



TECHNICAL NOTE

44 – Disinfecting coronavirus

Revised July 2020 – To cover cleaning and disinfecting all public pools in preparation for the reopening of pools and their subsequent operation and

Revised Oct 2020 – With further guidance on ways to clean and disinfect swimming pool equipment, dealing with some of the practical issues, including the use of alcohol wipes for impermeable types of equipment.

The managers and operators of swimming pools and similar public buildings or open spaces need to know how to disinfect areas which may have been used by people carrying the coronavirus responsible for the current COVID-19 pandemic. This technical note draws on information from a number of sources, to give clear guidelines for disinfection methodology.

How does COVID-19 spread?

COVID-19 is the illness caused by the *SARS-CoV-2* virus (severe acute respiratory syndrome coronavirus 2). Coronaviruses are a group of viruses that include those that have caused SARS and MERS, as well as many common colds. Because the *SARS-CoV-2* virus is new, its behaviour is not completely understood. But based on what is known so far, and our experience with other, similar coronaviruses, it seems that person-to-person transmission happens most frequently among close contacts (within about two metres) and particularly indoors. This transmission seems to be chiefly via respiratory droplets and infectious aerosols.¹

So close contact in the form of a hug, handshake, or being in a busy public space allows infected individuals to easily spread their respiratory droplets – for example during talking, sneezing, or coughing – which can then travel several metres. But because the larger respiratory droplets are heavy, they typically fall towards the ground. Depending on where they land, they could persist on a surface before being touched by a hand that transfers the virus to a nose, mouth or eye, leading to infection.

People can unknowingly carry and spread the virus either because they are in the early stages of COVID-19 or because they have only mild or even no symptoms (asymptomatic).

Survival on surfaces

All viruses are bits of genetic code bundled inside a collection of lipids and proteins, which can include a fat-based casing known as a viral envelope. Destroying an enveloped virus like *SARS-CoV-2* takes less effort than their non-enveloped counterparts, such as a norovirus, which can last for a month on surfaces. Enveloped viruses typically survive outside of the body for only a matter of days and are considered among the easiest to inactivate, because once their fragile exterior is broken down, they begin to degrade.



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Human coronaviruses survive on inanimate objects and remain viable for up to five days at temperatures of 22 to 25°C and relative humidity of 40 to 50% (ie typical of air-conditioned indoor environments). Survival on surfaces also depends on the surface type. Experimental studies² using SARS-Cov-2 have reported survival for:

- 72 hours – plastic
- 48 hours – stainless steel and glass
- 24 hours – cardboard, cloth and wood
- Less than 4 hours – copper.

Survival of the virus and therefore the risk of infection is reduced significantly after 72 hours, or by cleaning and disinfection.

Buildings unoccupied for seven days or more will need only normal routine cleaning before reopening, as SARS-CoV-2 has not been shown to survive on surfaces longer than this time.

Official guidance

The guidance from Public Health England (PHE) on cleaning and disinfection where SARS-Cov-2 is indicated is quite clear and is reproduced here.³

Public areas where a symptomatic individual has passed through and spent minimal time, such as corridors, but which are not visibly contaminated with body fluids can be cleaned thoroughly as normal.

All surfaces that the symptomatic person has come into contact with must be cleaned and disinfected, including:

- *objects which are visibly contaminated with body fluids*
- *all potentially contaminated high-contact areas such as bathrooms, door handles, telephones, grab-rails in corridors and stairwells*

Use disposable cloths or paper roll and disposable mop heads, to clean all hard surfaces, floors, chairs, door handles and sanitary fittings, following one of the options below:

- *use either a combined detergent disinfectant solution at a dilution of 1,000 parts per million available chlorine*

or

- *a household detergent followed by disinfection (1000 ppm av.cl.). Follow manufacturer's instructions for dilution, application and contact times for all detergents and disinfectants*

or

- *if an alternative disinfectant is used within the organisation, this should be checked and ensure that it is effective against enveloped viruses*



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Avoid creating splashes and spray when cleaning.

