Water, sanitation, hygiene and waste management for the COVID-19 virus

Technical brief
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1. Introduction and background

In late 2019, an acute respiratory disease emerged, known as novel coronavirus disease 2019 (COVID-19). The pathogen responsible for COVID-19 is severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2, also referred to as the COVID-19 virus), a member of the coronavirus family. In response to the growing spread of COVID-19, WHO has published a number of technical guidance documents on specific topics, including infection prevention and control (IPC). These documents are available at https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/infection-prevention-and-control.

This technical brief supplement the IPC documents by referencing and summarizing the WHO guidance on water, sanitation and health care waste that is relevant to viruses, including coronaviruses. This technical brief is written, in particular, for water and sanitation practitioners and providers. It is also for health care providers who want to know more about water, sanitation and hygiene (WASH) risks and practices.

The provision of safe water, sanitation and hygienic conditions is essential to protecting human health during all infectious disease outbreaks, including the COVID-19 outbreak. Ensuring good and consistently applied WASH and waste management practices in communities, homes, schools, marketplaces and health care facilities will further help to prevent human-to-human transmission of the COVID-19 virus.

The most important information concerning WASH and the COVID-19 virus is summarized here.

- Frequent and proper hand hygiene is one of the most important measures that can be used to prevent infection with the COVID-19 virus. WASH practitioners should work to enable more frequent and regular hand hygiene by improving facilities and using proven behaviour change techniques.
- WHO guidance on the safe management of drinking-water and sanitation services applies to the COVID-19 outbreak. Extra measures are not needed. In particular, disinfection will facilitate more rapid die-off of the COVID-19 virus.
- Many co-benefits will be realized by safely managing water and sanitation services and applying good hygiene practices. Such efforts will prevent many other infectious diseases, which cause millions of deaths each year.

Currently, there is no evidence about the survival of the COVID-19 virus in drinking-water or sewage. The morphology and chemical structure of the COVID-19 virus are similar to those of other surrogate human coronaviruses for which there are data about both survival in the environment and effective inactivation measures. Thus, this brief draws upon the existing evidence base and, more generally, existing WHO guidance on how to protect against viruses in sewage and drinking-water. This document is based on the current knowledge of the COVID-19 virus and it will be updated as new information becomes available.

1.1 COVID-19 transmission

There are two main routes of transmission of the COVID-19 virus: respiratory and contact. Respiratory droplets are generated when an infected person coughs or sneezes. Any person who is in close contact with someone who has respiratory symptoms (for example, sneezing, coughing) is at risk of being exposed to potentially infective respiratory droplets (*1*). Droplets may also land on surfaces where the virus could remain viable; thus, the immediate environment of an infected individual can serve as a source of transmission (known as contact transmission).

The risk of catching the COVID-19 virus from the faeces of an infected person appears to be low. There is some evidence that the COVID-19 virus may lead to intestinal infection and be present in faeces. Approximately 2–10% of cases of confirmed COVID-19 disease presented with diarrhoea (*2–4*), and two studies detected COVID-19 viral RNA fragments in the faecal matter of COVID-19 patients (*5,6*). However, to date only one study has cultured the COVID-19 virus from a single stool specimen (*7*). There have been no reports of faecal–oral transmission of the COVID-19 virus.

1.2 Persistence of the COVID-19 virus in drinking-water, faeces and sewage and on surfaces.

While persistence in drinking-water is possible, there is no current evidence from surrogate human coronaviruses that they are present in surface or groundwater sources or transmitted through contaminated drinking-water. The COVID-19 virus is an enveloped virus, with a fragile outer membrane. Generally, enveloped viruses are less stable in the environment and are more susceptible to oxidants, such as chlorine. While there is no evidence to date about survival of the COVID-19 virus in water or sewage, the virus is likely to become inactivated significantly faster than non-enveloped human enteric viruses with known waterborne transmission (such as adenoviruses, norovirus, rotavirus and hepatitis A). For example, one study found that a surrogate human coronavirus survived only 2 days in dechlorinated tap water and in hospital wastewater at 20° C (*8*). Other studies concur, noting that the human coronaviruses transmissible gastroenteritis coronavirus and mouse hepatitis virus demonstrated a 99.9% die-off in from 2 days (*9*) at 23° C to 2 weeks (*10*) at 25° C. Heat, high or low pH, sunlight and common disinfectants (such as chlorine) all facilitate die off.

