



EU HEALTHY GATEWAYS JOINT ACTION
GRANT AGREEMENT NUMBER: **801493**
PREPAREDNESS AND ACTION AT POINTS OF ENTRY
(PORTS, AIRPORTS, GROUND CROSSINGS)



Co-funded by
the Health Programme
of the European Union

INTERIM ADVICE FOR PREPAREDNESS AND RESPONSE TO CASES OF COVID-19 AT POINTS OF ENTRY IN THE EUROPEAN UNION (EU)/EUROPEAN ECONOMIC AREA MEMBER STATES (MS)

Suggested procedures for cleaning and disinfection of ships during the pandemic or when a case of COVID-19 has been identified on board

Version 1

06 April 2020

The EU HEALTHY GATEWAYS Joint Action has received funding from the European Union, in the framework of the Third Health Programme (2014-2020). The content of this document represents the views of the author only and is his/her sole responsibility; it cannot be considered to reflect the views of the European Commission and/or the Consumers, Health, Agriculture and Food Executive Agency (CHAFEA) or any other body of the European Union. The European Commission and the Agency do not accept any responsibility for use that may be made of the information it contains.



EU HEALTHY GATEWAYS JOINT ACTION
GRANT AGREEMENT NUMBER: 801493
PREPAREDNESS AND ACTION AT POINTS OF ENTRY
(PORTS, AIRPORTS, GROUND CROSSINGS)



Co-funded by
the Health Programme
of the European Union

Environmental persistence of SARS-CoV-2

The survival time of SARS-CoV-2 in the environment has been evaluated in recent publications reporting experimental studies that estimated the environmental stability of SARS-CoV-2 as up to three hours in the air post-aerosolisation, up to four hours on copper, up to 24 hours on cardboard and up to two to three days on plastic and stainless steel, albeit with significantly decreased titres [1]. SARS-CoV-2 RNA was identified on a variety of surfaces in cabins of both symptomatic and asymptomatic COVID-19 infected passengers, up to 17 days after cabins were vacated on the Diamond Princess, but prior to conducting disinfection procedures [2]. SARS-CoV-2 has been isolated from respiratory specimens, stool, urine and gastrointestinal mucosa [3-5]. SARS-CoV-2 has also been detected by PCR in rooms where COVID-19 patients were hospitalised, specifically from surfaces of the toilet bowl and sink, and the air exhaust outlets [6]. Furthermore, SARS-CoV-2 was also detected on different objects such as self-service printers used by patients to print the results of their own exams, desktop keyboards, doorknobs and on gloves [7]. In an analysis of 75,465 COVID-19 cases in China, airborne transmission was not reported [6]. There have been no reports of faecal–oral transmission of the COVID-19 virus to date [8].

Interim guidance for environmental cleaning in non-healthcare facilities exposed to SARS-CoV-2 can be found at: <https://www.ecdc.europa.eu/en/publications-data/interim-guidance-environmental-cleaning-non-healthcare-facilities-exposed-2019> [9].

Guidance on disinfection of environments in healthcare and non-healthcare settings potentially contaminated with SARS-CoV-2 can be found at:

<https://www.ecdc.europa.eu/en/publications-data/disinfection-environments-covid-19> [7].

Suggested procedures for cleaning and disinfection of ships during the pandemic or when a case of COVID-19 has been identified on board

During the pandemic and especially while case management is in progress on board a ship, a high level of cleaning and disinfection measures should be maintained on board as per the outbreak management plan available on the ship. Before disinfection, cleaning with detergent and warm water to remove all organic matter is necessary. Products with combined detergent/disinfection (sodium hypochlorite solution) properties used as a “one-step” process have not been proved to be as effective as the two-step process of cleaning and disinfection [10].

Cleaning and disinfection of environmental surfaces occupied by COVID-19 patients and contacts

Medical facilities and isolation/ quarantine areas

Medical facilities, cabins and quarters occupied by COVID-19 patients and contacts should be cleaned and disinfected in accordance with the following guidance:

- WHO guidance for infection prevention and control during health care when COVID-19 infection is suspected [11].
- ECDC Technical Report on disinfection of environments in healthcare and non-healthcare settings potentially contaminated with SARS-CoV-2 [7].
- WHO guidance for Water, sanitation, hygiene, and waste management for the COVID-19 virus [12].

