Cleaning and disinfection of environmental surfaces in the context of COVID-19

Interim guidance

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World Health Organization

Background

Coronavirus disease 2019 (COVID-19) is a respiratory infection caused by SARS-CoV-2 (COVID-19 virus). The COVID-19 virus is transmitted mainly through close physical contact and respiratory droplets, while airborne transmission is possible during aerosol generating medical procedures.[1] At time of publication, transmission of the COVID-19 virus had not been conclusively linked to contaminated environmental surfaces in available studies. However, this interim guidance document has been informed by evidence of surface contamination in health-care settings[2] and past experiences with surface contamination that was linked to subsequent infection transmission in other coronaviruses. Therefore, this guidance aims to reduce any role that fomites might play in the transmission of COVID-19 in health-care[3] and non-health care settings.[4]

Environmental surfaces in health-care settings include furniture and other fixed items inside and outside of patient rooms and bathrooms, such as tables, chairs, walls, light switches and computer peripherals, electronic equipment, sinks, toilets as well as the surfaces of non-critical medical equipment, such as blood pressure cuffs, stethoscopes, wheelchairs and incubators.[5] In non-healthcare settings, environmental surfaces include sinks and toilets, electronics (touch screens and controls), furniture and other fixed items, such as counter tops, stairway rails, floors and walls.

Environmental surfaces are more likely to be contaminated with the COVID-19 virus in health-care settings where certain medical procedures are performed.[6-8] Therefore, these surfaces, especially where patients with COVID-19 are being cared for, must be properly cleaned and disinfected to prevent further transmission. Similarly, this advice applies to alternative settings for isolation of persons with COVID-19 experiencing uncomplicated and mild illness, including households and non-traditional facilities.[9]

Transmission of the COVID-19 virus has been linked to close contact between individuals within closed settings, such as households, health facilities, assisted living and residential institution environments.[10] In addition, community settings outside of health-care settings have been found vulnerable to COVID-19 transmission events including publicly accessible buildings, faith-based community centres, markets, transportation, and business settings.[10,11] Although the precise role of fomite transmission and necessity for disinfection practices outside of health-care environments is currently unknown, infection prevention and control principles designed to mitigate the spread of pathogens in health-care settings, including cleaning and disinfection practices, have been adapted in this guidance document so that they can be applied in non-health care setting environments.* In all settings, including those where cleaning and disinfection are not possible on a regular basis due to resource limitations, frequent hand washing and avoiding touching the face should be the primary prevention approaches to reduce any potential transmission associated with surface contamination.[21]

Like other coronaviruses, SARS-CoV-2 is an enveloped virus with a fragile outer lipid envelope that makes it more susceptible to disinfectants compared to non-enveloped viruses such as rotavirus, norovirus and poliovirus.[22] Studies have evaluated the persistence of the COVID-19 virus on different surfaces. One study found that the COVID-19 virus remained viable up to 1 day on cloth and wood, up to 2 days on glass, 4 days on stainless steel and plastic, and up to 7 days on the outer layer of a medical mask.[23] Another study found that the COVID-19 virus survived 4 hours on copper, 24 hours on cardboard and up to 72 hours on plastic and stainless steel.[24] The COVID-19 virus also survives in a wide range of pH values and ambient temperatures but is susceptible to heat and standard disinfection methods.[23] These studies, however, were conducted under laboratory conditions in absence of cleaning and disinfection practices and should be interpreted with caution in the real-world environment.

The purpose of this document is to provide guidance on the cleaning and disinfection of environmental surfaces in the context of COVID-19.

This guidance is intended for health-care professionals, public health professionals and health authorities that are developing and implementing policies and standard operating procedures (SOP) on the cleaning and disinfection of environmental surfaces in the context of COVID-19. †

* The topics of current WHO interim guidance documents for non health care setting environments, including environmental cleaning and disinfection recommendations, include faith-based community settings,[12] funerary services,[13] workplaces,[14] food sector,[15] accommodation sector,[16] aviation sector,[17] maritime sector,[18] schools,[19] prisons and other places of detention.[20]

† This document is not intended to be comprehensive guidance on the practice of environmental cleaning and disinfection, which is covered in other relevant guidelines

Principles of environmental cleaning and disinfection

Cleaning helps to remove pathogens or significantly reduce their load on contaminated surfaces and is an essential first step in any disinfection process. Cleaning with water, soap (or a neutral detergent) and some form of mechanical action (brushing or scrubbing) removes and reduces dirt, debris and other organic matter such as blood, secretions and excretions, but does not kill microorganisms.[25] Organic matter can impede direct contact of a disinfectant to a surface and inactivate the germicidal properties or mode of action of several disinfectants. In addition to the methodology used, the disinfectant concentration and contact time are also critical for effective surface disinfection. Therefore, a chemical disinfectant, such as chlorine or alcohol, should be applied after cleaning to kill any remaining microorganisms.