It is not certain how long the virus that causes COVID-19 survives on surfaces, but it seems likely to behave like other coronaviruses. A recent review of the survival of human coronaviruses on surfaces found large variability, ranging from 2 hours to 9 days (*11*). The survival time depends on a number of factors, including the type of surface, temperature, relative humidity and specific strain of the virus. The same review also found that effective inactivation could be achieved within 1 minute using common disinfectants, such as 70% ethanol or sodium hypochlorite (for details, see Section 2.5 Cleaning practices).

1.3 Keeping water supplies safe

The COVID-19 virus has not been detected in drinking-water supplies, and based on current evidence, the risk to water supplies is low (*12*). Laboratory studies of surrogate coronaviruses that took place in well-controlled environments indicated that the virus could remain infectious in water contaminated with faeces for days to weeks (*10*). A number of measures can be taken to improve water safety, starting with protecting the source water; treating water at the point of distribution, collection or consumption; and ensuring that treated water is safely stored at home in regularly cleaned and covered containers.

Conventional, centralized water treatment methods that utilize filtration and disinfection should inactivate the COVID-19 virus. Other human coronaviruses have been shown to be sensitive to chlorination and disinfection with ultraviolet (UV) light (*13*). As enveloped viruses are surrounded by a lipid host cell membrane, which is not robust, the COVID-19 virus is likely to be more sensitive to chlorine and other oxidant disinfection processes than many other viruses, such as coxsackieviruses, which have a protein coat. For effective centralized disinfection, there should be a residual concentration of free chlorine of ≥0.5 mg/L after at least 30 minutes of contact time at pH < 8.0 (*12*). A chlorine residual should be maintained throughout the distribution system.

In places where centralized water treatment and safe piped water supplies are not available, a number of household water treatment technologies are effective in removing or destroying viruses, including boiling or using high-performing ultrafiltration or nanomembrane filters, solar irradiation and, in non-turbid waters, UV irradiation and appropriately dosed free chlorine.[1]

1.4 Safely managing wastewater and faecal waste

There is no evidence to date that the COVID-19 virus has been transmitted via sewerage systems with or without wastewater treatment. Furthermore, there is no evidence that sewage or wastewater treatment workers contracted severe acute respiratory syndrome (SARS), which is caused by another type of coronavirus that caused a large outbreak of acute respiratory illness in 2003. As part of an integrated public health policy, wastewater carried in sewerage systems should be treated in well-designed and well-managed centralized wastewater treatment works. Each stage of treatment (as well as retention time and dilution) results in a further reduction of the potential risk. A waste stabilization pond (that is, an oxidation pond or lagoon) is generally considered to be a practical and simple wastewater treatment technology that is particularly well suited to destroying pathogens, as relatively long retention times (that is, 20 days or longer) combined with sunlight, elevated pH levels, biological activity and other factors serve to accelerate pathogen destruction. A final disinfection step may be considered if existing wastewater treatment plants are not optimized to remove viruses. Best practices for protecting the health of workers at sanitation treatment facilities should be followed. Workers should wear appropriate personal protective equipment (PPE), which includes protective outerwear, gloves, boots, goggles or a face shield, and a mask; they should perform hand hygiene frequently; and they should avoid touching eyes, nose and mouth with unwashed hands.

2. WASH in health care settings

Existing recommendations for water, sanitation and hygiene measures in health care settings are important for providing adequate care for patients and protecting patients, staff[2] and caregivers from infection risks (*14*). The following actions are particularly important: (i) managing excreta

[1] Generally, the listed technologies are effective in inactivating viruses, but performance can vary widely depending on the manufacturing process, type of materials, design and use. It is important to verify the performance of a specific technology.

[2] Staff includes not only health care staff but also ancillary staff, such as cleaning staff, hygienists, laundry staff and waste workers.

