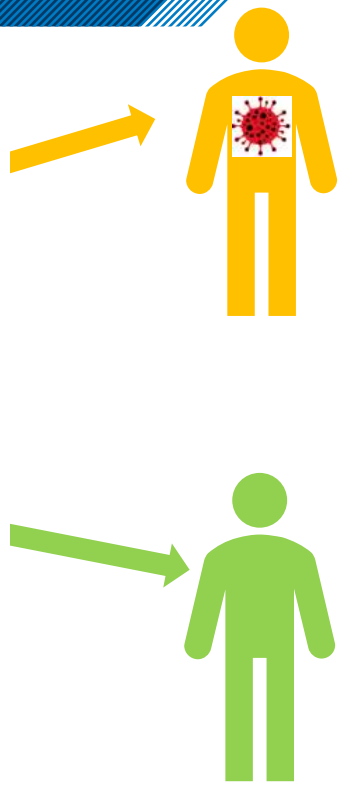
Peter Dazeley/The Image Bank via Getty Images

Risk of infection after close contact with a COVID positive person

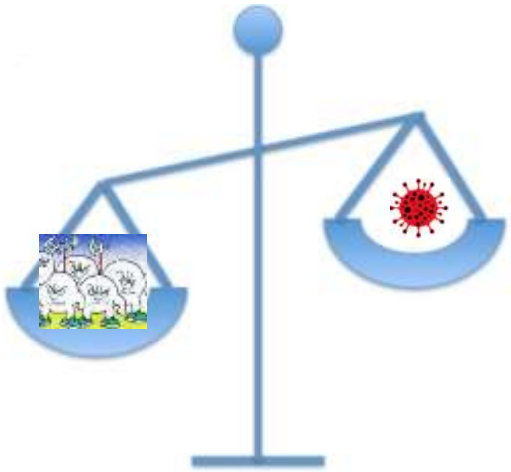
Infected

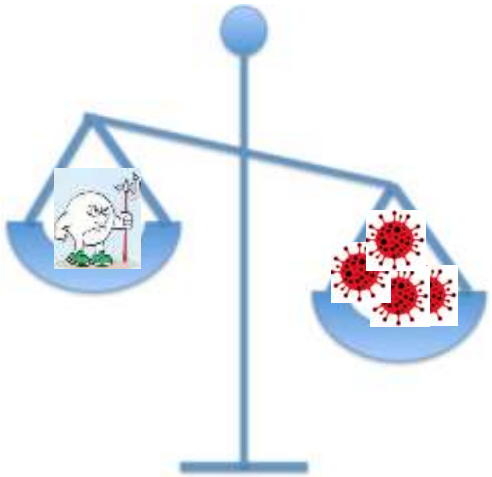




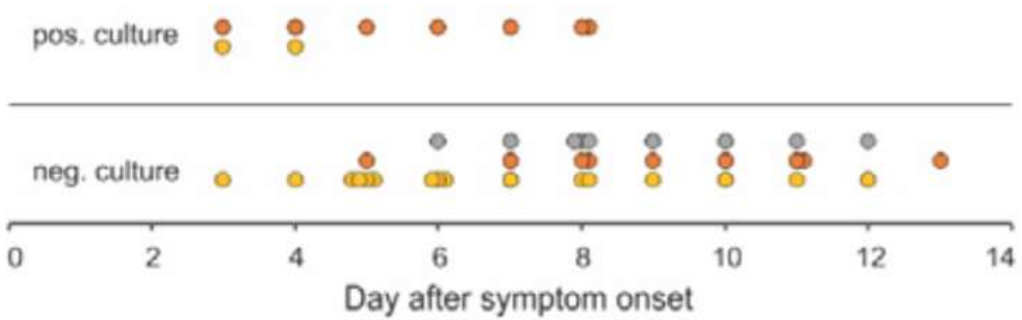


Disease





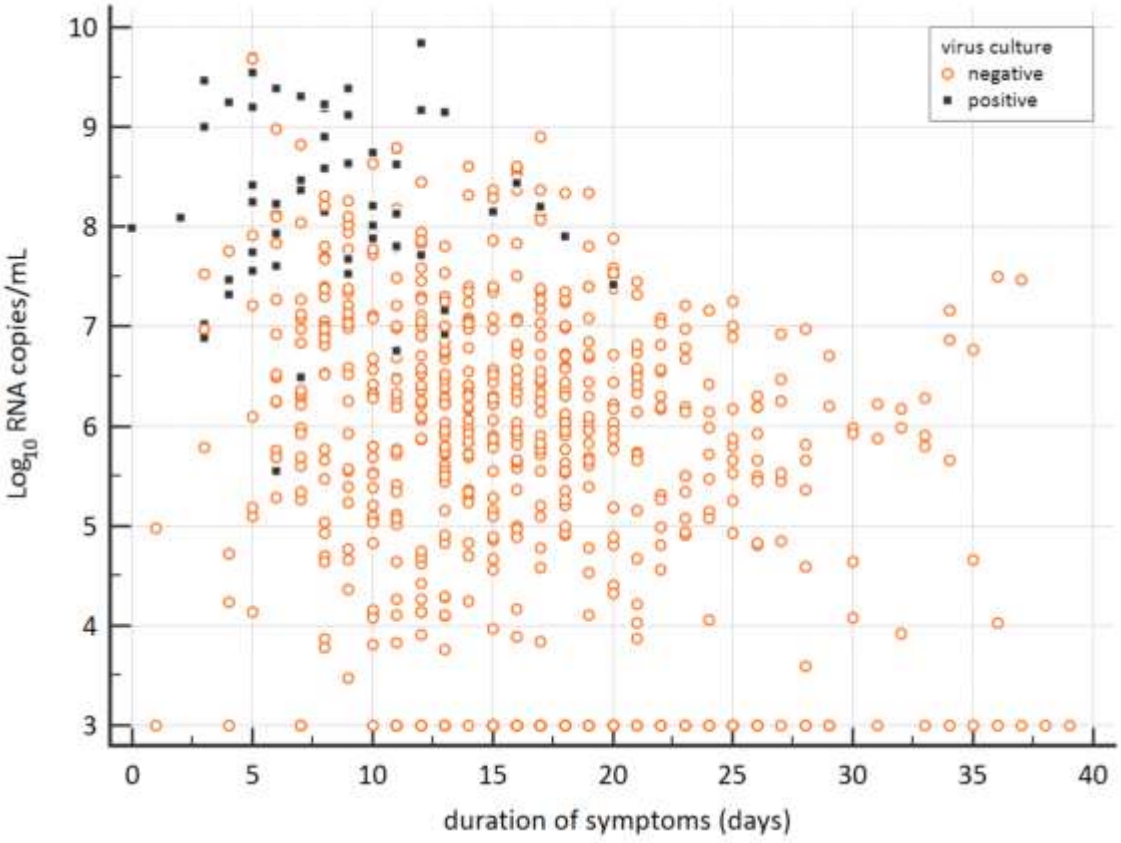
Presence of SARS-CoV viral RNA cannot be directly interpreted as potential infectious virus



