Water, sanitation, hygiene, and waste management for SARS-CoV-2, the virus that causes COVID-19

Interim guidance

29 July 2020

Background

This interim guidance supplements the infection prevention and control (IPC) documents by summarizing WHO guidance on water, sanitation, hygiene (WASH) and waste management relevant to viruses, including coronaviruses. This document is an update to the interim guidance document entitled 'Water, sanitation, hygiene, and waste management for the COVID-19 virus', published on 23 March 2020. It is intended for water and sanitation practitioners and providers, and health-care providers who want to know more about WASH and waste risks and practices in relation to COVID-19.

The provision of safe water, sanitation and waste management and hygienic conditions is essential for preventing and for protecting human health during all infectious disease outbreaks, including of coronavirus disease 2019 (COVID-19). Ensuring evidenced-based and consistently applied WASH and waste management practices in communities, homes, schools, marketplaces, and health-care facilities will help prevent human-to-human transmission of pathogens including SARS-CoV-2, the virus that causes COVID-19.

This guidance was originally published in March 2020. This third edition provides additional details on risks associated with excreta and untreated sewage, hand hygiene, protecting WASH workers and supporting the continuation and strengthening of WASH services, especially in underserved areas. This additional information has been prepared in response to questions that the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) have received about the prevention and control of COVID-19 in settings where WASH services are limited.

The most important information concerning WASH and the SARS-CoV-2 is summarized here.

- Frequent and correct hand hygiene is one of the most important measures to prevent infection with SARS-CoV-2. WASH practitioners should work to enable, inform and motivate more frequent and regular hand hygiene by building a supportive environment to improve and sustain access to hand hygiene facilities and by using a multimodal strategy (refer to hand hygiene practices) to support good hand hygiene behaviour. Performing hand hygiene at the right time, using the right technique with either alcohol-based hand rub or soap and water is critical.

- Existing WHO guidance on the safe management of drinking-water and sanitation services also applies to the COVID-19 pandemic. Water disinfection and wastewater treatment can reduce viruses. Sanitation workers should have proper training and access to personal protective equipment (PPE) and in many scenarios, a specific combination of PPE elements is recommended.

- Many other infectious diseases can be prevented and health co-benefits realized by safely managing water and sanitation services, and by applying good hygiene practices and waste management.

Based on existing knowledge and research there is no indication that SARS-CoV-2 can persist in drinking water. For wastewater, some recent studies have found RNA fragments but not infectious virus (see section 2 for details) in wastewater. The morphology and chemical structure of this virus are similar to those of other coronaviruses[a] for which there are data both on their survival in the environment and on effective measures to inactivate them. This guidance draws on the existing evidence base and current WHO guidance on how to protect against possible exposure to viruses in wastewater, drinking-water and waste.

1. COVID-19 transmission

The main routes of transmission of SARS-CoV-2 are respiratory droplets and direct contact. Any person who is in close contact with an infected individual is at risk of being exposed to potentially infective respiratory droplets. (1,2) 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.

[a] These coronaviruses include: human coronavirus 229E (HCoV), human coronavirus HKU1, human coronavirus OC43, severe acute respiratory syndrome coronavirus (SARS). In addition, evidence is drawn from transmissible gastroenteritis virus (TGEV) and mouse hepatitis virus (MHV).

The risk of transmission of SARS-CoV-2 from the faeces of an infected person and the fecal-oral pathway appears to be low. While several studies have detected SARS-CoV-2 viral RNA fragments in the faecal matter of patients throughout their illness and after recovery, (3-5) current evidence underscores the difficulty of culturing virus in excreta. Three studies report infectious virus in faeces (6-8), while others have not found infectious virus in this medium. (9) Furthermore, shed virus is rapidly inactivated during transit through the colon. (10) One study found infectious SARS-CoV-2 in the urine of one patient (11) and viral RNA has been detected in gastrointestinal tissue. (3)

2. Persistence of SARS-CoV-2 in drinking-water, wastewater and on surfaces

While the presence of SARS-CoV-2 us in untreated drinking-water is possible, infectious virus has not been detected in drinking-water supplies. There is at least one documented instance of detecting RNA fragments of SARS-CoV-2 in a river, during the peak of the epidemic in northern Italy. It is suspected the river was affected by raw, untreated sewage. (12) Other coronaviruses have not been detected in surface or groundwater sources and thus the risk coronaviruses pose to drinking-water supplies is low. (13)

