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Suggested procedures for cleaning and disinfection of ships during the COVID-19 pandemic

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Introduction

SARS-CoV-2 can persist on environmental surfaces. The virus could be transmitted when someone touches a contaminated surface and then touches their mouth, nose or eyes. Disinfection of environmental surfaces is one of the measures applied to prevent and control COVID-19 transmission and this is particularly important on board ships, where often a large number of persons share the same environment and touch the same environmental surfaces.

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 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 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].

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].

Training of cleaning staff and use of PPE

Staff who will perform cleaning and disinfection should be trained to apply cleaning and disinfection procedures and in the adequate selection and use of personal protective equipment (PPE) [7, 9-11].

Recommended PPE for cleaning and disinfection crew includes [12]:

- Disposable gloves

- FFP2 (N95)/FFP3 (N99) respirator[2] (tested for fitting, valved or non-valved) for high risk areas cleaning and disinfection (if respirator is not available, medical mask can be used, limitations and risks of mask use should be assessed on case-by-case basis)
- Goggles (or face shield)
- Long-sleeved water-resistant gown
- Gloves (Heavy duty gloves or disposable gloves)
- Boots

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 [13].

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% (1000ppm) sodium hypochlorite (NaClO) (dilution 1:50, if household bleach is used, which is usually at an initial concentration of 5%) for at least 10 minutes contact time. Cleaning cloths may be washed at a 90°C temperature and then may be reused. 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 a confirmed or suspect COVID-19 patient is staying) [7].

Antimicrobial agents effective against coronaviruses

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[13].

[2] A list of respirators approved under standards used in other countries that are similar to NIOSH-approved N95 respirators are presented here: https://www.cdc.gov/niosh/npptl/respirators/testing/NonNIOSH.html

For ships that sail in the US, the United States Environmental Protection Agency is the competent authority to certify disinfectants and a list of disinfectants for use against SARS-CoV-2 is available here: https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2

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

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

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

	Non-healthcare setting	**General settings**
Surfaces	Neutral detergent AND Virucidal disinfectant OR 0,1% sodium hypochlorite OR 70% ethanol [S]	Neutral detergent [S]
Toilets	Virucidal disinfectant OR 0,1% sodium hypochlorite [S]	Virucidal disinfectant OR 0,1% sodium hypochlorite [O]
Textiles	Hot-water cycle (90°C) AND Regular laundry detergent Alternative: lower temperature cycle +bleach or other laundry products [S]	n/a
Cleaning equipment	Single-use disposable OR Non-disposable disinfected with Virucidal disinfectant OR 0,1% sodium hypochlorite [O]	Single-use disposable OR Non-disposable cleaned at the end of cleaning session [S]
PPE for cleaning staff	Surgical mask	Uniform

	Uniform and plastic apron Gloves	Gloves

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

Suggested procedures for cleaning and disinfection of ships during the COVID-19 pandemic

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 proven to be as effective as the two-step process of cleaning and disinfection [13].

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 [15].
- 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 [10].

Medical facilities and isolation/ quarantine areas should be cleaned and disinfected daily [10, 15].

Medical facilities, cabins and quarters occupied by COVID-19 patients and contacts should firstly be ventilated well and then cleaned and disinfected [7]. Rooms where aerosol generating procedures (AGP) have been performed (e.g. bag-valve ventilation, administration of nebulised medicines 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). These facilities should be kept ventilated – if feasible – when the patient is hosted also (i.e. by keeping the window open and the door closed).

- 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 high-efficiency particulate air (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.

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

- Critical surfaces in medical facilities should be cleaned and disinfected with 0.5% (5000ppm) 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% (5000ppm) sodium hypochlorite (NaClO) (dilution 1:10, if household bleach is used, which is usually at an initial concentration of 5%)[3] is suggested. Surfaces should be rinsed with clean water after 10 minutes contact time for chlorine.
- For other non-critical surfaces, the use of 0.1% (1000ppm) sodium hypochlorite (NaClO) (dilution 1:50, if household bleach is used, which is usually at an initial concentration of 5%) is suggested with 10 minutes contact time [7]. 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, 10]. Before using alcohol based disinfectants a risk assessment for safe application (risk of fire or explosion) of disinfection products should be conducted especially if 70% alcohol will be used on large surfaces.

Bathrooms and toilets in medical facilities and isolation/ quarantine areas

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% (1000ppm[4]) sodium hypochlorite (NaClO) (dilution 1:50, if household

[3] To make the chlorine solution with a concentration of 5000ppm, mix 1-part household bleach with 5% sodium hypochlorite to 9-parts water.

[4] 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.

bleach is used, which is usually at an initial concentration of 5%) is suggested [7] with 10 minutes contact time. Surfaces should be rinsed with clean water after 10 minutes contact time for chlorine. A dedicated toilet is recommended for suspect and confirmed cases. If it is not possible to provide separate toilets for the patient and for the cabin mate, the shared toilet should be cleaned and disinfected at least twice daily [10].

Frequently touched areas and other hard surfaces on board the ship

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. [13].

Cleaning environmental surfaces with water and detergent, and applying commonly used disinfectants (such as 0.1% (1000ppm) sodium hypochlorite with 10 minutes contact time (dilution 1:50, if household bleach is used, which is usually at an initial concentration of 5%) or 70% ethanol with 10 minutes contact time) is an effective and sufficient procedure [10, 15]. The sodium hypochlorite solution should be used immediately and prepared fresh every time it is needed [13].

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 [13].

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 [13]. 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 [13]. Other disinfectant agents that are less damaging to furnishings could be used (see paragraph "*Antimicrobial agents effective against coronaviruses*" above). Leisure facilities such as deckchairs should not be overlooked [13].

Mattresses

Soiled mattresses should be steam cleaned or discarded [13].

Carpets and furnishings

Carpets and furnishings that cannot be laundered can be cleaned with detergent and warm water, followed by steam [13]. Vacuuming of carpets should not take place in cabins occupied by infected people, unless the carpet has been previously disinfected [13]. Contaminated carpets should be steam cleaned and then disinfected [13].

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 [13].

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 [16].

Textiles and laundry

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 0.1% (1000ppm) sodium hypochlorite (NaClO) (dilution 1:50, if household bleach is used, which is usually at an initial concentration of 5%) for approximately 10 minutes, rinsed with clean water and dried fully in sunlight.

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 [13].

- All persons dealing with soiled linen from patients with COVID-19 should wear appropriate PPE, which includes heavy duty gloves, face 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 [17].
- 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 [17].
- 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 (non-alginate) 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.

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 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% (5000ppm) 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.

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 [13].

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 accordance with the policy of the port reception facility [13].

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 [13].

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 (e.g. Norovirus) [13].

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 at a minimum temperature of 24°C (75°F) with an exposure time of 7 seconds and then air dried [13, 18].

Food preparation areas

If there is an on-going outbreak on board a ship, then food contact and non-food contact surfaces at the food preparation areas should be disinfected with 0.1% (1000ppm) sodium hypochlorite (NaClO) (dilution 1:50, if household bleach is used, which is usually at an initial concentration of 5%) with 10 minutes contact time and then rinsed, or with other licensed virucidal products approved to be used on food contact surfaces.

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