Wollfel

https://doi.org/10.1101/2020.03.05.20030502.

9 patients with mild COVID



Kampen et al

https://doi.org/10.1101/2020.06.08.20125310

129 patients on ICU and MC

Definitions: Aerosol , airborne and droplet infection

Aerosol

- Cloud of droplets of different size
- Small droplets < 5um and nuclei

Infectious aerosol

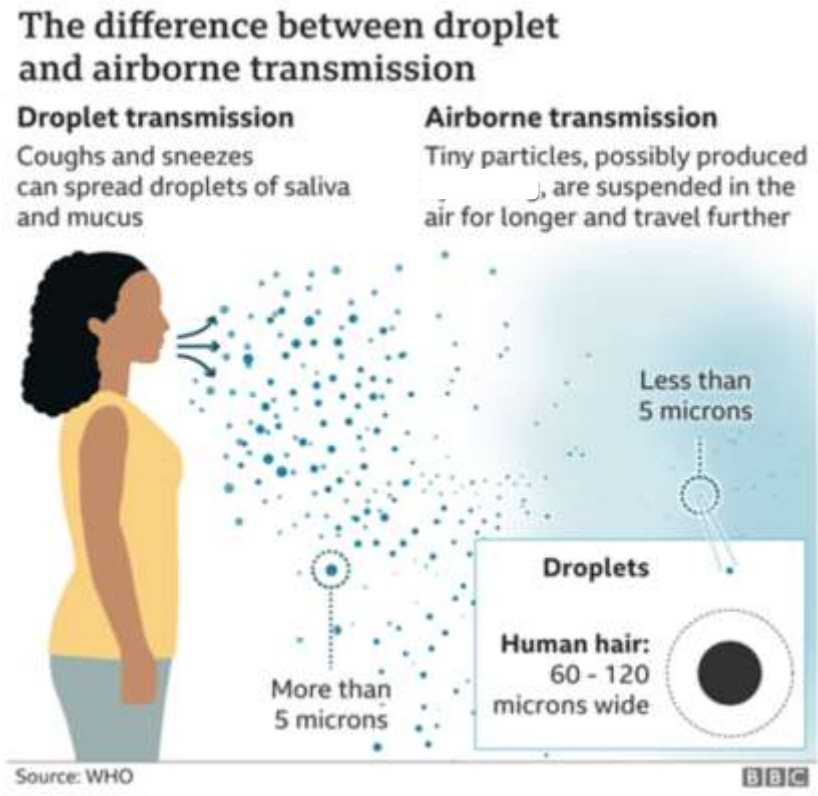
- Small droplets/nuclei with viable micro-organism