Disinfectant solutions must be prepared and used according to the manufacturer's recommendations for volume and contact time. Concentrations with inadequate dilution during preparation (too high or too low) may reduce their effectiveness. High concentrations increase chemical exposure to users and may also damage surfaces. Enough disinfectant solution should be applied to allow surfaces to remain wet and untouched long enough for the disinfectant to inactivate pathogens, as recommended by the manufacturer.

Training in health-care settings

Environmental cleaning is a complex infection prevention and control intervention that requires a multipronged approach, which may include training, monitoring, auditing and feedback, reminders and displaying SOPs in key areas.

Training for cleaning staff should be based on the policies and SOPs of the health-care facility and national guidelines. It should be structured, targeted, and delivered in the right style (e.g. participatory, at the appropriate literacy level), and it should be mandatory during staff induction to a new workplace. The training programme should include instructions on risk assessment and ensure demonstrative competencies of safe disinfectant preparation, mechanical cleaning and equipment use, standard precautions and transmission-based precautions. Refresher courses are recommended to encourage and reinforce good practice. In health-care facilities and public buildings, posters or other guidance should be visible to cleaning workers and others to guide and remind them about the proper procedures on disinfectant preparation and use.

Cleaning and disinfection techniques and supplies

Cleaning should progress from the least soiled (cleanest) to the most soiled (dirtiest) areas, and from the higher to lower levels so that debris may fall on the floor and is cleaned last in a systematic manner to avoid missing any areas. Use fresh cloths at the start of each cleaning session (e.g., routine daily cleaning in a general inpatient ward). Discard cloths that are no longer saturated with solution. For areas considered to be at high risk of COVID-19 virus contamination, use a new cloth to clean each patient bed. Soiled cloths should be reprocessed properly after each use and an SOP should be available for the frequency of changing cloths.

Cleaning equipment (e.g. buckets) should be well maintained. Equipment used for isolation areas for patients with COVID-19 should be colour-coded and separated from other equipment. Detergent or disinfectant solutions become contaminated during cleaning and progressively less effective if the organic load is too high; therefore, the continued use of the same solution may transfer the microorganisms to each subsequent surface. Thus, detergent and/or disinfectant solutions must be discarded after each use in areas with suspected/confirmed patients with COVID-19. It is recommended that fresh solution be prepared on a daily basis or for each cleaning shift. Buckets should be washed with detergent, rinsed, dried and stored inverted to drain fully when not in use.[28]

Products for environmental cleaning and disinfection

Follow the manufacturer's instructions to ensure that disinfectants are prepared and handled safety, wearing the appropriate personal protective equipment (PPE) to avoid chemical exposure.[26]

The selection of disinfectants should take account of the microorganisms targeted, as well as the recommended concentration and contact time, the compatibility of the chemical disinfectants and surfaces to be tackled, toxicity, ease of use and stability of the product. The selection of disinfectants should meet local authorities' requirements for market approval, including any regulations applicable to specific sectors, for example health-care and food industries.[‡]

The use of chlorine-based products

Hypochlorite-based products include liquid (sodium hypochlorite), solid or powdered (calcium hypochlorite) formulations. These formulations dissolve in water to create a dilute aqueous chlorine solution in which undissociated hypochlorous acid (HOCl) is active as the antimicrobial compound. Hypochlorite displays a broad spectrum of antimicrobial activity and is effective against several common pathogens at various concentrations. For example, hypochlorite is effective against rotavirus at a concentration of 0.05% (500 ppm), however, higher concentrations of 0.5% (5000 ppm) are required for some highly resistant pathogens in the health-care setting such as *C. auris* and *C. difficile.*[30,31]

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including the WHO's *Essential environmental health standards in health care*[25] and the joint U.S. Centers for Disease Control and Prevention & Infection Control Africa Network's document *Best practices for environmental cleaning in healthcare facilities in resource-limited settings.*[26] This guidance does not address the procedures for decontamination of instruments and semi-critical and critical medical devices, which can be found in the WHO document on *Decontamination and reprocessing of medical devices for health-care facilities.*[27]