Any cloths and mop heads used must be disposed of by double bagging in waste bags, leaving for 24 hours and disposing into waste bags. This waste should be double bagged, stored securely and put in communal waste areas after 72 hours.

When items cannot be cleaned using detergents or laundered, for example, upholstered furniture and mattresses, steam cleaning should be used.

Any items that are heavily contaminated with body fluids and cannot be cleaned by washing should be disposed of.

There is also guidance from the World Health Organisation (WHO):

Cleaning and Disinfection of environmental surfaces in the context of COVID-19 (<https://www.who.int/publications/i/item/cleaning-and-disinfection-of-environmental-surfaces-in-the-context-of-COVID-19>)
Last accessed 2nd July 2020.

Personal protective equipment

Disposable or washing up gloves and disposable aprons should be worn for cleaning. If an area has been heavily contaminated – eg with visible bodily fluids – eye, mouth and nose protection should also be used. After cleaning is finished, dispose of gloves and aprons by double bagging, store securely for 72 hours and then placed in the waste for disposal. Hands should be washed regularly with soap and warm/hot water for 20 seconds; and after removing gloves, aprons and other protection used while cleaning.

Temperature and humidity

High humidities will mean that larger droplets do not lose water by evaporation and therefore drop out of the air more quickly. Conversely, the survival of SARS-CoV2 at high humidities is still not known, some aerosolised organisms (ie of a size that can be inhaled) may survive better at high humidity, whereas others die more rapidly. Therefore regular cleaning of surfaces is very important.

Cleaning and disinfection

Cleaning must be undertaken systematically, to avoid missing anywhere. It should be progressive – ie from the least soiled (cleanest) to the most soiled areas (dirtiest), and from upper to lower levels so that debris can fall on the floor and be cleaned last.

Washhand basin drains are likely to be contaminated with a range of bacterial pathogens, so should be cleaned downwards from the taps to the drain, which should always be cleaned last and then the cloth changed or discarded. **Pool surrounds** are dealt with as a separate section later.



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If a chlorine disinfectant solution or bleach is applied to a surface with a lot of dirt, the dirt will use up some of the available chlorine as it is oxidised, so the amount available to inactivate any virus is reduced. At the same time, irritant byproducts are released. So, as the PHE guidance above makes clear, surfaces should be cleaned before disinfection: wash first with hot soapy water (detergent) to clean; rinse off the detergent thoroughly and leave surfaces to air dry.

Disinfection should then be undertaken by applying a solution of chlorine as detailed in the table below. To deal with coronavirus, a stronger than usual solution is recommended (1000mg/l, middle column in the table).

Chlorine-based disinfectants are very effective against a wide range of viruses and bacteria, both in the pool and elsewhere in the pool building, but see the note below about stainless steel. When chlorine is added to water, a chemical reaction produces a weak acid called hypochlorous acid. This is able to penetrate microorganisms like bacteria and viruses and inactivate them. This must be done properly to be effective as explained below.

Alcohol hand cleansers and alcohol wipes may also be used but they must have at least 70% isopropyl alcohol or 60% ethyl alcohol by volume to inactivate viruses. These will need to be COSHH assessed (www.hse.gov.uk/COSHH), particularly in relation to storage of large volumes and the fire hazard associated with it.

Suitable disinfectants for viral and bacterial inactivation in swimming pool settings

In a pool setting disinfection comes in a number of forms.

1. **Sodium hypochlorite** is a chemical compound with the formulae NaOCl or NaClO. Sodium hypochlorite solutions are clear, greenish to yellow liquids with an odour of chlorine. Swimming pool grade sodium hypochlorite solution has a chlorine concentration of between 10 and 14% weight for weight.
2. **Calcium hypochlorite** is an inorganic compound with the formula $\text{Ca}(\text{ClO})_2$. It is a relatively stable, usually white solid. It smells strongly of chlorine, owing to its slow decomposition in moist air. There are various compositions, each with different concentration of calcium hypochlorite, but up to 78% available chlorine.
3. **Household bleach** is a water solution of sodium hypochlorite. Common household laundry bleach (unthickened / without gel added), used to whiten and disinfect laundry, is typically 5% chlorine. As a surface disinfectant, chlorine bleach is approved for use in safe food production. It is also used to help prevent the spread of infections in homes, hospitals, nursing homes, schools and day care facilities.