Within wastewater, infectious SARS-CoV-2 has not been detected in untreated or treated sewage. RNA fragments of SARS-CoV-2 have been detected in untreated sewage and sludge in a number of countries and municipalities, with RNA signals, generally starting around the same time cases were first reported (February and March 2020) and increasing as the number of confirmed cases increase. (14-17) The RNA signal reduces considerably once community caseloads decrease. In addition, efforts are ongoing to analyse historical wastewater samples for SARS-CoV-2. For example, a pre-print (not peer reviewed) paper from Santa Catalina Brazil, RNA suggests that fragments of SARS-CoV-2 were first detected in late November 2019, while the first case was not reported until early March 2020. (18)

In the majority of sampling exercises, RNA fragments of SARS-CoV-2 have not been detected in treated sewage, but there have been at least two instance where small concentrations of RNA fragments were detected in sewage that had undergone partial but not full treatment. (12, 17, 19)

SARS-CoV-2 is enveloped and thus less stable in the environment compared to non-enveloped human enteric viruses with known waterborne transmission (such as adenoviruses, norovirus, rotavirus and hepatitis A virus). One study found that other human coronaviruses[b] persisted two days in dechlorinated tap water and in untreated hospital wastewater at 20°C. (20) In comparison, high levels of reduction (>4 log) of the influenza virus were found in drinking-water[c] after contact time of only five minutes and a chlorine residual of 0.3 mg/L. (21) Other studies find similar reductions in days to weeks. Significant (99.9% reduction) of coronaviruses was observed in two days in primary sewage effluent[d] at 23°C, two weeks in pasteurized settled sewage at 25 °C and four weeks in reagent grade water[e] at 25°C. (22, 23). Higher temperature, high or low pH and sunlight all facilitate virus reduction.

Recent experimental evidence indicates that SARS-CoV-2 survival on surfaces is similar to that of SARS-CoV-1 (24), the virus that causes severe acute respiratory syndrome (SARS). In laboratory controlled conditions, the median half-life of infectious SARS-CoV-2 on surfaces is 1-7 hours depending on the surface (copper being the shortest and plastic the greatest). (25) However, infectious virus can be detected as long as 7 days (25,26). In health care facilities, at least one study has found RNA fragments on surfaces including the floor and bedrails, (27) while another found no RNA on surfaces at all. (19) The survival time of the virus depends on several factors, including the initial virus concentration, type and smoothness of the surface, temperature and relative humidity. The same study also found that effective inactivation could be achieved within 1 minute using common disinfectants, such as 70% ethanol or 0.1% sodium hypochlorite (see cleaning practices).

3. Safely managing wastewater and faecal sludge

Though little evidence is available, some data suggest that transmission via faeces, is possible but unlikely, especially where faeces become aerosolized (see further the section entitled “Sanitation and plumbing”). Because of the potential infectious disease risks from excreta, including the potential presence of SARS-CoV-2, wastewater and sludge should be contained, and treated either on-site or conveyed off-site and treated in well-designed and managed wastewater and/or faecal sludge treatment plants. Standard treatment processes are effective for enveloped viruses, including SARS-CoV-2. Each stage of treatment combining physical, biological and chemical processes (e.g. retention time, dilution, oxidation, sunlight, elevated pH, and biological activity) results in a further reduction of the potential risk of exposure and accelerates pathogen reduction. A final disinfection step may be considered if existing treatment plants are not optimized to remove viruses.

Sanitation services and workers are essential for operational support during the COVID-19 pandemic. Existing recommendations for protecting the health of sanitation workers should be followed. (28) Workers should follow standard operating procedures which includes wearing appropriate PPE (protective outerwear, heavy-duty gloves, boots, medical mask, goggles and/or a face shield), minimising spills, washing dedicated tools and clothing, performing hand hygiene frequently, obtaining vaccinations for sanitation related diseases and self-monitoring for any signs of COVID-19 or other infectious disease with support of the employer. Additional precautions to prevent transmission between workers, which apply to the general

[b] Observed inactivation of severe acute respiratory-associated coronavirus (SARS-CoV).
[c] H5N1 avian influenza virus is also an enveloped virus.
[d] Observed inactivation of human coronavirus 229E (HCoV) and feline peritonitis virus (FIPV).
[e] Observed inactivation of transmissible gastroenteritis virus (TGEV) and mouse hepatitis virus (MHV).

population as well, include avoiding touching the eyes, nose or mouth with unwashed hands, sneezing into one's sleeve or a disposal tissue, practising physical distancing while working, travelling to and from work and staying home if one develops symptoms associated with COVID-19 (e.g. fever, dry cough, fatigue).