Ventilation before cleaning and disinfection

- These facilities should be cleaned and disinfected daily [12, 13].
- Medical facilities, cabins and quarters occupied by COVID-19 patients and contacts should firstly be ventilated well [7].
 - Rooms where aerosol generating procedures (AGP) have been performed (e.g. bag-valve ventilation, administration of nebulised medicines, bronchoscopy, etc.) need to be ventilated with fresh air for 1–3 hours if they are not functioning under negative pressure, before cleaning and admitting new patient(s).
 - In rooms where windows do not open and the ventilation system functions in a closed circuit, air recirculation should be turned off and the system should work with 100% fresh air supply. Other options may include, after expert engineering advice: placing temporary HEPA filters over the vents and exhausts in the rooms housing COVID-19 patients or using a portable HEPA air filtration system placed in close proximity to where the patient was located.

Suggested concentrations of disinfectants

After ventilation, cleaning and disinfection must follow using a disinfectant effective against viruses [7] (see paragraph “*Antimicrobial agents effective against coronaviruses*” below).

- Critical surfaces in medical facilities should be cleaned and disinfected with 0.5% sodium hypochlorite (NaClO) (dilution 1:10, if household bleach is used, which is usually at an initial concentration of 5%) is suggested. Surfaces should be rinsed with clean water after 10 minutes contact time for chlorine.
- If excreta are on surfaces, the excreta should be carefully removed with towels and immediately safely disposed of as infectious waste. The area should then be cleaned and disinfected with 0.5% sodium hypochlorite (NaClO) (dilution 1:10, if household bleach is used, which is usually at an initial concentration of 5%) is suggested. Surfaces should be rinsed with clean water after 10 minutes contact time for chlorine.
- For other non-critical surfaces, the use of 0.05% sodium hypochlorite (NaClO) (dilution 1:100, if household bleach is used, which is usually at an initial concentration of 5%) is suggested [9] with 10 minutes contact time. Surfaces should be rinsed with clean water after 10 minutes contact time for chlorine.
- For surfaces that could be damaged by sodium hypochlorite, 70% concentration of ethanol with 10 minutes contact time is needed for decontamination, after cleaning with a neutral detergent [7, 12].

Bathrooms and toilets

Cleaning of toilets, bathroom sinks and sanitary facilities need to be carefully performed, avoiding splashes. Disinfection should follow normal cleaning using a disinfectant effective against viruses, or 0.1% sodium hypochlorite which is equivalent to 1000ppm² [7] with 10 minutes contact time. Surfaces should be rinsed with clean water after 10 minutes contact time for chlorine. If it is not possible to provide separate toilets, the toilet should be cleaned and disinfected at least twice daily [12].

² To make the chlorine solution with a concentration of 1000ppm, 4 teaspoons or 20 ml of household bleach (5%) should be diluted in 1 liter of water.

14. Centers for Disease Control and Prevention. *Cleaning and Disinfection for Households - Interim Recommendations for U.S. Households with Suspected or Confirmed Coronavirus Disease 2019 (COVID-19)*. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/cleaning-disinfection.html>.
15. European Centre for Disease Prevention and Control, *ECDC TECHNICAL REPORT. Infection prevention and control in the household management of people with suspected or confirmed coronavirus disease(COVID-19)*. 2020, ECDC: Stockholm



EU HEALTHY GATEWAYS JOINT ACTION
GRANT AGREEMENT NUMBER: 801493
PREPAREDNESS AND ACTION AT POINTS OF ENTRY
(PORTS, AIRPORTS, GROUND CROSSINGS)



Co-funded by
the Health Programme
of the European Union

Cleaning and disinfecting of all other environmental surfaces (other than medical or isolation/quarantine areas)

All other areas should be cleaned and disinfected following the procedures applied in accordance with the outbreak management plan on the ship [10].

Frequently touched areas and other hard surfaces

All frequently touched areas such as all accessible surfaces of walls and windows, should be cleaned frequently (at least daily and if possible more often) and carefully [7]. Examples of these surfaces are doorknobs and door bars, chairs and armrests, table tops, light switches, handrails, water taps, elevator buttons, etc. [9].

Cleaning environmental surfaces with water and detergent, and applying commonly used hospital disinfectants (such as 0.05% sodium hypochlorite with 10 minutes contact time or 70% ethanol with 10 minutes contact time) is an effective and sufficient procedure [11, 12]. This solution should be used immediately and prepared fresh every time it is needed [16].