Airborne infection

- Infection caused by small infectious droplets/nuclei

Droplet infection

- Infection caused by microorganisms which are (mainly) spread by droplets (>5um) .



Infectious aerosol generating procedures (iAGP)

Medical procedures generating infectious aerosols:

-depends on procedure: AGP?

-depends on infection 

-depends on localization of infection

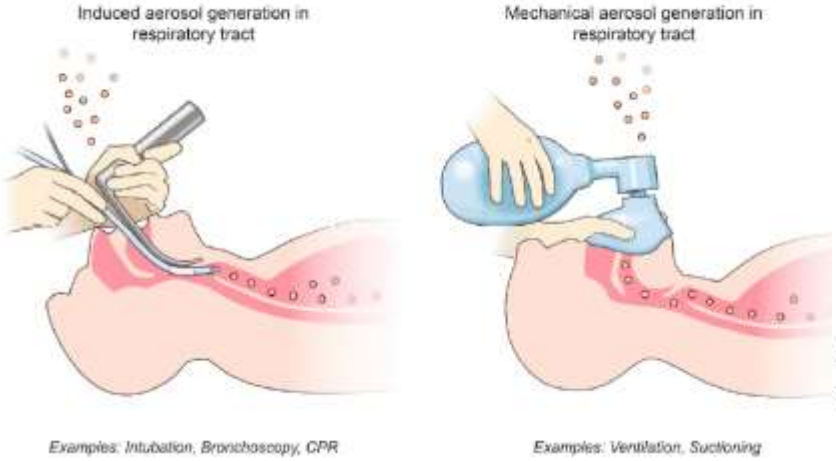
-depends on localization of AGP procedure

Federatie Medisch Specialisten

LEIDRAAD

Medische procedures die een infectieuze aerosol genereren (IAGP) met SARS-CoV-2

Viruses 2019, *11*, 940



Commonly performed medical procedures that are often considered AGPs, or that create uncontrolled respiratory secretions, include:

- open suctioning of airways
- sputum induction
- cardiopulmonary resuscitation
- endotracheal intubation and extubation
- non-invasive ventilation (e.g., BiPAP, CPAP)
- bronchoscopy
- manual ventilation

WHO

CDC

Based on limited available data, it is uncertain whether aerosols generated from some procedures may be infectious, such as:

- nebulizer administration*
- high flow O2 delivery

*Aerosols generated by nebulizers are derived from medication in the nebulizer. It is uncertain whether potential associations between performing this common procedure and increased risk of infection might be due to aerosols generated by the procedure or due to increased contact