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Ethyl or isopropyl alcohol (ethanol and isopropanol) is used in medical wipes and most commonly in antibacterial hand sanitiser gels for their bactericidal and anti-fungal effects. They are effective in inactivating COVID-19. Ethanol should be at least 60% by volume and iso-propanol at least 70% by volume.

More information on this can be found:

<https://www.cdc.gov/infectioncontrol/guidelines/disinfection/index.html>

4. Other forms of disinfection

If an alternative disinfectant is used within the organisation, this should be checked and ensure that it is effective against enveloped viruses.

Chlorine dioxide or solutions of chlorine dioxide could also be used but the suppliers need to be consulted about the concentrations to use and the equipment manufacturers need to be consulted about whether chlorine dioxide may damage the equipment.

Preparing disinfectant solutions

Appropriate personal protective equipment (PPE) should be used throughout preparing and application.

Chemical	Active chlorine typical strength % w/w	Quantity of chemical added per 1 litre of water to make a 1000mg/l COVID-19 disinfectant solution eg for surface disinfection	Quantity of chemical added per 1 litre of water to make a 100mg/l disinfectant solution eg for disinfecting buoyancy aids by soaking
Household bleach (unthickened)	5%	20ml	2ml
Sodium hypochlorite	10%	10ml	1ml
Calcium hypochlorite	65%	1.5g	0.15g
Calcium hypochlorite superfast	78%	1.2g	0.12g

Note : A (plastic) teaspoon contains approximately 5g (or ml) and a tablespoon is about 15g.

So, for example, 200ml or 40 teaspoons or 13 tablespoons of household bleach would be required in a 10 litre bucket of water to make 1000 mg/l COVID-19 disinfectant solution.

Chlorine for residual disinfection

Chlorine works well in swimming pools as long as the target concentration is maintained. The time taken to inactivate microbiological hazards depends on the nature of the organism. *E.coli*, which is found in human and animal faeces in large numbers is very sensitive to chlorine and is killed within seconds. Parasites such as *Cryptosporidium* and *Giardia* are much more resistant and can survive for days. For this reason it is important that a combination of pool management strategies are used including disinfection, filtration and coagulation.



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Cleaning and disinfection frequency

Frequently touched surfaces – eg door/toilet handles, lockers and changing cubicles, ladder rails, and push buttons on equipment – should be cleaned and disinfected at least twice daily and also when known to be contaminated with secretions, excretions or body fluids.

Touch points in public areas – lifts and corridor handrails, electronic equipment including mobile phones, desk phones, tablets, desktops and keyboards etc – should be disinfected at least twice daily with 70% iso-propyl alcohol or 60% ethyl alcohol or a product specified by the manufacturer. This is particularly important when they are used by many people.

Changing rooms, toilets and lockers areas should be zoned – with areas in use and areas cleaned and disinfected being rotated. This ensures users do not come into direct contact with the chlorinated surfaces once wet. These areas should be cleaned and disinfected frequently at least twice daily, but ideally after every period/session/user group/club use.

Outdoor footwear in clean areas

Issuing disposable plastic overshoes should be considered to reduce the pollution introduced from outdoor shoes in the changing room areas, thus increasing the effectiveness of cleaning and disinfection.

Pool surrounds

If the surround drains to the pool then care must be taken when cleaning. Any detergent that gets into the pool is likely to cause foaming or combine with the free chlorine residual, reducing the effective disinfectant reserve.

There are a number of solutions to this.

- If the poolside cleaning residues go to a waste water drain and not into the swimming pool deck level overflow channel there is no problem.
- The deck-level channel may be valved, enabling it to be isolated from the pool return and redirected so it flows to a waste water drain. Cleaning residue from the pool surround can then be run to waste without causing any problems by entering the main pool water circulation system.
- A SELV or battery-operated scrubber dryer floor cleaning machine will put down the cleaning solution, scrub the surface and dry afterwards. They should be emptied after each use and sumps and hose allowed to dry to avoid the risk of microbial growth (including *Legionella*).