Public toilets, sinks and other sanitary facilities

All public toilets and hand contact surfaces (e.g. handrails) should be cleaned on a regular basis, with the frequency of cleaning increased when an outbreak is occurring. Public toilets should be cleaned at least once per hour when in use [10].

Cleaning of public toilets, bathroom sinks and sanitary facilities used by several people should be carefully performed. Consider the use of a disinfectant effective against viruses, such as 0.1% sodium hypochlorite with 10 minutes contact time, or other licensed virucidal products following the instructions for use provided by the manufacturer [7].

Chairs, sofas, wall coverings

Chlorine bleach can damage textiles [10]. Chairs and sofas, as well as wall coverings and window treatments, should be thoroughly disinfected with suitable virucidal disinfectant after all visible contaminants have been removed. Allowing them to air dry in the sun is beneficial, if possible [10]. Other disinfectant agents that are less damaging to furnishings could be used (see paragraph "*Antimicrobial agents effective against coronaviruses*" below). Leisure facilities such as deckchairs should not be overlooked [10].

Mattresses

Soiled mattresses should be steam cleaned or discarded [10].

Carpets and furnishings

Carpets and furnishings that cannot be laundered can be cleaned with detergent and warm water, followed by steam [10]. Vacuuming of carpets should not take place in cabins occupied

by infected people, unless the carpet has been previously disinfected [10]. Contaminated carpets should be steam cleaned and then disinfected [10].

Steam cleaning claims to be an effective method of cleaning soft surfaces such as carpets and curtains. However, steam cleaning is questionable as a disinfection method alone, as it is difficult to reach high enough temperatures within soft furnishings. It may be that steam cleaning has a role in combination with other measures. If detergents are used, application must be done with a clean disposable cloth [10].

Coronaviruses can be inactivated after 90-, 60- and 30-min exposure at 56 degrees C, at 67 degrees C and at 75 degrees C, respectively [17].

Textiles

All textiles (e.g. bed linens, curtains, etc.) should be washed using a hot-water cycle (90°C) and adding laundry detergent [7]. If a hot-water cycle cannot be used due to the characteristics of the tissues, specific chemicals should be added when washing the textiles (e.g. bleach or laundry products containing sodium hypochlorite, or decontamination products specifically developed for use on textiles) [7]. Alternatively, if a hot-water cycle cannot be used, linen can be soaked in hot water and soap in a large drum, using a stick to stir and avoiding splashing. If hot water is not available, linen can be soaked in 0.05% chlorine for approximately 30 minutes, rinsed with clean water and dried fully in sunlight [18].

Electronics

For electronics such as cell phones, tablets, touch screens, remote controls and keyboards follow the manufacturer's instructions and consider the following:

- remove visible contamination if present
- consider use of wipeable covers

If no manufacturer guidance is available, consider the use of alcohol-based wipes or sprays containing at least 70% alcohol to disinfect touch screens. Dry surfaces thoroughly to avoid pooling of liquids [14].

Body fluid spills

If excreta are on surfaces, the excreta should be carefully removed with towels and immediately safely disposed of as infectious waste. The area should then be cleaned and disinfected with 0.5% sodium hypochlorite (NaClO) (dilution 1:10, if household bleach is used, which is usually at an initial concentration of 5%) is suggested. Surfaces should be rinsed with clean water after 10 minutes contact time for chlorine.



EU HEALTHY GATEWAYS JOINT ACTION
GRANT AGREEMENT NUMBER: **801493**
PREPAREDNESS AND ACTION AT POINTS OF ENTRY
(PORTS, AIRPORTS, GROUND CROSSINGS)



Co-funded by
the Health Programme
of the European Union

Laundry

Laundry from cabins of suspect COVID-19 cases and contacts should be handled as infectious, in accordance with the outbreak management plan provided on board for other infectious diseases [10].

- All persons dealing with soiled linen from patients with COVID-19 should wear appropriate personal protective equipment (PPE), which includes heavy duty gloves, mask, eye protection (face shield/goggles), long-sleeved gown, apron (if gown is not fluid resistant), boots or closed shoes before touching any soiled linen [18].
- Any solid excrement on the linen must be removed first by scraping it off with a flat, firm object and putting it in the toilet [18].
- Laundry should be transported to the laundry area in separate trolleys/carts in sealed bags designated as bio-waste.
- Ideally, dissolvable alginate laundry bags should be used for all items from the cabins of affected people as they can be placed in washing machines without opening.
- Once in the laundry, they must be laundered and handled separately from other items.
- Soiled laundry suspected of being contaminated must not be sorted or come into contact with any surfaces in the laundry area. Any (nonalginate) bags labelled as bio-waste should be emptied directly into the washers. A suitable detergent should be used in the washing machine, e.g. accelerated potassium peroxymonosulfate.

