

Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents

G. Kampf, et al.

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Definition:

Coronaviruses: all coronaviruses including emerging SARS-CoV and MERS- CoV as well as veterinary coronaviruses such as transmissible gastroenteritis virus (TGEV), mouse hepatitis virus (MHV) and canine coronavirus (CCV)

Study Population:

Review of 22 studies

目前已知感染人類的冠狀病毒共計有七種，SARS-CoV-2 為二十年來除了 SARS-CoV 及 MERS-CoV 外第三種高致病性的冠狀病毒。觸摸受汙染的平面後再接觸自身口、鼻、眼等黏膜為常見傳染途徑。本文章統整各種冠狀病毒在各種表面上的存活時間與消毒方式效果，希望對於 SARS-CoV-2 的防治有參考作用。

Results:

1. Severe Acute Respiratory Syndrome (SARS) coronavirus, Middle East Respiratory Syndrome (MERS) coronavirus or endemic human coronaviruses (HCoV) can persist on inanimate surfaces like metal, glass or plastic for up to 9 days
SARS-CoV、MERS-CoV、HCoV 等最長可以在金屬、玻璃、塑膠等無機物表面生存達 9 天。
2. Veterinary coronaviruses have been shown to persist even longer for 28 d.

動物界的冠狀病毒甚至可以在無機物表面生存長達 28 天

3. A higher temperature such as 30°C or 40°C reduced the duration of persistence of highly pathogenic MERS-CoV, TGEV and MHV

溫度高 (如高於 30°C 時) ，病毒存活時間較短

4. Coronaviruses on inanimate surfaces can be efficiently inactivated by surface disinfection procedures with 62–71% ethanol, 0.5% hydrogen peroxide or 0.1% sodium hypochlorite (1:50 dilution of bleach) within 1 minute.

有用的消毒劑可以在一分鐘內達到消毒效果：70%酒精、0.5%雙氧水、0.1%次氯酸鈉

5. Other biocidal agents such as 0.05–0.2% benzalkonium chloride or 0.02% chlorhexidine digluconate are less effective

效果較差的消毒劑：0.02% chlorhexidine digluconate、0.05–0.2% Benzalkonium chloride

6. No data were found to describe the frequency of hands becoming contaminated with coronavirus.

對於手部觸摸物體表面多久才會將病毒傳到手上，目前沒有相關研究

Conclusion:

1. Most data were described with the endemic human coronavirus strain HCoV-229E. It can remain infectious for from 2 hours up to 9 days in different types of materials
2. Coronaviruses on inanimate surfaces can be efficiently inactivated by surface disinfection procedures with 62–71% ethanol, 0.5% hydrogen peroxide or 0.1% sodium hypochlorite within 1 minute.
3. 0.02% chlorhexidine digluconate are less effective for coronaviruses

The WHO recommends to preferably apply alcohol-based hand rubs for the decontamination of hands

目前多數建議使用含酒精的洗手液進行手部清潔

Table I
Persistence of coronaviruses on different types of inanimate surfaces

Type of surface	Virus	Strain / isolate	Inoculum (viral titer)	Temperature	Persistence	Reference
Steel	MERS-CoV	Isolate HCoV-EMC/2012	10^5	20°C	48 h	[21]
				30°C	8–24 h	
	TGEV	Unknown	10^6	4°C	≥ 28 d	[22]
				20°C	3–28 d	
	MHV	Unknown	10^6	40°C	4–96 h	
				4°C	≥ 28 d	[22]
Aluminium	HCoV	Strain 229E	10^3	20°C	4–28 d	
				40°C	4–96 h	
				21°C	5 d	[23]
Metal	HCoV	Strains 229E and OC43	5×10^3	21°C	2–8 h	[24]
Wood	SARS-CoV	Strain P9	10^5	RT	5 d	[25]
Paper	SARS-CoV	Strain P9	10^5	RT	4 d	[25]
	SARS-CoV	Strain P9	10^5	RT	4–5 d	[25]
	SARS-CoV	Strain GVU6109	10^6	RT	24 h	[26]
Glass	SARS-CoV	Strain P9	10^5	RT	3 h	
			10^4		< 5 min	
			10^5	RT	4 d	[25]
Plastic	HCoV	Strain 229E	10^3	21°C	5 d	[23]
				22°-25°C	≤ 5 d	[27]
				20°C	48 h	[21]
PVC	MERS-CoV	Isolate HCoV-EMC/2012	10^5	30°C	8–24 h	
				RT	4 d	[25]
	SARS-CoV	Strain P9	10^5	RT	6–9 d	[28]
	SARS-CoV	Strain FFM1	10^7	RT	2–6 d	[28]
	HCoV	Strain 229E	10^7	RT	5 d	[23]
	HCoV	Strain 229E	10^3	21°C	5 d	[23]
Silicon rubber	HCoV	Strain 229E	10^3	21°C	5 d	[23]
Surgical glove (latex)	HCoV	Strains 229E and OC43	5×10^3	21°C	≤ 8 h	[24]
Disposable gown	SARS-CoV	Strain GVU6109	10^6	RT	2 d	[26]
			10^5		24 h	
			10^4		1 h	
Ceramic	HCoV	Strain 229E	10^3	21°C	5 d	[23]
Teflon	HCoV	Strain 229E	10^3	21°C	5 d	[23]

MERS = Middle East Respiratory Syndrome; HCoV = human coronavirus; TGEV = transmissible gastroenteritis virus; MHV = mouse hepatitis virus; SARS = Severe Acute Respiratory Syndrome; RT = room temperature.