Where none of these are applicable, care must be taken to ensure that detergent does not get into to the pool water.



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Stainless steel and similar metal fittings and surfaces

Stainless steel hand rails and fittings should not be disinfected with a strong chlorine disinfectant solution as this will increase the risk of pitting corrosion. They should be wiped over with alcohol wipes at least twice daily to deactivate the virus. Stainless steel fittings that are washed continually by the pool water will not need further disinfection.

Buoyancy aids

The advice from government and Public Health England is that all equipment and surfaces that have been in contact with symptomatic people should be cleaned and then disinfected with 1,000mg/l hypochlorite solution.

Current evidence is that some infected people can shed the virus before developing symptoms or despite never having symptoms. This is particularly true of children, younger adults and healthy members of the population – all likely users of pools. Consequently, it is safe to assume that the pool environment will at some stage become contaminated with the virus.

In non-health care settings the World Health Organisation guidance (Cleaning and disinfection of environmental surfaces in the context of COVID-19 Interim guidance 15 May 2020) is that 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 may be used at a recommended concentration of 0.1% (1,000 mg/l). Alternatively, 60% v/v ethanol or 70% v/v isopropanol solution may be used for surface disinfection.

For floating equipment PWTAG advises that after each use open celled or stitched floats and buoyancy aids etc should be submerged in a solution of 100mg/l hypochlorite for one hour, then rinsed off with tap water before re-use. This can be done by using a dirty and clean storage system so that used flotation devices are submerged for an hour before transfer to the clean holding area. Submerging can be achieved by placing a heavier item on top of the float to keep it below the surface. If this is not achievable then the float should be inverted and each side exposed to the chlorine solution for one hour. This is to ensure adequate disinfection of any viral cells in water retained within the open celled material, and in water passing through stitching into the material.

If the surface of the floats or other equipment are completely impermeable, sealed and smooth then the surface disinfection procedure using 100mg/l should be followed and for floats the surfaces should be wiped over or dipped in a 100mg/l hypochlorite solution, left for an hour and rinsed with tap water prior to the next use.



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Alternatively, anything with an impermeable, non-porous surface could be wiped down with 60% v/v ethanol or 70% v/v isopropanol and then allowed to air dry.

Inflatable slides and play equipment

PWTAG recommends that they are not used at this time, as inflating them could create aerosols, they are not easy to clean and it is difficult to maintain distancing. Also, sliding down them results in skin abrasion which increases the risk of infection and their use also creates enhanced splashing and hence aerosol formation.

Maintenance of pool disinfection

The free chlorine reserve in the pool water should be readily available to reduce the risk of cross infection between bathers by pathogens in the water. Reserves should not be depleted by having to deal with dirty bathers or pool equipment. Therefore users should be reminded of the need to shower before swimming/coming to the pool and regular cleaning of equipment should be a high priority.



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References

- 1 Dhand, R., & Li, J. (2020). *Coughs and Sneezes: Their Role in Transmission of Respiratory Viral Infections, Including SARS-CoV-2*. *American Journal of Respiratory and Critical Care Medicine*, Published June 16, 2020 <https://www.atsjournals.org/doi/pdf/10.1164/rccm.202004-1263PP>
- 2 Van Doremalen, N., Bushmaker, T., Morris, D.H., Holbrook, M.G., Gamble, A., Williamson, B.N., et al., 2020. *Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1*. *N Engl J Med* 382, 1564–1567. (<https://doi.org/10.1056/NEJMc2004973>, accessed 6 May 2020) <https://www.nejm.org/doi/10.1056/NEJMc2004973>
- 3 Public Health England. *Covid-19 Cleaning in non-healthcare settings*. Updated 15 May 2020. [Internet] 2020 [cited 2 July 2020] Available from: (<https://www.gov.uk/government/publications/covid-19-decontamination-in-non-healthcare-settings/covid-19-decontamination-in-non-healthcare-settings>)