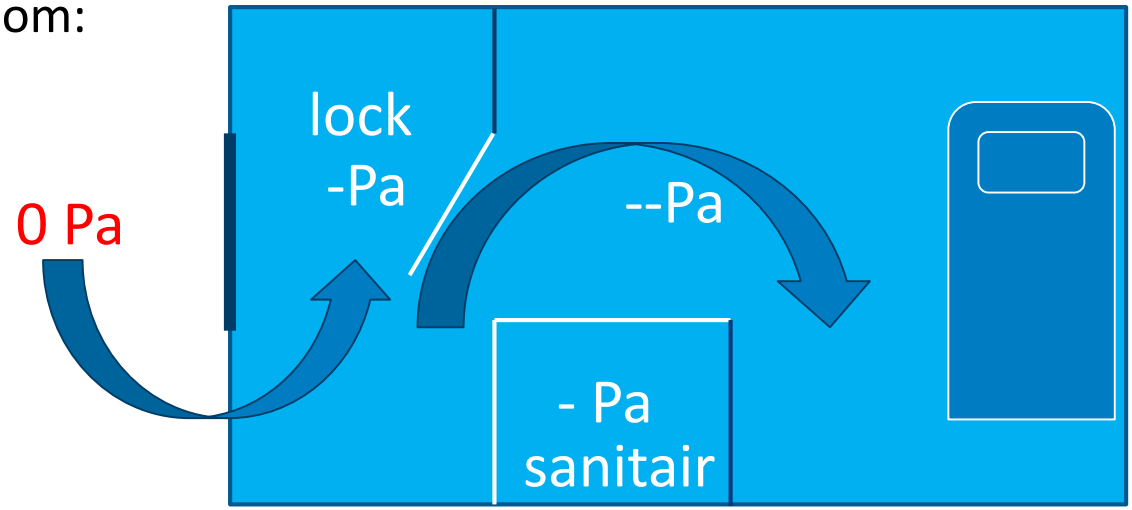
Precautions depend on risk of transmission
Personal protective equipment (PPE) & isolation

- Protection of respiratory tract by a mask
  - Surgical/medical mask
  - FFP2 respirator (aerosol generating procedures)
- Protection of the eyes by safety glasses/goggles/facemask
- Gown with long sleeves
- Gloves
    - **Proper donning and doffing very important!**

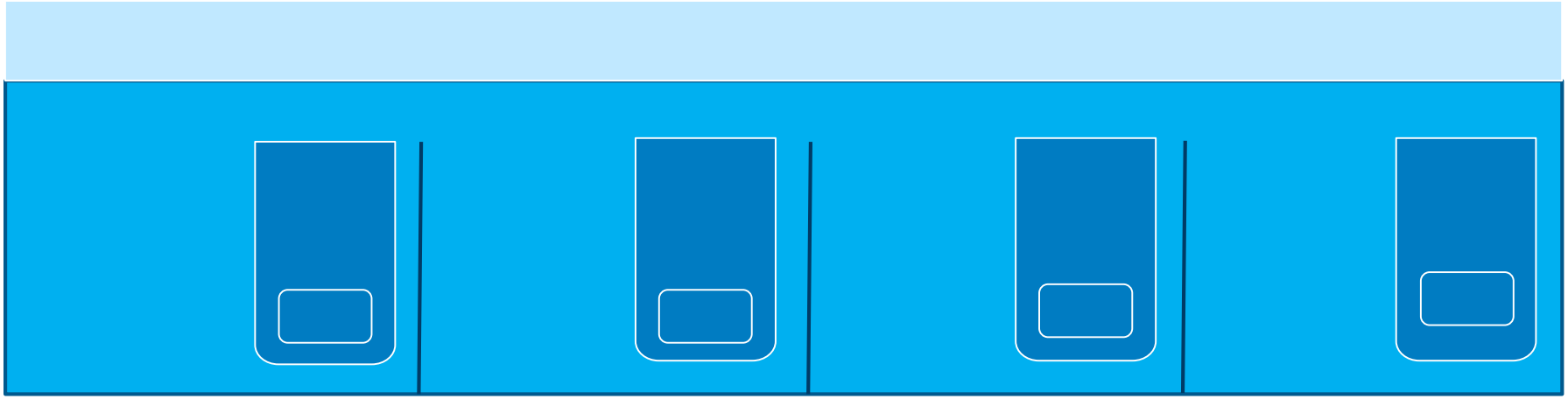
- Seperating COVID-19 suspected and positive patients by isolation
  - Single room
  - Isolation room

Source isolation

Isolation room:



Cohortation:



Air and surface contamination by SARS-CoV-2 virus in a tertiary hospital in Wuhan, China

Li Tan[a,1], Boyi Ma[b,1], Xiaoquan Lai[a,1], Lefei Han[c], Peihua Cao[d], Junji Zhang[e], Jianguo Fu[f], Qian Zhou[g], Shiqing Wei[a], Zhenling Wang[a], Weijun Peng[a], Lin Yang[c,*], Xinping Zhang[g,**]

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Table 1
Comparison of SARS-CoV-2 contamination among the environmental samples taken from patients with mild/moderate and severe/critical COVID-19.