(faeces and urine) safely, including ensuring that no one comes into contact with it and that it is treated and disposed of correctly; (ii) engaging in frequent hand hygiene using appropriate techniques; (iii) implementing regular cleaning and disinfection practices; and (iv) safely managing health care waste. Other important and recommended measures include providing sufficient safe drinking-water to staff, caregivers and patients; ensuring that personal hygiene can be maintained, including hand hygiene, for patients, staff and caregivers; regularly laundering bedsheets and patients' clothing; providing adequate and accessible toilets (including separate facilities for confirmed and suspected cases of COVID-19 infection); and segregating and safely disposing of health care waste. For details on these recommendations, please refer to *Essential environmental health standards in health care* (*14*).

2.1 Hand hygiene practices

Hand hygiene is extremely important. Cleaning hands with soap and water or an alcohol-based hand rub should be performed according to the instructions known as "My 5 moments for hand hygiene" (*15*). If hands are not visibly dirty, the preferred method is to perform hand hygiene with an alcohol-based hand rub for 20−30 seconds using the appropriate technique (*16*). When hands are visibly dirty, they should be washed with soap and water for 40−60 seconds using the appropriate technique (*17*). Hand hygiene should be performed at all five moments, including before putting on PPE and after removing it, when changing gloves, after any contact with a patient with suspected or confirmed COVID-19 infection or their waste, after contact with any respiratory secretions, before eating and after using the toilet (*18*). If an alcohol-based hand rub and soap are not available, then using chlorinated water (0.05%) for handwashing is an option, but it is not ideal because frequent use may lead to dermatitis, which could increase the risk of infection and asthma and because prepared dilutions might be inaccurate (*19*). However, if other options are not available or feasible, using chlorinated water for handwashing is an option.

Functional hand hygiene facilities should be present for all health care workers at all points of care and in areas where PPE is put on or taken off. In addition, functional hand hygiene facilities should be available for all patients, family members and visitors, and should be available within 5 m of toilets, as well as in waiting and dining rooms and other public areas.

2.2 Sanitation and plumbing

People with suspected or confirmed COVID-19 disease should be provided with their own flush toilet or latrine that has a door that closes to separate it from the patient's room. Flush toilets should operate properly and have functioning drain traps. When possible, the toilet should be flushed with the lid down to prevent droplet splatter and aerosol clouds. If it is not possible to provide separate toilets, the toilet should be cleaned and disinfected at least twice daily by a trained cleaner wearing PPE (that is, gown, gloves, boots, mask, and a face shield or goggles). Furthermore, and consistent with existing guidance, staff and health care workers should have toilet facilities that are separate from those used by all patients.

WHO recommends the use of standard, well-maintained plumbing, such as sealed bathroom drains, and backflow valves on sprayers and faucets to prevent aerosolized faecal matter from entering the plumbing or ventilation system (*20*), together with standard wastewater treatment (*21*). Faulty plumbing and a poorly designed air ventilation system were implicated as contributing factors to the spread of the aerosolized SARS coronavirus in a high-rise apartment building in Hong Kong in 2003 (*22*). Similar concerns have been raised about the spread of the COVID-19 virus from faulty toilets in high-rise apartment buildings (*23*). If health care facilities are connected to sewers, a risk assessment should be conducted to confirm that wastewater is contained within the system (that is, the system does not leak) prior to its arrival at a functioning treatment or disposal site, or both. Risks pertaining to the adequacy of the collection system or to treatment and disposal methods should be assessed following a safety planning approach (*24*), with critical control points prioritized for mitigation.

For smaller health care facilities in low-resource settings, if space and local conditions allow, pit latrines may be the preferred option. Standard precautions should be taken to prevent contamination of the environment by excreta. These precautions include ensuring that at least 1.5 m exist between the bottom of the pit and the groundwater table (more space should be allowed in coarse sands, gravels and fissured formations) and that the latrines are located at least 30 m horizontally from any groundwater source (including both shallow wells and boreholes) (*21*). If there is a high groundwater table or a lack of space to dig pits, excreta should be retained in impermeable storage containers and left for as long as feasibly possible to allow for a reduction in virus levels before moving it off-site for additional treatment or safe disposal, or both. A two-tank system with parallel tanks would help to facilitate inactivation by maximizing retention times, as one tank could be used until full, then allowed to sit while the next tank is being filled. Particular care should be taken to avoid splashing and the release of droplets while cleaning or emptying tanks.