Waste management

Waste from cabins of suspect cases and contacts should be handled as infectious, in accordance with the outbreak management plan provided on board for other infectious diseases [10].

Waste on board the ship should be collected in safely sealed plastic bags to ensure that there is no leakage and delivered to port facilities. Waste management staff at the port should not handle these plastic bags, however if this is unavoidable handling should be done using gloves. Final disposal of the sealed plastic bags should be done in an approved waste disposal site [10].

Infectious waste should be handled separately from the other types of waste on board, and properly labelled and disposed of in accordance with the standards described in the European Manual for Hygiene Standards and Communicable Diseases Surveillance on board ships [10].

Food service utensils used by COVID-19 patients

Food service utensils from cabins of suspect cases and contacts should be handled as infectious, in accordance with the outbreak management plan provided on board for other infectious diseases [10].

If single use (disposable) dishes and cutlery are not used, then after completion of the meal the serving tray, dishes and cutlery should be transported to the dishwashing area in a bag, then

washed and disinfected at 77°C or more for at least 30 seconds, or at 82°C or with a 200 ppm chlorine solution [10].

Food contact surfaces

If there is an on-going outbreak on board a ship, then food contact and non-food contact surfaces should be disinfected with 0.1% sodium hypochlorite with 10 minutes contact time and then rinsed, or other licensed virucidal products approved to be used on food contact surfaces.

Cleaning equipment and materials

All areas should be cleaned and disinfected using separate cloths and buckets for cleaning and disinfection. Wastewater from cleaning must be disposed of as sewage [10].

It is suggested to use single-use, disposable cleaning equipment [7, 14]. If disposable cleaning equipment is not available, the cleaning material (cloth, sponge etc.) should be placed in a disinfectant solution effective against viruses, or 0.1% sodium hypochlorite for at least 10 minutes contact time. If neither solution is available, the material should be discarded and not reused [7].

The use of different equipment for cleaning the different areas is recommended. In the event of a shortage of cleaning equipment, the cleaning process should start from the cleanest areas, moving towards the dirtiest areas (e.g. an area where AGP has been performed) [7].

Training of cleaning staff and use of PPE

Staff who will perform cleaning and disinfection should be trained in the adequate selection and use of PPE [7, 12, 13].

Recommended PPE for cleaning and disinfection crew according to EU HEALTHY GATEWAYS guidance includes [19]:

- Disposable gloves
- FFP2/FFP3 respirator (tested for fitting, valved or non-valved) *If respirator not available, medical mask can be used (limitations and risks of mask use assessed on case-by-case basis)
- Goggles (or face shield)
- Long-sleeved water-resistant gown
- Heavy duty gloves (over disposable gloves)
- Boots

Antimicrobial agents effective against coronaviruses

Antimicrobial agents effective against different coronaviruses can be found in the following table, which has been extracted from the ECDC guidance for environmental cleaning in non-healthcare facilities exposed to SARS-CoV-2 [20].

Table 1. Antimicrobial agents effective against different coronaviruses: human coronavirus 229E (HCoV-229E), mouse hepatitis virus (MHV-2 and MHV-N), canine coronavirus (CCV), transmissible gastroenteritis virus (TGEV), and severe acute respiratory syndrome coronavirus (SARS-CoV)¹

Antimicrobial agent	Concentration	Coronaviruses tested	References
Ethanol	70%	HCoV-229E, MHV-2, MHV-N, CCV, TGEV	[4,6,7]
Sodium hypochlorite	0.1–0.5%	HCoV-229E	[6]
	0.05–0.1%	SARS-CoV	[5]
Povidone-iodine	10% (1% iodine)	HCoV-229E	[6]
Glutaraldehyde	2%	HCoV-229E	[6]
Isopropanol	50%	MHV-2, MHV-N, CCV	[7]
Benzalkonium chloride	0.05%	MHV-2, MHV-N, CCV	[7]
Sodium chlorite	0.23%	MHV-2, MHV-N, CCV	[7]
Formaldehyde	0.7%	MHV-2, MHV-N, CCV	[7]

Source: ECDC Technical Report. Interim guidance for environmental cleaning in non-healthcare facilities exposed to SARS-CoV-2 <https://www.ecdc.europa.eu/en/publications-data/interim-guidance-environmental-cleaning-non-healthcare-facilities-exposed-2019>

Disinfectants are classified as biocidal products and are regulated in the European Union by the Biocidal Product Regulation (BPR) No 528/2012. Biocidal products that have been authorised by the BPR and have virucidal activity are efficacious against SARS-CoV-2 [9]. Biocidal products must be applied on board ships following the specifications described in Chapter 8 of the European Manual for Hygiene Standards and Communicable Diseases Surveillance on board ships [15].