Sample	Grouped by disease severity		Grouped by seroconversion			Grouped by PCR tests	
	Mild (n = 15)	Severe/critical (n = 9)	IgM(+)/IgG(+) (n = 18)	IgM(−)/IgG(+) (n = 5)	IgM(−)/IgG(−) (n = 1)	PCR(−) (n = 14)	PCR(+) (n = 10)
Days from onset (median, IQR)	45 (36–50)	48 (36–52)	48 (43–52)	35 (34–47)	22 (22–22)	47.0 (35–52)	46 (37–48)
Positive RT-PCR test for throat specimen, positive/total (%)[a]	7/15 (46.6%)	3/9 (33.3%)	8/18(44.4%)	2/5 (40.0%)	0/0 (0.0%)	–	–
Body fluids, positive/total (%)							
Sputum	–	2/5 (40.0%)	1/1 (100.0%)	1/4 (25.0%)	–	0/3 (0.0%)	2/2 (100.0%)
Saliva[b]	1/31 (3.2%)	1/5 (20.0%)	1/35 (2.9%)	0/1 (0.0%)	–	1/1 (100.0%)	1/35 (2.9%)
Air near patients, positive/total (%)	0/2 (0.0%)	1/10 (10.0%)	0/4 (0.0%)	1/8 (12.5%)	–	1/6 (16.7%)	0/6 (0.0%)
Low-touch surfaces, positive/total (%)	0/17 (0.0%)	1/22 (4.5%)	1/25 (4.0%)	0/13 (0.0%)	0/1 (0.0%)	1/22 (4.5%)	0/17 (0.0%)
High-touch surfaces, positive/total (%)	2/83 (2.4%)	7/122 (5.7%)	5/140 (3.6%)	4/61 (6.6%)	0/4 (0.0%)	6/119 (5.0%)	3/86 (3.5%)
Hands of patients, positive/total (%)	2/14 (14.3%)	–	2/12 (16.7%)	0/2 (0.0%)	–	2/7 (28.6%)	0/7 (0.0%)
Masks, positive/total (%)	0/28 (0.0%)	0/8 (0.0%)	0/32 (0.0%)	0/4 (0.0%)	–	0/18 (0.0%)	0/18 (0.0%)
Ventilator circuit, positive/total (%)	–	1/7 (14.3%)	0/4 (0.0%)	1/3 (33.3%)	–	0/6 (0.0%)	1/1 (100.0%)
PPE of HCP, positive/total (%)	–	0/54 (0.0%)	0/42 (0.0%)	0/12 (0.0%)	–	0/52 (0.0%)	0/2 (0.0%)
Total surface sample, positive/total (%)[c]	4/142 (2.8%)	9/213 (4.2%)	8/255 (3.1%)	5/95 (5.3%)	0/5 (0.0%)	9/224 (4.0%)	4/131 (3.1%)

Results: A total of 367 air and surface swab samples were collected from the patient care areas of 15 patients with mild COVID-19 and nine patients with severe/critical COVID-19. Only one air sample taken during the intubation procedure tested positive. High-touch surfaces were slightly more likely to be contaminated with SARS-CoV-2 RNA than low-touch surfaces.

Aerosol and Surface Distribution of Severe Acute Respiratory Syndrome Coronavirus 2 in Hospital Wards, Wuhan, China, 2020

Zhen-Dong Guo[1], Zhong-Yi Wang[1], Shou-Feng Zhang[1], Xiao Li, Lin Li, Chao Li, Yan Cui, Rui-Bin Fu, Yun-Zhu Dong, Xiang-Yang Chi, Meng-Yao Zhang, Kun Liu, Cheng Cao, Bin Liu, Ke Zhang, Yu-Wei Gao✉, Bing Lu✉, and Wei Chen✉