Inactivation of coronaviruses by different types of biocidal agents in suspension tests

Biocidal agent	Concentration	Virus	Strain / isolate	Exposure time	Reduction of viral infectivity (log ₁₀)	Reference
Ethanol	95%	SARS-CoV	Isolate FFM-1	30 s	≥ 5.5	[29]
	85%	SARS-CoV	Isolate FFM-1	30 s	≥ 5.5	[29]
	80%	SARS-CoV	Isolate FFM-1	30 s	≥ 4.3	[29]
	80%	MERS-CoV	Strain EMC	30 s	> 4.0	[14]
	78%	SARS-CoV	Isolate FFM-1	30 s	≥ 5.0	[28]
	70%	MHV	Strains MHV-2 and MHV-N	10 min	> 3.9	[30]
2-Propanol	70%	CCV	Strain I-71	10 min	> 3.3	[30]
	100%	SARS-CoV	Isolate FFM-1	30 s	≥ 3.3	[28]
	75%	SARS-CoV	Isolate FFM-1	30 s	≥ 4.0	[14]
	75%	MERS-CoV	Strain EMC	30 s	≥ 4.0	[14]
	70%	SARS-CoV	Isolate FFM-1	30 s	≥ 3.3	[28]
	50%	MHV	Strains MHV-2 and MHV-N	10 min	> 3.7	[30]
2-Propanol and 1-propanol	50%	CCV	Strain I-71	10 min	> 3.7	[30]
	45% and 30%	SARS-CoV	Isolate FFM-1	30 s	≥ 4.3	[29]
Benzalkonium chloride		SARS-CoV	Isolate FFM-1	30 s	≥ 2.8	[28]
	0.2%	HCoV	ATCC VR-759 (strain OC43)	10 min	0.0	[31]
Didecyltrimethyl ammonium chloride	0.05%	MHV	Strains MHV-2 and MHV-N	10 min	> 3.7	[30]
	0.05%	CCV	Strain I-71	10 min	> 3.7	[30]
	0.00175%	CCV	Strain S378	3 d	3.0	[32]
	0.0025%	CCV	Strain S378	3 d	> 4.0	[32]
Chlorhexidine digluconate	0.02%	MHV	Strains MHV-2 and MHV-N	10 min	0.7–0.8	[30]
Sodium hypochlorite	0.02%	CCV	Strain I-71	10 min	0.3	[30]
	0.21%	MHV	Strain MHV-1	30 s	≥ 4.0	[33]
	0.01%	MHV	Strains MHV-2 and MHV-N	10 min	2.3–2.8	[30]
	0.01%	CCV	Strain I-71	10 min	1.1	[30]
Hydrogen peroxide	0.001%	MHV	Strains MHV-2 and MHV-N	10 min	0.3–0.6	[30]
		CCV	Strain I-71	10 min	0.9	[30]
	0.5%	HCoV	Strain 229E	1 min	> 4.0	[34]
	1%	SARS-CoV	Isolate FFM-1	2 min	> 3.0	[28]
Formaldehyde	0.7%	SARS-CoV	Isolate FFM-1	2 min	> 3.0	[28]
	0.7%	MHV		10 min	> 3.5	[30]
	0.7%	CCV	Strain I-71	10 min	> 3.7	[30]
	0.009%	CCV		24 h	> 4.0	[35]
Glutaraldehyde	2.5%	SARS-CoV	Hanoi strain	5 min	> 4.0	[36]
	0.5%	SARS-CoV	Isolate FFM-1	2 min	> 4.0	[28]
Povidone iodine	7.5%	MERS-CoV	Isolate HCoV-EMC/2012	15 s	4.6	[37]
	4%	MERS-CoV	Isolate HCoV-EMC/2012	15 s	5.0	[37]
	1%	SARS-CoV	Hanoi strain	1 min	> 4.0	[36]
	1%	MERS-CoV	Isolate HCoV-EMC/2012	15 s	4.3	[37]
	0.47%	SARS-CoV	Hanoi strain	1 min	3.8	[36]
	0.25%	SARS-CoV	Hanoi strain	1 min	> 4.0	[36]
	0.23%	SARS-CoV	Hanoi strain	1 min	> 4.0	[36]
	0.23%	SARS-CoV	Isolate FFM-1	15 s	≥ 4.4	[38]
	0.23%	MERS-CoV	Isolate HCoV-EMC/2012	15 s	≥ 4.4	[38]

SARS = Severe Acute Respiratory Syndrome; MERS = Middle East Respiratory Syndrome; MHV = mouse hepatitis virus; CCV = canine coronavirus; HCoV = human coronavirus.