2.3 Toilets and the handling of faeces

It is critical to conduct hand hygiene when there is suspected or direct contact with faeces (if hands are dirty, then soap and water are preferred to the use of an alcohol-based hand rub). If the patient is unable to use a latrine, excreta should be collected in either a diaper or a clean bedpan and immediately and carefully disposed of into a separate toilet or latrine used only by suspected or confirmed cases of COVID-19. In all health care settings, including those with suspected or confirmed COVID-19 cases, faeces must be treated as a biohazard and handled as little as possible. Anyone handling faeces should follow WHO contact and droplet precautions (*18*) and use PPE to prevent exposure, including long-sleeved gowns, gloves, boots, masks, and goggles or a face shield. If diapers are used, they should be disposed of as infectious waste as they would be in all situations. Workers should be properly trained in how to put on, use and remove PPE so that these protective barriers are maintained and not breached (*25*). If PPE is not available or the supply is limited, hand hygiene should be regularly practiced, and workers should keep at least 1 m distance from any suspected or confirmed cases.

If a bedpan is used, after disposing of excreta from it, the bedpan should be cleaned with a neutral detergent and water, disinfected with a 0.5% chlorine solution, and then rinsed with clean water; the rinse water should be disposed of in a drain or a toilet or latrine. Other effective disinfectants include commercially available quaternary ammonium compounds, such as cetylpyridinium chloride, used according to manufacturer's instructions, and peracetic or peroxyacetic acid at concentrations of 500−2000 mg/L (*26*).

Chlorine is ineffective for disinfecting media containing large amounts of solid and dissolved organic matter. Therefore, there is limited benefit to adding chlorine solution to fresh excreta and, possibly, this may introduce risks associated with splashing.

2.4 Emptying latrines and holding tanks, and transporting excreta off-site

There is no reason to empty latrines and holding tanks of excreta from suspected or confirmed COVID-19 cases unless they are at capacity. In general, the best practices for safely managing excreta should be followed. Latrines or holding tanks should be designed to meet patient demand, considering potential sudden increases in cases, and there should be a regular schedule for emptying them based on the wastewater volumes generated. PPE (that is, a long-sleeved gown, gloves, boots, masks, and goggles or a face shield) should be worn at all times when handling or transporting excreta offsite, and great care should be taken to avoid splashing. For crews, this includes pumping out tanks or unloading pumper trucks. After handling the waste and once there is no risk of further exposure, individuals should safely remove their PPE and perform hand hygiene before entering the transport vehicle. Soiled PPE should be put in a sealed bag for later safe laundering (see Section 2.5,

Cleaning practices). Where there is no off-site treatment, in-situ treatment can be done using lime. Such treatment involves using a 10% lime slurry added at 1 part lime slurry per 10 parts of waste.

2.5 Cleaning practices

Existing recommended cleaning and disinfection procedures for health care facilities should be followed consistently and correctly (*19*). Laundry should be done and surfaces in all environments in which COVID-19 cases receive care (for example, treatment units, community care centres) should be cleaned at least once a day and when a patient is discharged (*27*). Many disinfectants are active against enveloped viruses, such as the COVID-19 virus, including commonly used hospital disinfectants. Currently, WHO recommends using:

- 70% ethyl alcohol to disinfect small areas between uses, such as reusable dedicated equipment (for example, thermometers);
- sodium hypochlorite at 0.5% (equivalent to 5000 ppm) for disinfecting surfaces.

All individuals dealing with soiled bedding, towels and clothes from patients with COVID-19 infection should wear appropriate PPE before touching it, including heavy duty gloves, a mask, eye protection (goggles or a face shield), a long-sleeved gown, an apron if the gown is not fluid resistant, and boots or closed shoes. They should perform hand hygiene after exposure to blood or body fluids and after removing PPE. Soiled linen should be placed in clearly labelled, leak-proof bags or containers, after carefully removing any solid excrement and putting it in a covered bucket to be disposed of in a toilet or latrine. Machine washing with warm water at 60–90° C with laundry detergent is recommended. The laundry can then be dried according to routine procedures. If machine washing is not possible, linens can be soaked in hot water and soap in a large drum using a stick to stir and being careful to avoid splashing. The drum should then be emptied, and the linens soaked in 0.05% chlorine for approximately 30 minutes. Finally, the laundry should be rinsed with clean water and the linens allowed to dry fully in sunlight.