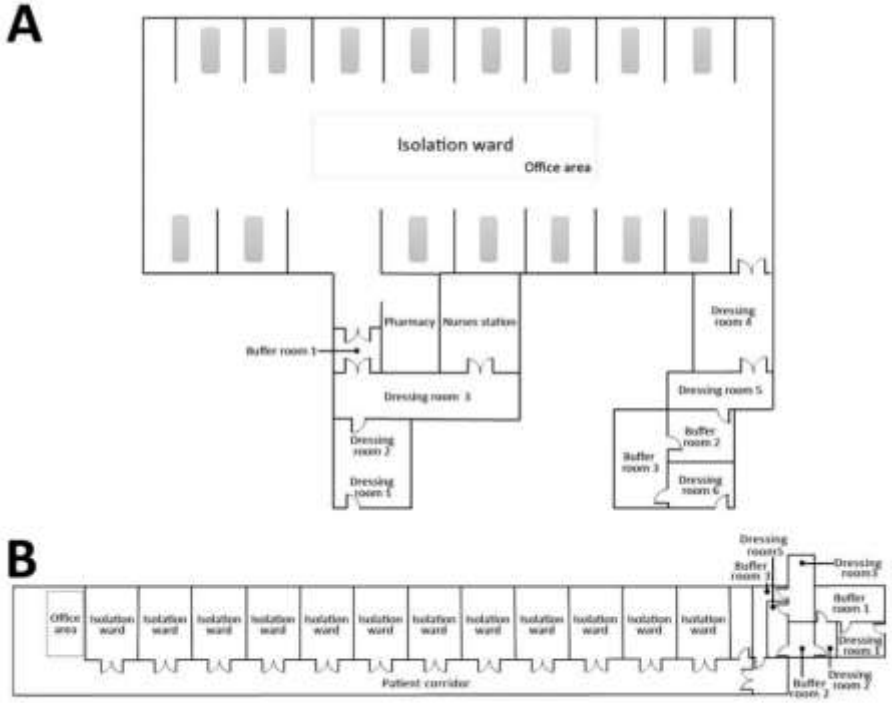

Figure 1. Layout of the intensive care unit (ICU) (A) and general ward (B) at Huoshenshan Hospital, Wuhan, China. For the ICU, the order of dressing is dressing room 1, dressing room 2,...

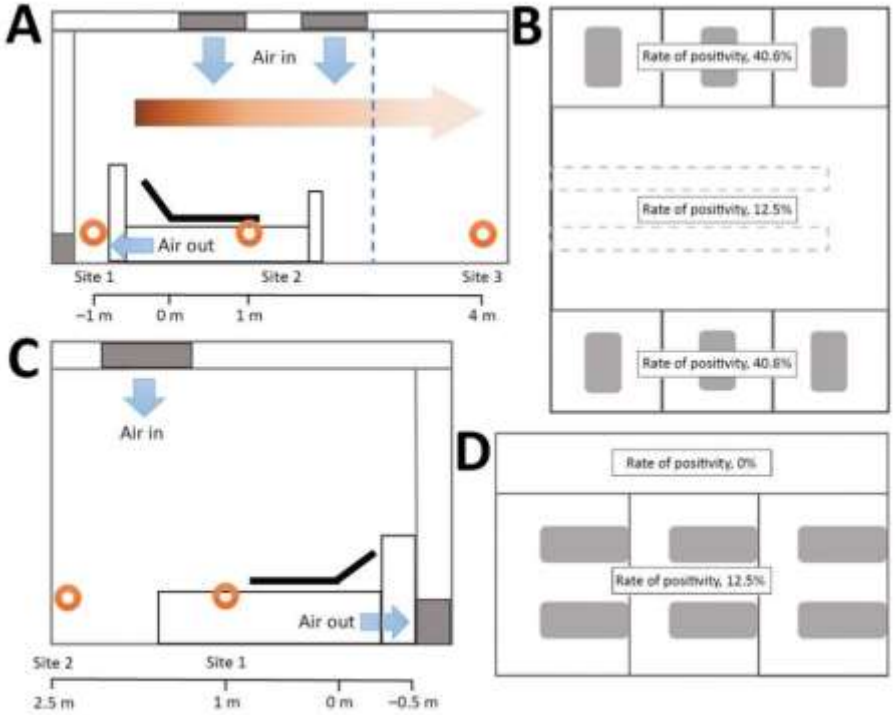

Figure 2. Spatial distribution of severe acute respiratory syndrome coronavirus 2 aerosols in isolation wards of the intensive care unit (ICU) and the general ward at Huoshenshan Hospital, Wuhan, China. A) The air...

Contamination was greater in intensive care units than general wards. Virus was widely distributed on floors, computer mice, trash cans, and sickbed handrails and was detected in air ≈4 m from patients.

To conclude

- Droplet precautions are effective for general wards
- Airborne precautions should be taken when aerosol generating procedures or treatments are performed
- More and further contamination of the environment is found on ICU wards where patients with severe disease are treated and more aerosol generating procedures and treatments take place
- Presence of SARS-CoV-2 viral RNA is not equal to potential infectious virus.