4. Keeping water supplies safe

Several measures can improve water safety. These include: 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. Such measures can be effectively planned, implemented and monitored using water safety plans. (29)

Conventional, centralized water treatment methods that utilize filtration and disinfection should significantly reduce the concentration of SARS-CoV-2. Other human coronaviruses have been shown to be sensitive to chlorination and disinfection with ultraviolet (UV) light. (30, 31) 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. (13) A chlorine residual should be maintained throughout the distribution system including distribution via water trucks or alternative transport systems (e.g. bicycle, cart, etc).

In addition, for effective water treatment, water utility managers can adopt several other preventive measures, as part of a broader water-safety planning approach. These measures include: ensuring adequate stocks of chemical additives and consumable reagents for water-quality testing, ensuring that critical spare parts, fuel and contractors can still be accessed and that there are contingency plans for staff and training to maintain the required supply of safe drinking-water.

Water utilities personnel should be briefed on COVID-19 preventive measures. They may wear masks according to global recommendations (32) and depending on local government mask use policy, they may respect physical distancing between workers and with the public, and practise and hygiene frequently.

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. These include: boiling or using high-performing ultrafiltration or nanomembrane filters, solar irradiation and, in non-turbid waters, ultraviolet (UV) irradiation and appropriately dosed chlorine products such as sodium hypochlorite and NaDCC.[f]

Due to the closure of public or private buildings as part of the pandemic response, many premises may experience low or no water flow over a period of weeks or months. This may result in water stagnation and an associated deterioration of water quality (e.g. survival or regrowth of microbial pathogens due to chlorine decay and leaching of harmful metals from pipework). This deterioration may present a public health risk when such premises are re-inhabited. To minimize such risks, a site-specific programme of flushing pipes should be undertaken within the premises before re-occupancy. This should ensure that all stagnant water throughout the premises is replaced with safe (disinfected), fresh water from the distribution main. Before use, hot water systems should be returned to an operating temperature of 60ºC or greater and a circulation temperature exceeding 50ºC to manage microbial risks, including those from *Legionella*.[g] Cold water systems should be returned to less than 25ºC and ideally below 20ºC. On-site storage tanks or cooling towers may require batch-disinfection before becoming operational again.(33) Water quality testing should be performed in advance of re-occupancy to verify that the water used within the premises meets national drinking-water quality regulations and standards and that it is safe for human consumption and other relevant uses (such as showering). [h]

5. Surveillance of SARS-CoV-2 in wastewater and sludge

Research is underway in many countries to detect non-infective viral fragments of SARS-CoV-2 in wastewater and sludge. Similar methods have been successfully used in the polio eradication programme to detect virus circulation in the population including among asymptomatic cases, and thereby complementing surveillance in humans. Further research and capacity building are needed on the analytical methods (particularly for settings with low sewerage coverage), modelling, interpretation of data to inform decision making and public health actions. Surveillance of COVID-19 in wastewater and sludge may compliment public health data and provide, for example, information on when cases may spike 5-7 days in advance of such spikes being detected by health facilities and health authorities. (14)

Environmental surveillance should not be used as a substitute for robust surveillance of COVID-19 cases. In addition, the primary aim of governments, utilities and investments should focus on continuity and expanding safely managed sanitation services to protect against COVID-19 and a number of other infectious diseases.

WASH in health care settings

[f] 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.

[g] For further information and links to guiding resources on *Legionella*, visit https://www.who.int/news-room/fact-sheets/detail/legionellosis

[h] For further information on the safe management of drinking water in buildings, see *Water safety in buildings* (WHO, 2011) https://apps.who.int/iris/bitstream/handle/10665/76145/9789241548106_eng.pdf;jsessionid=E6B079A1590740875EEA1C5E98C45945?sequence=1

Existing recommendations for WASH and waste measures in health-care settings are important for providing adequate care for patients and protecting patients, staff[i] and caregivers from infection risks. (34) New WASH recommendations are not required to prevent SARS-CoV-2 transmission, but the following standard WASH related actions are particularly important for this:

- engaging in frequent hand hygiene using appropriate techniques;
- implementing regular environmental cleaning and disinfection practices;
- managing excreta (faeces and urine) safely;
- safely managing health-care waste produced by COVID-19 cases
- and safely managing dead bodies

Other important and recommended measures include providing sufficient and 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 bedlinen and patients' clothing; providing adequate and accessible toilets (including separate facilities for confirmed and suspected COVID-19 cases); and segregating and safely disposing of health-care waste. (34)

1. Hand hygiene practices

Hand hygiene is extremely important to prevent the spread of SARS-CoV-2. All health-care facilities should have regular programmes aimed at promoting best hand hygiene practices and at ensuring the availability of the necessary infrastructure (equipment and supplies) as well as operation and maintenance protocols.