[‡] A list of disinfectants for use against the COVID-19 virus is currently being actively updated by the U.S. Environmental Protection Agency (EPA) with caution that inclusion of a disinfectant within this list does not constitute endorsement by their agency.[29]

The recommendation of 0.1% (1000 ppm) in the context of COVID-19 is a conservative concentration that will inactivate the vast majority of other pathogens that may be present in the health-care setting. However, for blood and body fluids large spills (i.e. more than about 10mL) a concentration of 0.5% (5000 ppm) is recommended.[26]

Hypochlorite is rapidly inactivated in the presence of organic material; therefore, regardless of the concentration used, it is important to first clean surfaces thoroughly with soap and water or detergent using mechanical action such as scrubbing or friction. High concentrations of chlorine can lead to corrosion of metal and irritation of skin or mucous membrane, in addition to potential side-effects related to chlorine smell for vulnerable people such as people with asthma.[32]

Commercial sodium hypochlorite products with different levels of concentration may be readily available for use in a variety of settings. In Europe and North America chlorine concentrations in commercially available products vary between 4% and 6%.[34] Concentration may also vary according to national regulations and manufacturers' formulations. To achieve the desired concentration, it is necessary to prepare sodium hypochlorite by diluting the basic aqueous solution with a given proportion of clean, non-turbid water to produce the final desired concentration (Table 1).[34]

Table 1. Calculation of sodium hypochlorite concentrations

[% chlorine in liquid sodium hypochlorite / % chlorine desired] − 1 = Total parts of water for each part sodium hypochlorite.
Ex: [5% in liquid sodium hypochlorite/ 0.5% chlorine desired] -1 = 9 parts of water for each part sodium hypochlorite

Solid formulations of hypochlorite (powder or granules) may also be available in a variety of settings. Solid formulations are available as concentrated, high-test hypochlorite (HTH) (65-70%) and as chlorine or calcium hypochlorite powder (35%). To produce the final desired concentration, the weight (in grams) of calcium hypochlorite that should be added per litre of water can be determined based on the calculation in Table 2.

Table 2. Calculation of chlorine solutions from calcium hypochlorite

[% chlorine desired / % chlorine in hypochlorite powder or granules] × 1 000 = grams of calcium hypochlorite powder for each litre of water.
Ex: [0.5% chlorine desired / 35% in hypochlorite powder] × 1 000 = 0.0143 × 1 000 = 14.3
Therefore, you must dissolve 14.3 grams of calcium hypochlorite powder in each litre of water used to make a 0.5% chlorine solution.

Chlorine can decay rapidly in solutions depending on the source of chlorine and environmental conditions, for example ambient temperature or UV exposure. Chlorine solutions should be stored in opaque containers, in a well-ventilated, covered area that is not exposed to direct sunlight.[35] Chlorine solutions are most stable at high pH (>9) but the disinfectant properties of chlorine are stronger at lower pH (<8). Solutions of 0.5% and 0.05% chlorine have been shown to be stable for more than 30 days at temperatures of 25-35°C when the pH is above 9. However, chlorine solutions at lower pH have much shorter shelf lives.[36] Thus, ideally chlorine solutions should be freshly prepared every day. If this is not possible and the chlorine solution must be used for several days, they should be tested daily to ensure that the chlorine concentration is maintained. Several tests can be used to gauge chlorine strength, and these include chemical titration, chemical spectrometry or colorimetry, colour wheels and test strips, in order of decreasing accuracy.[37]

Spraying disinfectants and other no-touch methods

In indoor spaces, routine application of disinfectants to environmental surfaces by spraying or fogging (also known as fumigation or misting) is not recommended for COVID-19. One study has shown that spraying as a primary disinfection strategy is ineffective in removing contaminants outside of direct spray zones.[38] Moreover, spraying disinfectants can result in risks to the eyes, respiratory or skin irritation and the resulting health effects.[39] Spraying or fogging of certain chemicals, such as formaldehyde, chlorine-based agents or quaternary ammonium compounds, is not recommended due to adverse health effects on workers in facilities where these methods have been utilized.[40,41] Spraying environmental surfaces in both health-care and non-health care settings such as patient households with disinfectants may not be effective in removing organic material and may miss surfaces shielded by objects, folded fabrics or surfaces with intricate designs. If disinfectants are to be applied, this should be done with a cloth or wipe that has been soaked in disinfectant.