Disinfectants should be used according to manufacturers' instructions. If household bleach is used as a disinfectant, then the solution should be mixed daily to preserve its strength.

Cleaning options for different settings can be found in the following table, which has been extracted from the ECDC's guidance for disinfection of environments in healthcare and non-healthcare settings contaminated with SARS-CoV-2 [7].

Table 1. Cleaning options for different settings. S: Suggested, O: Optional.

	Healthcare setting	Non-healthcare setting	General settings
Surfaces	<ul style="list-style-type: none"> • Neutral detergent AND • Virucidal disinfectant OR • 0.05% sodium hypochlorite OR • 70% ethanol <p>[S]</p>	<ul style="list-style-type: none"> • Neutral detergent AND • Virucidal disinfectant OR • 0.05% sodium hypochlorite OR • 70% ethanol <p>[S]</p>	<ul style="list-style-type: none"> • Neutral detergent <p>[S]</p>
Toilets	<ul style="list-style-type: none"> • Virucidal disinfectant OR • 0.1% sodium hypochlorite <p>[S]</p>	<ul style="list-style-type: none"> • Virucidal disinfectant OR • 0.1% sodium hypochlorite <p>[S]</p>	<ul style="list-style-type: none"> • Virucidal disinfectant OR • 0.1% Sodium hypochlorite <p>[O]</p>
Textiles	<ul style="list-style-type: none"> • Hot-water cycle (90°C) AND • regular laundry detergent • alternative: lower temperature cycle + bleach or other laundry products <p>[S]</p>	<ul style="list-style-type: none"> • Hot-water cycle (90°C) AND • regular laundry detergent • alternative: lower temperature cycle + bleach or other laundry products <p>[S]</p>	n/a
Cleaning equipment	<ul style="list-style-type: none"> • Single-use disposable OR • Non-disposable disinfected with: <ul style="list-style-type: none"> • Virucidal disinfectant OR • 0.1% sodium hypochlorite <p>[S]</p>	<ul style="list-style-type: none"> • Single-use disposable OR • Non-disposable disinfected with: <ul style="list-style-type: none"> • Virucidal disinfectant OR • 0.1% sodium hypochlorite <p>[O]</p>	<ul style="list-style-type: none"> • Single-use disposable OR • Non-disposable cleaned at the end of cleaning session <p>[S]</p>
PPE for cleaning staff	<ul style="list-style-type: none"> • Surgical mask • Disposable long-sleeved water-resistant gown • Gloves • FFP2 or 3 when cleaning facilities where AGP have been performed <p>[S]</p>	<ul style="list-style-type: none"> • Surgical mask • Uniform and plastic apron • Gloves <p>[S]</p>	<ul style="list-style-type: none"> • Uniform • Gloves <p>[S]</p>
Waste management	<ul style="list-style-type: none"> • Infectious clinical waste category B (UN3291) <p>[S]</p>	<ul style="list-style-type: none"> • In a separate bag in the unsorted garbage <p>[S]</p>	<ul style="list-style-type: none"> • Unsorted garbage <p>[S]</p>

Source: ECDC TECHNICAL REPORT Disinfection of environments in healthcare and non-healthcare settings potentially contaminated with SARS-CoV-2. March 2020
https://www.ecdc.europa.eu/sites/default/files/documents/Environmental-persistence-of-SARS-CoV-2-virus-Options-for-cleaning2020-03-26_0.pdf

Bibliography for contact times for different disinfectants

According to a recent review study by Kampf et al. where 22 experimental studies were reviewed on the persistence of human and veterinary coronaviruses on inanimate surfaces, as well as inactivation strategies with biocidal agents used for chemical disinfection, human coronaviruses can be efficiently inactivated by surface disinfection procedures with 62-71% ethanol, 0.5% hydrogen peroxide or 0.1% sodium hypochlorite within 1 minute [21]. Details are presented in the two tables below.