All health-care facilities should establish hand hygiene programmes, if they do not have them already, or strengthen existing ones. In addition, rapid activities to prevent the spread of SARS-CoV-2 are needed, such as procurement of adequate quantities of hand hygiene supplies; hand hygiene refresher courses and communications campaigns. Cleaning hands using an alcohol-based hand rub or with water and soap should be done according to the instructions known as "My 5 moments for hand hygiene". (35) These are: 1. before touching a patient, 2. before clean/aseptic procedures, 3. after body fluid exposure/risk, 4. after touching a patient, and 5. after touching patient surroundings.[j] If hands are not visibly dirty, the preferred method is using an alcohol-based hand rub for 20−30 seconds using the appropriate technique. (36) When hands are visibly dirty, they should be washed with soap and water for 40−60 seconds using the appropriate technique. In addition to performing hand hygiene at each of the five moments, it should be performed in the following situations: before putting on PPE and after removing it; when changing gloves; after any contact with a patient with suspected or confirmed SARS-CoV-2 infection, their waste or the environment in that patient's immediate surroundings; after contact with respiratory secretions; before food preparation and consumption; and after using the toilet. (37)

Functional hand hygiene facilities should be available for all health-care workers at all points of care, in areas where PPE is put on or taken off, and where health-care waste is handled. In addition, functional hand hygiene facilities should be available for all patients, family members, caregivers and any other visitors, and should be available within 5 metres of the toilets, as well as at the entry/exit of the facility, in waiting and dining rooms and in other public areas.

An effective alcohol-based hand rub product should contain between 60% and 80% of alcohol and its efficacy should be proven according to the European Norm 1500 or the standards of the ASTM International (formerly, the American Society for Testing and Materials) known as ASTM E-1174. These products can be purchased on the market, but can also be produced locally in pharmacies using the formula and instructions provided by WHO. (38)

2. Sanitation and plumbing

People with suspected or confirmed SARS-CoV-2 infection should be provided with their own toilet (either a flush or dry toilet). Where this is not possible, patients sharing the same ward should have access to toilets that are not used by patients in other wards. Each toilet cubicle should have a door that closes. Flush toilets should operate properly and have functioning drain traps. The toilet should be flushed with the lid down to prevent droplet splatter and aerosol clouds.(39) If it is not possible to provide separate toilets for COVID-19 patients, then the toilets they share with other non-COVID-19 patients should be cleaned and disinfected more regularly (e.g. at least twice daily by a trained cleaner wearing PPE-impermeable gown, or if not available, an apron, heavy-duty gloves, boots, mask and googles or a face shield). Health-care staff should have access to toilet facilities that are separate from those used by 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(40), together with existing recognised wastewater and sludge treatment processes.(28) Regularly flushing water through seals to ensure they are functioning is important. Faulty plumbing and a poorly designed air ventilation system were among the contributing factors for the spread of the aerosolized SARS-CoV-1 coronavirus in a high-rise apartment building in Hong Kong Special Administrative Region in 2003. (41) If health-care facilities are connected to sewers, a risk assessment should be conducted to confirm whether wastewater is contained and does not leak from the system before it reaches a functioning treatment and disposal site. Risks related to the adequacy of the collection system or to treatment and disposal methods should be assessed following a sanitation safety planning approach. (42)

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

[j] Further resources are available at https://www.who.int/infection-prevention/campaigns/clean-hands/5moments/en/

If health-care facility toilets are not connected to sewers, hygienic on-site containment and treatment systems should be ensured such as pit latrines and septic tanks. Sludge should be safely contained and when containers are full transported for off-site treatment or treated on-site where space and soil conditions permit. For unlined pits, precautions should be taken to prevent contamination of the environment, ensuring that at least a distance of 1.5m 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 latrine pits are located at least 30 m horizontally from any groundwater source (including both shallow wells and boreholes). (43)

There is no reason to empty latrine pits and holding tanks of excreta from suspected or confirmed COVID-19 cases unless they are at capacity. In general, the best practices for the safe management of excreta should be followed. Pit 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 excreta and wastewater volumes generated.