Some countries have approved no-touch technologies for applying chemical disinfectants (e.g. vaporized hydrogen peroxide) in health-care settings such as fogging-type applications.[42] Furthermore, devices using UV irradiation have been designed for health-care settings. However, several factors may affect the efficacy of UV irradiation, including distance from the UV device; irradiation dose, wavelength and exposure time; lamp placement; lamp age; and duration of use. Other factors include direct or indirect line of sight from the device; room size and shape; intensity; and reflection.[5] Notably, these technologies developed for use in health-care settings are used during terminal cleaning (cleaning a room after a patient has been discharged or transferred), when rooms are unoccupied for the safety of staff and patients. These technologies supplement but do not replace the need for manual cleaning procedures.[44] If using a no-touch disinfection technology, environmental surfaces must be cleaned manually first by brushing or scrubbing to remove organic matter.[44]

Spraying or fumigation of outdoor spaces, such as streets or marketplaces, is also not recommended to kill the COVID-19 virus or other pathogens because disinfectant is inactivated by dirt and debris and it is not feasible to manually clean and remove all organic matter from such spaces. Moreover, spraying porous surfaces, such as sidewalks and unpaved walkways, would be even less effective. Even in the absence of organic matter, chemical spraying is unlikely to adequately cover all surfaces for the duration of the required contact time needed to inactivate pathogens. Furthermore, streets and sidewalks are not considered to be reservoirs of infection for COVID-19. In addition, spraying disinfectants, even outdoors, can be harmful for human health.

Spraying individuals with disinfectants (such as in a tunnel, cabinet, or chamber) **is not recommended under any circumstances**. This could be physically and psychologically harmful and would not reduce an infected person's ability to spread the virus through droplets or contact. Moreover, spraying individuals with chlorine and other toxic chemicals could result in eye and skin irritation, bronchospasm due to inhalation, and gastrointestinal effects such as nausea and vomiting.[40, 45]

Health-care settings environment

Environmental cleaning and disinfection in clinical, non-traditional facilities and home-based health-care settings should follow detailed SOPs with a clear delineation of responsibilities (e.g. housekeeping or clinical staff), regarding the type of surfaces and frequency of cleaning (Table 3). Particular attention should be paid to environmental cleaning of high-touch surfaces and items, such as light switches, bed rails, door handles, intravenous pumps, tables, water/beverage pitchers, trays, mobile cart rails and sinks, which should be performed frequently. However, all touchable surfaces should be disinfected. Cleaning practices and cleanliness should be routinely monitored. The number of cleaning staff should be planned to optimize cleaning practices. Health workers should be made aware of cleaning schedules and cleaning completion times to make informed risk assessments when performing touch contact with surfaces and equipment, to avoid contaminating hands and equipment during patient care.[46]

Table 3. Health-care setting: Recommended frequency of cleaning of environmental surfaces, according to the patient areas with suspected or confirmed COVID-19 patients.

Patient area	Frequency [a]	Additional guidance
Screening/triage area	At least twice daily	• Focus on high-touch surfaces, then floors (last)
Inpatient rooms / cohort – occupied	At least twice daily, preferably three times daily, in particular for high-touch surfaces	• Focus on high-touch surfaces, starting with shared/common surfaces, then move to each patient bed; use new cloth for each bed if possible; then floors (last)
Inpatient rooms – unoccupied (terminal cleaning)	Upon discharge/transfer	• Low-touch surfaces, high-touch surfaces, floors (in that order); waste and linens removed, bed thoroughly cleaned and disinfected
Outpatient / ambulatory care rooms	After each patient visit (in particular for high-touch surfaces) and at least once daily terminal clean	• High-touch surfaces to be disinfected after each patient visit • Once daily low-touch surfaces, high-touch surfaces, floors (in that order); waste and linens removed, examination bed thoroughly cleaned and disinfected
Hallways / corridors	At least twice daily [b]	• High-touch surfaces including railings and equipment in hallways, then floors (last)
Patient bathrooms/ toilets	Private patient room toilet: at least twice daily Shared toilets: at least three times daily	• High-touch surfaces, including door handles, light switches, counters, faucets, then sink bowls, then toilets and finally floor (in that order) • Avoid sharing toilets between staff and patients

[a] Environmental surfaces should also be cleaned and disinfected whenever visibly soiled or if contaminated by a body fluid (e.g., blood); [b] Frequency can be once a day if hallways are not frequently used.