Table II
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]
		SARS-CoV	Isolate FFM-1	30 s	≥ 2.8	[28]
	0.2%	HCoV	ATCC VR-759 (strain OC43)	10 min	0.0	[31]
	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]
Didecylmethyl ammonium chloride	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]
	0.001%	MHV	Strains MHV-2 and MHV-N	10 min	0.3–0.6	[30]
	0.001%	CCV	Strain I-71	10 min	0.9	[30]
Hydrogen peroxide	0.5%	HCoV	Strain 229E	1 min	> 4.0	[34]
Formaldehyde	1%	SARS-CoV	Isolate FFM-1	2 min	> 3.0	[28]
	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]
	2.5%	SARS-CoV	Hanoi strain	5 min	> 4.0	[36]
Glutardialdehyde	0.5%	SARS-CoV	Isolate FFM-1	2 min	> 4.0	[28]
	7.5%	MERS-CoV	Isolate HCoV-EMC/2012	15 s	4.6	[37]
Povidone iodine	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.

Source: Kampf, G., et al., *Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents*. J Hosp Infect, 2020. **104**(3): p. 246-251

Table III
Inactivation of coronaviruses by different types of biocidal agents in carrier tests

Biocidal agent	Concentration	Virus	Strain / isolate	Volume / material	Organic load	Exposure time	Reduction of viral infectivity (log ₁₀)	Reference
Ethanol	71%	TGEV	Unknown	50 µl / stainless steel	None	1 min	3.5	[39]
	71%	MHV	Unknown	50 µl / stainless steel	None	1 min	2.0	[39]
	70%	TGEV	Unknown	50 µl / stainless steel	None	1 min	3.2	[39]
	70%	MHV	Unknown	50 µl / stainless steel	None	1 min	3.9	[39]
	70%	HCoV	Strain 229E	20 µl / stainless steel	5% serum	1 min	> 3.0	[40]
	62%	TGEV	Unknown	50 µl / stainless steel	None	1 min	4.0	[39]
Benzalkoniumchloride	62%	MHV	Unknown	50 µl / stainless steel	None	1 min	2.7	[39]
	0.04%	HCoV	Strain 229E	20 µl / stainless steel	5% serum	1 min	< 3.0	[40]
Sodium hypochlorite	0.5%	HCoV	Strain 229E	20 µl / stainless steel	5% serum	1 min	> 3.0	[40]
	0.1%	HCoV	Strain 229E	20 µl / stainless steel	5% serum	1 min	> 3.0	[40]
	0.06%	TGEV	Unknown	50 µl / stainless steel	None	1 min	0.4	[39]
	0.06%	MHV	Unknown	50 µl / stainless steel	None	1 min	0.6	[39]
Glutardialdehyde	0.01%	HCoV	Strain 229E	20 µl / stainless steel	5% serum	1 min	< 3.0	[40]
	2%	HCoV	Strain 229E	20 µl / stainless steel	5% serum	1 min	> 3.0	[40]
Ortho-phthalaldehyde	0.55%	TGEV	Unknown	50 µl / stainless steel	None	1 min	2.3	[39]
	0.55%	MHV	Unknown	50 µl / stainless steel	None	1 min	1.7	[39]
Hydrogen peroxide	Vapor of unknown concentration	TGEV	Purdue strain type 1	20 µl / stainless steel	None	2–3 h	4.9–5.3*	[41]

TGEV = transmissible gastroenteritis virus; MHV = mouse hepatitis virus; HCoV = human coronavirus; *depending on the volume of injected hydrogen peroxide.

Source: Kampf, G., et al., *Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents*. J Hosp Infect, 2020. **104**(3): p. 246-251