A properly-designed septic tank will remove most solids from sewage, and the liquid effluent can infiltrate into the ground through a leach field or soakpit. If soil conditions are not favourable for infiltration, fully lined tanks can be used, however combined excreta and flushing water will necessitate frequent emptying. Latrine pits or holding tanks should be designed to meet patient demand, and there should be a regular schedule for emptying them based on the wastewater volumes generated. There is no reason to empty latrine pits and holding tanks of excreta from suspected or confirmed COVID-19 cases unless they are full. Faecal sludge can be treated in a specialized treatment plant, either located off-site or on the premises of the health-care facility. Municipal authorities may position faecal sludge transfer stations near health facilities to reduce the time, cost and potential for uncontrolled dumping of sludge in drains and agricultural areas. (28)

For personnel working with untreated sewage for which there are considerable infectious risks, standard PPE should be worn (protective outerwear, heavy-duty gloves, boots, masks, goggles or a face shield). It should be worn at all times when handling or transporting excreta offsite, and great care should be taken to avoid the splashing and release of droplets. For sanitation workers, 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 safe laundering later (see Environmental cleaning and laundry). Workers should be properly trained in how to put on and remove PPE, so that these protective barriers are not breached. (44) If PPE is not available or the PPE supply is limited, the frequency of correct hand hygiene should increase, and workers should keep at least 1m distance from suspected or confirmed cases.

Untreated faecal sludge and wastewater from health facilities should never be released on land used for food production, aquaculture or disposed of in recreational waters.

3. Toilets and the handling of faeces

It is critical to perform hand hygiene (see Hand hygiene general recommendations) when there is suspected or known contact with faeces. If the patient is unable to use a toilet, excreta should be collected in either a diaper or a clean bedpan and immediately disposed of carefully into a separate toilet or pit latrine used only by suspected or confirmed COVID-19 cases. In all health-care settings, including those with suspected or confirmed COVID-19 cases, faeces must be treated as a biohazard.

After disposing of excreta, bedpans 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 toilet. Other effective disinfectants include commercially available quaternary ammonium compounds and peracetic or peroxyacetic acid. (45)

Chlorine is not effective for disinfecting matter containing large amounts of solid and dissolved organic matter. Therefore, it is neither not useful nor recommended to add chlorine solution to fresh excreta and, possibly, such addition can introduce risks associated with splashing.

4. 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 segregate, recycle and dispose of 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. Health care waste generated from facilities treating COVID-19 patients is no different than waste coming from facilities without COVID-19 patients. Additional treatment or disinfection beyond existing safe waste management recommendations are not needed.

The majority of waste generated in health care facilities is general, non-infectious waste (e.g. packing, food waste, disposable hand drying towels). General waste should be segregated from infectious in clearly marked bins, bagged and tied, and disposed as general municipal waste. Infectious waste produced during patient care, including those with confirmed COVID-19 infection (e.g. sharps, bandages, pathological waste) and should be collected safely in clearly marked lined containers and sharp boxes. This waste should be treated, preferably on-site, and then safely disposed. Preferred treatment options are high temperature, dual chamber incineration or autoclaving. (46) If waste is moved off-site, it is critical to understand where and how it will be treated and disposed. Waste generated in waiting areas of health-care facilities can be classified as non-hazardous and should be disposed in strong black bags and closed completely before collection and disposal by municipal waste services. If such municipal waste services are not available, as interim measure, safely burying or controlled burning may be done until more sustainable and environmentally friendly measures can be put in place. All those who handle health-care waste should wear appropriate PPE (long-sleeved gown, heavy-duty gloves, boots, mask, and goggles or a face shield) and perform hand hygiene after removing it.

Many cities report a large increase (5 times greater than before the pandemic) of medical waste generated in hospitals, especially through the use of PPE. (47) Therefore, it is important to increase capacity to handle and treat this health-care waste without delay. Additional waste treatment capacity, preferably through alternative treatment technologies, such as autoclaving or high temperature burn incinerators, may need to be procured and systems may need to be put in place to ensure their sustained operation. (48) Ideally safe waste disposal is linked to purchasing and investments in PPE. As an interim measure safely burying health care waste may be done until more sustainable measures can be put in place. Manual chemical disinfection of waste is not recommended, as it is not regarded as a reliable and efficient method. In addition, countries should work to establish sustainable waste management chains, including addressing logistics, recycling, treatment technologies and policies.