If excreta are on surfaces (such as linens or the floor), the excreta should be carefully removed with towels and immediately safely disposed of in a toilet or latrine. If the towels are single use, they should be treated as infectious waste; if they are reusable, they should be treated as soiled linens. The area should then be cleaned and disinfected (with, for example, 0.5% free chlorine solution), following published guidance on cleaning and disinfection procedures for spilled body fluids (*27*).

2.6 Safely disposing of greywater or water from washing PPE, surfaces and floors.

Current WHO recommendations are to clean utility gloves or heavy duty, reusable plastic aprons with soap and water and then decontaminate them with 0.5% sodium hypochlorite solution after each use. Single-use gloves (that is, nitrile or latex) and gowns should be discarded after each use and not reused; hand hygiene should be performed after PPE is removed. If greywater includes disinfectant used in prior cleaning, it does not need to be chlorinated or treated again. However, it is important that such water is disposed of in drains connected to a septic system or sewer or in a soak-away pit. If greywater is disposed of in a soakaway pit, the pit should be fenced off within the health facility grounds to prevent tampering and to avoid possible exposure in the case of overflow.

2.7 Safe management of health care waste

Best practices for safely managing health care waste should be followed, including assigning responsibility and sufficient human and material resources to dispose of such waste safely. There is no evidence that direct, unprotected human contact during the handling of health care waste has resulted in the transmission of the COVID-19 virus. All health care waste produced during the care of COVID-19 patients should be collected safely in designated containers and bags, treated, and then safely disposed of or treated, or both, preferably on-site. If waste is moved off-site, it is critical to

understand where and how it will be treated and destroyed. All who handle health care waste should wear appropriate PPE (that is, boots, apron, long-sleeved gown, thick gloves, mask, and goggles or a face shield) and perform hand hygiene after removing it. For more information refer to the WHO guidance, *Safe management of wastes from health-care activities* (*28*).

3. Considerations for WASH practices in homes and communities

Upholding best WASH practices in the home and community is also important for preventing the spread of COVID-19 and when caring for confirmed cases at home. Regular and correct hand hygiene is of particular importance.

3.1 Hand hygiene

Hand hygiene in non−health care settings is one of the most important measures that can be used to prevent COVID-19 infection. In homes, schools and crowded public spaces − such as markets, places of worship, and train or bus stations − regular handwashing should occur before preparing food, before and after eating, after using the toilet or changing a child's diaper and after touching animals. Functioning handwashing facilities with water and soap should be available within 5 m of toilets.

3.2 Treatment and handling requirements for excreta

Best WASH practices, particularly handwashing with soap and clean water, should be strictly applied and maintained because these provide an important additional barrier to COVID-19 transmission and to the transmission of infectious diseases in general (*17*). Consideration should be given to safely managing human excreta throughout the entire sanitation chain, starting with ensuring access to regularly cleaned, accessible and functioning toilets or latrines and to the safe containment, conveyance, treatment and eventual disposal of sewage.

When there are suspected or confirmed cases of COVID-19 in the home setting, immediate action must be taken to protect caregivers and other family members from the risk of contact with respiratory secretions and excreta that may contain the COVID-19 virus. Frequently touched surfaces throughout the patient's care area should be cleaned regularly, such as beside tables, bed frames and other bedroom furniture. Bathrooms should be cleaned and disinfected at least once a day. Regular household soap or detergent should be used for cleaning first and then, after rinsing, regular household disinfectant containing 0.5% sodium hypochlorite (that is, equivalent to 5000 ppm or 1 part household bleach with 5% sodium hypochlorite to 9 parts water) should be applied.
PPE should be worn while cleaning, including mask, goggles, a fluid-resistant apron and gloves (*29*), and hand hygiene with an alcohol-based hand rub or soap and water should be performed after removing PPE.

Note on document development and background

The content in this technical brief is based on the information currently available about the COVID-19 virus and the persistence of other viruses in the coronavirus family. It reflects input and advice from microbiologists and virologists, infection control experts, and those with practical knowledge about WASH and IPC in emergencies and disease outbreaks.

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