Selecting a disinfectant product for environmental surfaces in health-care settings should consider the logarithmic (decimal order of magnitude) reduction for the COVID-19 virus, and also for other health care-associated pathogens, including *Staphylococcus aureus*, *Salmonella sp*, *Pseudomonas aeruginosa*, *Acinetobacter baumannii,* and hepatitis A and B viruses. In some contexts, environmentally persistent organisms, such as *Clostridioides difficile* and *Candida auris*, that are resistant to certain disinfectants, should also be considered when selecting a disinfectant. Thus, appropriate disinfectants need to be carefully selected for health-care facilities.[47]

After cleaning, the following disinfectants and defined concentrations can be used on environmental surfaces to achieve a >3 log^{10} reduction of human coronavirus,[33] and they are also effective against other clinically relevant pathogens in the health-care setting.[22]

- Ethanol 70-90%
- Chlorine-based products (e.g., hypochlorite) at 0.1% (1000 ppm) for general environmental disinfection or 0.5% (5000 ppm) for blood and body fluids large spills (See section: The use of chlorine-based products)
- Hydrogen peroxide ≥0.5%

Contact time of a minimum of 1 minute is recommended for these disinfectants[21] or as recommended by the manufacturers. Other disinfectants can be considered, provided the manufacturers recommend them for the targeted microorganisms, especially enveloped viruses. Manufacturers' recommendations for safe use as well as for avoiding mixing types of chemical disinfectants should always be considered when preparing, diluting or applying a disinfectant.

Non-health care settings environment

There is no evidence for equating the risk of fomite transmission of the COVID-19 virus in the hospital setting to any environment outside of hospitals. However, it is still important to reduce potential for COVID-19 virus contamination in non-healthcare settings, such as in the home, office, schools, gyms or restaurants. High-touch surfaces in these non-health care settings should be identified for priority disinfection. These include door and window handles, kitchen and food preparation areas, counter tops, bathroom surfaces, toilets and taps, touchscreen personal devices, personal computer keyboards, and work surfaces. The disinfectant and its concentration should be carefully selected to avoid damaging surfaces and to avoid or minimize toxic effects on household members or users of public spaces.

The environmental cleaning techniques and cleaning principles should be followed as far as possible. Surfaces should always be cleaned with soap and water or a detergent to remove organic matter first, followed by disinfection. In non-health care settings, sodium hypochlorite (bleach) may be used at a recommended concentration of 0.1% (1000 ppm).[5] Alternatively, alcohol with 70%-90% concentration may be used for surface disinfection.

Personal safety when preparing and using disinfectants

Cleaners should wear adequate personal protective equipment (PPE) and be trained to use it safely. When working in places where suspected or confirmed COVID-19 patients are present, or where screening, triage and clinical consultations are carried out, cleaners should wear the following PPE: gown, heavy duty gloves, medical mask, eye protection (if risk of splash from organic material or chemicals), and boots or closed work shoes.[48]

Disinfectant solutions should always be prepared in well-ventilated areas. Avoid combining disinfectants, both during preparation and usage, as such mixtures cause respiratory irritation and can release potentially fatal gases, in particular when combined with hypochlorite solutions.

Personnel preparing or using disinfectants in health care settings require specific PPE, due to the high concentration of disinfectants used in these facilities and the longer exposure time to the disinfectants during the workday.[49] Thus, PPE for preparing or using disinfectants in health care settings includes uniforms with long-sleeves, closed work shoes, gowns and/or impermeable aprons, rubber gloves, medical mask, and eye protection (preferably face shield)[§].

In non-health care settings, resource limitations permitting, where disinfectants are being prepared and used, the minimum recommended PPE is rubber gloves, impermeable aprons and closed shoes.[34] Eye protection and medical masks may also be needed to protect against chemicals in use or if there is a risk of splashing.

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[§] For more information on appropriate PPE use in the context of COVID-19, please see Rational use of personal protective equipment for coronavirus disease (COVID-19) and considerations during severe shortages: interim guidance[35].

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WHO continues to monitor the situation closely for any changes that may affect this interim guidance. Should any factors change, WHO will issue a further update. Otherwise, this interim guidance document will expire 2 years after the date of publication

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