5. Environmental cleaning and laundry

Existing recommended cleaning and disinfection procedures for health-care facilities should be followed consistently and correctly. (49) Linen should be laundered and the areas where COVID-19 patients receive care should be cleaned and disinfected frequently (at least twice daily, but more frequently for high touch surfaces such as light switches, bed rails, tables and mobile carts). (50) Many disinfectants are active against enveloped viruses, such as SARS-CoV-2, including commonly-used hospital disinfectants. Currently, WHO recommends using:

- 70% ethyl alcohol to disinfect small surface areas and equipment between uses, such as reusable dedicated equipment (for example, thermometers);
- sodium hypochlorite at 0.1% (1000 ppm) for disinfecting surfaces and 0.5% (5000 ppm) for disinfection of blood or bodily fluids spills in health-care facilities.

The efficacy of all disinfectants is affected, to different degrees, by organic material. Thus, it is essential to clean surfaces with a detergent and water before applying a disinfectant. The concentration and exposure time of any disinfectant are critical parameters for its efficacy. After applying disinfectant to a surface, it is necessary to wait for the required exposure time and drying to ensure that surface microorganisms are killed. Spraying disinfectants is not recommendation, especially on individuals as this could result in serious harm and has no proven efficacy. For more details on this topic, see WHO guidance on cleaning and disinfection. (50)

All individuals in charge of environmental cleaning, laundry and dealing with soiled bedding, towels and clothes from patients with SARS-CoV-2 infection should wear appropriate PPE, including heavy-duty gloves, a mask, eye protection (goggles or a face shield), a long-sleeved gown, 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 either a flush or dry toilet. Machine washing with warm water at 60−90°C and 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, taking care 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, if possible in sunlight.

Excreta found on surfaces such as linen or the floor should be carefully removed with towels and immediately disposed of safely in a toilet. 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 following published guidance on cleaning and disinfection procedures for spilled body fluids. (49)

6. Safe disposal of greywater or water from washing PPE, surfaces and floors

WHO recommends that utility gloves and heavy-duty, reusable plastic aprons are cleaned with soap and water, and then decontaminated with 0.5% sodium hypochlorite solution each time they are used. Single-use gloves and gowns should be discarded as infectious waste 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. Likewise, used bathing water from COVID-19 patients does not need to disinfected. However, it is important that such water is disposed of in drains connected to a septic system, a 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.

7. Safe management of dead bodies

While the risk of transmission of COVID-19 from handling the body of a deceased person is low, health care workers and others handling dead bodies should apply standard precautions at all times. Health care workers or mortuary staff preparing the body should wear: scrub suit, impermeable disposable gown (or disposable gown with impermeable apron), gloves, mask, face shield (preferably) or goggles, and boots. After use, PPE should be carefully removed and decontaminated or disposed of as infectious waste as soon as possible and hand hygiene should be performed. The body of a deceased person confirmed or suspected to have SARS-CoV-2 infection should be wrapped in cloth or fabric and transferred without delay to the mortuary area. Body bags are not necessary for SARS-CoV-2 although they may be used for other reasons (e.g. excessive body fluid leakage). (51)

Considerations for WASH practices in homes and communities

Upholding recommended water, sanitation and health-care waste practices in the home and in the community is important for reducing the spread of COVID-19. The provision of water enables regular hand hygiene and cleaning. Water services should not be cut off because of consumers' inability to pay, and governments should prioritize providing access to people without access to water services, through

other immediate actions such as. protected boreholes, tanker trucks, extending piped supplies etc.).

Individuals and organizations involved in providing water, sanitation and hygiene services such as treatment plant operators, sanitation workers and plumbers should be designated as providing essential services and be allowed to continue their work during movement restrictions and have access to PPE and hand hygiene facilities to protect their health. This also applies to those promoting hygiene in the community.

1. Hand hygiene general recommendations

Hand hygiene has been shown to prevent respiratory illness. (52) Handwashing is recommended after coughing and sneezing and/or disposing of a tissue, on entering the home having come from public places, before preparing food, before and after eating and feeding/breastfeeding, after using the toilet or changing a child's diaper and after touching animals. For people with limited WASH services it is vital to prioritize the key times for hand hygiene.