References

1. van Doremalen, N., et al., *Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1*. N Engl J Med, 2020.
2. Moriarty, L.F., et al., *Public Health Responses to COVID-19 Outbreaks on Cruise Ships - Worldwide, February-March 2020*. MMWR Morb Mortal Wkly Rep, 2020. **69**(12): p. 347-352.
3. Ling, Y., et al., *Persistence and clearance of viral RNA in 2019 novel coronavirus disease rehabilitation patients*. Chin Med J (Engl), 2020.
4. Ren, L.L., et al., *Identification of a novel coronavirus causing severe pneumonia in human: a descriptive study*. Chin Med J (Engl), 2020.
5. Holshue, M.L., et al., *First Case of 2019 Novel Coronavirus in the United States*. N Engl J Med, 2020. **382**(10): p. 929-936.
6. Ong, S.W.X., et al., *Air, Surface Environmental, and Personal Protective Equipment Contamination by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) From a Symptomatic Patient*. JAMA, 2020.
7. European Centre for Disease Prevention and Control, *ECDC TECHNICAL REPORT. Disinfection of environments in healthcare and nonhealthcare settings potentially contaminated with SARS-CoV-2*. 2020, ECDC: Stockholm
8. World Health Organization. *Scientific brief - Modes of transmission of virus causing COVID-19: implications for IPC precaution recommendations*. 29 March 2020 [cited 30/03/20; Available from: <https://www.who.int/news-room/commentaries/detail/modes-of-transmission-of-virus-causing-covid-19-implications-for-ipc-precaution-recommendations>].
9. European Centre for Disease Prevention and Control, *ECDC TECHNICAL REPORT - Guidelines for the use of non-pharmaceutical measures to delay and mitigate the impact of 2019-nCoV February 2020* 2020: Stockholm.
10. EU SHIPSAN ACT JOINT ACTION (20122103) - European Commission Directorate General for Health and Food Safety, *European Manual for Hygiene Standards and Communicable Diseases Surveillance on Passenger Ships*. Second ed. 2016: EU SHIPSAN ACT JOINT ACTION (20122103).
11. World Health Organization, *Laboratory testing for 2019 novel coronavirus (2019-nCoV) in suspected human cases*. 2020.
12. World Health Organization, *Global Surveillance for COVID-19 caused by human infection with COVID-19 virus. Interim guidance v6*. 2020.
13. World Health Organization. *Interim guidance - Clinical management of severe acute respiratory infection (SARI) when COVID-19 is suspected*. 2020 13 March 2020; Available from: [https://www.who.int/publications-detail/clinical-management-of-severe-acute-respiratory-infection-when-novel-coronavirus-\(ncov\)-infection-is-suspected](https://www.who.int/publications-detail/clinical-management-of-severe-acute-respiratory-infection-when-novel-coronavirus-(ncov)-infection-is-suspected).
14. Centers for Disease Control and Prevention. *Cleaning and Disinfection for Households - Interim Recommendations for U.S. Households with Suspected or Confirmed Coronavirus Disease 2019 (COVID-19)*. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/cleaning-disinfection.html>.

EU HEALTHY GATEWAYS JOINT ACTION
GRANT AGREEMENT NUMBER: 801493
PREPAREDNESS AND ACTION AT POINTS OF ENTRY
(PORTS, AIRPORTS, GROUND CROSSINGS)

15. European Centre for Disease Prevention and Control, *ECDC TECHNICAL REPORT. Infection prevention and control in the household management of people with suspected or confirmed coronavirus disease(COVID-19)*. 2020, ECDC: Stockholm
16. European Centre for Disease Prevention and Control, *ECDC TECHNICAL REPORT. Infection prevention and control and preparedness for COVID-19 in healthcare settings – third update*. 2020, ECDC: Stockholm
17. Duan, S.M., et al., *Stability of SARS coronavirus in human specimens and environment and its sensitivity to heating and UV irradiation*. Biomed Environ Sci, 2003. **16**(3): p. 246-55.
18. World Health Organization. *Interim Guidance - Rational use of personal protective equipment for coronavirus disease 2019 (COVID-19)*. 2020 27 February 2020 04/03/2020]; Available from: https://apps.who.int/iris/bitstream/handle/10665/331215/WHO-2019-nCov-IPCPPE_use-2020.1-eng.pdf.
19. EU HEALTHY GATEWAYS JOINT ACTION PREPAREDNESS AND ACTION AT POINTS OF ENTRY (PORTS, A., GROUND CROSSINGS),. *WHO, WHERE, HOW Overview of Personal Protective Equipment (PPE) recommended for staff at Points of Entry and crew on board conveyances in the context of COVID-19*. 2020 07/03/2020; 2nd:[Available from: <https://www.healthygateways.eu/Novel-coronavirus>.
20. European Centre for Disease Prevention and Control, *Interim guidance for environmental cleaning in non-healthcare facilities exposed to SARS-CoV-2* 2020: Stockholm.
21. Kampf, G., et al., *Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents*. J Hosp Infect, 2020. **104**(3): p. 246-251.