As part of a new hand hygiene campaign, WHO recommends that universal access to hand hygiene facilities should be provided in front of all public buildings and transport hubs – such as markets, shops, places of worship, schools and train or bus stations. (53) In addition, functioning handwashing facilities with water and soap should be available within 5m of all toilets, both public and private.

The number or size of these hand hygiene stations should be adapted to the number and type of users such as children or those with limited mobility, to encourage use and reduce waiting times. The installation, supervision and maintenance of equipment, including where necessary, regular refilling of water and soap and/or alcohol-based hand rub should be under the overall leadership of local public health authorities. Maintaining supplies should be the responsibility of the manager of the building or store, transport provider etc. Civil society and the private sector can be engaged to support the functioning and correct use of such facilities and to prevent vandalism.

2. Hand hygiene materials

The ideal hand hygiene materials for communities and homes in order of effectiveness are:

- Water and soap **or** alcohol-based hand rub
- Ash
- Water alone

Hand hygiene stations can consist of either water,[k] such as sinks attached to a piped-water supply, refillable water reservoir or clean, covered buckets with taps equipped with plain soap or alcohol-based hand rub dispensers. Where alcohol-based hand rub or bar soap is not feasible, commerical liquid soap or locally-made "soapy water" solutions made by mixing detergent with water can be used[l]. The ratio of detergent to water will depend on types and strengths of locally available product. (54) Soap does not need to be antibacterial and evidence indicates that normal soap is effective in inactivating enveloped viruses, such as coronaviruses.(55,56)Alcohol-based hand rub should contain at least 60% alcohol. Such products should be certified and, where supplies are limited or prohibitively expensive, can be produced locally according to WHO-recommended formulations. (38) Highly concentrated alcohol is toxic if ingested and hence needs to be handled with care. It needs to be kept out of reach of children, and children must be supervised by an adult when using alcohol-based hand-rub.

The ability to dry hands after washing is important for effective hand hygiene. The level of residual moisture left on hands after washing can be an important determinant of pathogens being transmitted from hands to surfaces and vice versa. (57) While clean, single-use towels are recommended they may not be available and can add to environmental waste. Alternatively, air-drying hands with an air-drying system or by shaking can be done.

When soap and water or alcohol-based hand rub are not available within households, the use of ash can be considered. (36,58,59) Ash, in particular, may inactivate pathogens by raising the pH. (60) Finally, washing with water alone, although the least effective of the four options, can result in reductions in faecal contamination on hands and in diarrhoea. (61,62) Regardless of the type of material, the washing and rubbing of hands, and the amount of rinsing water in particular, are important determinants in the reduction of pathogen contamination on hands. (63)

3. Water quality and quantity requirements for handwashing

The quality of water used for handwashing does not need to meet drinking-water standards. Evidence suggests that even water with moderate faecal contamination when used with soap and the correct technique can be effective in removing pathogens from hands. (64) However, efforts should be made to use and source water of the highest quality possible (e.g. at least an improved water source)[m]. Reported quantities of water used for handwashing that have enabled reduction of faecal contamination ranges from 0.5-2 litres per person, per handwashing session. (63) Recent experience from the field suggest a handwashing session with as little as 0.2 litres is sufficient. (65) Furthermore, the quantity of water used has been associated with less viral contamination of hands. (66) Where water is limited, hands can be wetted with water, the water then turned off while lathering with soap and scrubbing for at least 20 seconds, and then the water can be turned on again to rinse. Water should always be allowed to flow to a

[k] Water does not need to be drinking-water quality.

[l] If alcohol-based hand rubs or soap and water are not available or feasible, then using chlorinated water (0.05%) for handwashing is an option as a short-term measure.

[m] An improved water source is one that is protected from faecal contamination and included piped water, public tap, boreholes, protected dug wells, protected springs and rainwater (source: WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene: https://washdata.org/)

drainage area or receptacle, and hands should not be rinsed in a communal basin, as this may increase contamination.

4. Handwashing facility options

A number of design features should be considered in selecting and/or innovating on existing handwashing facility options. These features include:

- turning the tap on/off: either a sensor, foot pump, or large handle so the tap can be turned off with the arm or elbow;
- soap dispenser: for liquid soap either sensor-controlled or large enough to operate with the lower arm; for a bar of soap, the soap dish should drain well, so that the soap does not get soggy;
- grey water: ensure the grey water is directed to, and collected in, a covered container if not connected to a piped system;
- drying hands: paper towels and a bin provided; if not possible encourage air drying for several seconds;
- materials: generally, the materials should be easily cleanable and repair/replacement parts can be sourced locally;
- accessible: should be accessible to all users, including children and those with limited mobility.
- physical distancing between users should be of 1m at least, this can be done by marking the ground, and by ensuring adequate numbers of hand-washing facilities to prevent crowds building up.

A number of handwashing designs have been implemented in households, schools and in public settings in both developed and developing countries. (67) In schools, a number of simple, easy-to-maintain, and durable low-cost designs have been successfully implemented. (68)

5. Disinfection at home and safe management of excreta

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 SARS-CoV-2. Support must include clear instructions on the safe and correct use and storage of cleaners and disinfectants, including keeping them out of reach of children to prevent harms from misuse including poisoning. (69) Frequently touched surfaces throughout the patient's care area should be cleaned regularly, such as tables and other bedroom furniture. Cutlery and crockery should be washed and dried after each use and not shared with others. Bathrooms shared by COVID-19 patients and other household members 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 0.1% sodium hypochlorite (that is, equivalent to 1000 ppm or 1 part household bleach with 5% sodium hypochlorite to 50 parts water) should be applied. PPE should be worn while cleaning, including mask, goggles, a fluid-resistant apron and gloves, (36) and hand hygiene should be performed after removing PPE. Where households have limited resources, efforts should be made to provide PPE supplies – at a minimum, masks – and hand hygiene supplies to households caring for COVID-19 patients. 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 and to the safe containment, conveyance, treatment and eventual disposal of sewage and sludge.

6. Management of waste generated at home

Waste generated at home during quarantine, while caring for a sick family member or during the recovery period should be packed in strong bags and closed completely before disposal and eventual collection by municipal waste services. If such services are not available, as interim measure, safely burying or controlled burning may be done until more sustainable and environmentally friendly measures can be put in place. Tissues or other materials used when sneezing or coughing should immediately be thrown in a waste bin. After such disposal, correct hand hygiene should be performed.

In places where there is limited supply and a high demand for masks, there is a likelihood of people collecting used face masks and re-selling them. Therefore, efforts are needed to ensure and improve safe waste disposal and fenced, regulated waste areas. Masks and other PPE may also clog sewers and waterways resulting in human and broader ecological impacts. Investments in waste management, including sourcing environmentally friendly products along with regulation on improper disposal can help reduce such issues. Finally, those tasked with collecting waste should wear PPE (heavy duty gloves, boots, coveralls, and masks when working in confined spaces) and have facilities for regularly conducting hand hygiene.

7. Use of public pools and beaches

Risk of transmission of SARS-CoV-2 from fresh and coastal water or swimming pools and spas water contaminated with faeces is very low. Existing recommendations for managing the quality of bathing water apply. (70,71)

For a conventional public or semi-public swimming pool with good hydraulics and filtration, operating within its engineered bathing load, adequate routine disinfection should be achieved with a free chlorine level of 1 mg/l throughout the pool. Lower free chlorine concentrations (0.5 mg/l or less) will be adequate when chlorine is used in combination with ozone or UV disinfection. The pH should be maintained between 7.2 and 7.8 for chlorine disinfectants. This should be sufficient to eliminate enteric pathogens and enveloped viruses, like coronaviruses, which are sensitive to chlorine disinfection.

The risk of transmission of SARS-CoV-2 increases where bathers and people visiting beaches, pools and spas are in small, crowded conditions including in changing rooms, toilets and showers, restaurants and kiosks. General recommendations on hand hygiene, physical distancing and the use of face masks (32) when appropriate are recommended along with regular cleaning (once or more times a day) and maintenance of toilet facilities.

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Contributors

This interim guidance was written by staff from WHO and UNICEF. In addition, a number of experts and WASH practitioners contributed. They include Matt Arduino, US Centers for Disease Control and Prevention, United States of America; David Berendes, US Centers for Disease Control and Prevention, United States of America; Lisa Casanova, Georgia State University, United States of America; David Cunliffe, SA Health, Australia; Rick Gelting, US Centers for Disease Control and Prevention, United States of America; Dr Thomas Handzel, US Centers for Disease Control and Prevention, United States of America; Paul Hunter, University of East Anglia, United Kingdom; Ana Maria de Roda Husman, National Institute for Public Health and the Environment, the Netherlands; Peter Maes, Médicins Sans Frontières, Belgium; Molly Patrick, US Centers for Disease Control and Prevention, United States of America; Mark Sobsey, University of North Carolina-Chapel Hill, United States of America.

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

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