A simple and high effective disinfection procedure to prevent the transfer of SARS-CoV-2 from odor traps in sanitary areas of public facilities

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Introduction

All sanitary areas (toilets, washrooms) that are used by several people are places of transmission of pathogens [5 - 20].
This also applies to the new corona virus SARS-CoV-[2].
Only a few days ago, this was proven by Chinese scientists for patient toilets in a Chinese hospital [3].
Corona viruses are extremely resistant to the environment [4,2] .
This means that they can survive on surfaces and in liquids for a relatively long time outside the human body and also keep their infection potential for a long time. The survival of viruses in liquids is expected to be greatest compared to surfaces [2].
Corona viruses can survive for several weeks in waste water [2].
We know from laboratory examinations [5] and practical clinical examinations [5,9] that in the sanitary areas the odor traps under sinks and in toilet bowls are important sources of germs outside the human body [5, 9, 11, 14 - 20].
Aerosol formation when using the wash basin and toilet bowl [5.9] (similar to sneezing) can cause the pathogens to reach the hands and surfaces, in the worst case also directly into the oral cavity, the nasopharynx and the lungs.
In shared toilets and washrooms, the transmission of the virus is very good and possible in spite of surface disinfection.
All public institutions (schools, day-care centers, all kinds of business premises, hospitals, old-age and nursing facilities, medical practices, hotels, restaurants) are affected.

In the following work, a very simple, high effective, quick and inexpensive method, which can be carried out immediately by everyone, is presented, by means of which viruses such as SARS CoV-2 are killed in the odor traps in the shortest possible time.

This disinfection is also a contribution to weakening a second wave of infection.

For these reasons, it is desirable to carry out this disinfection both in the schools and day-care centers currently closed and before reopening, as well as in all other public facilities and business premises.

10 facts about pathogens in sanitary rooms

1. Pathogens of all kinds get into the odor traps under sinks, in toilet bowls, under bathtubs and in floor drains through bowel movements and washing hands or body.

2. Due to the constant presence of water in odor traps, these pathogens survive there for weeks and months and their infectivity remains [2, 11, 14]. Bacterial pathogens multiply in odor traps [9, 11].

3. When using toilet bowls, wash basins, showers and floor drains, aerosols are always produced [5, 9].

4. These aerosols contain all kinds of the pathogens that were previously in the odor traps [5, 9].

5. The germ-containing aerosols emerge from the toilet bowl or when washing hands and body from the sink and shower and floor drains when flushing [5.9].

6. These germ-containing aerosols reach surfaces and body parts (preferably hands) [5].

7. Pathogens can survive for several hours in aerosols and their infectivity is maintained [4,5].

8. SARS-CoV-2 was also detected in the air in toilet rooms in Wuhan [3].

9. The aerosols from the hand wash basin can also get directly into the lungs of the user.

10. Pathogens survive for several hours on surfaces and hands [4].

SARS-CoV-2 in sanitary facilities.

For SARS –CoV-2, droplet infection from aerosols from person to person is generally considered to be dominant. The recommended preventive measures (masks, clearance, ventilation) are tailored to this.

The contact smear infection by infectious particles from deposited aerosols from body excretions (stool on surfaces and parts of the body, preferably hands) is prevented by hand hygiene (washing and disinfection).

The transmission of SARS-CoV-2 by microscopic fecal particles has been discussed in the past few weeks by a Chinese laboratory and a US laboratory after genetic traces of the SARS-CoV-2 coronavirus have been found in stool samples from infected patients [1].

These findings are regarded as evidence for the presence of the transmission path via infected stool, which is common for enteritic and pneumoenteritic viruses, for SARS-CoV-2.

The Chinese authors also assume that the high speed and dynamics of the spread of the new SARS-CoV-2 can be explained only by the co-existence of this transmission path [1].

With this transmission path, transmission through aerosol formation when using sanitary components (toilet bowls, wash basins, showers, bathtubs and floor drains) into which infected fecal particles enter is of particular importance.

The transmission of enteric (intestinal) viruses such as norovirus through sanitary facilities for vomiting diarrhea is a well-known fact.

The SARS epidemic in Hong Kong 2003 is an example of how pneumoenteritic viruses such as SARS-CoV-1 (and now also SARS-CoV-2) can be transmitted via the wastewater and sanitation sector [1, 21].

During SARS epidemic in 2003 in the Amoy Gardens residential complex in Hong Kong, some (10-20%) of patients with severe acute respiratory syndrome (SARS) experienced diarrhea. As a result, SARS-CoV-1 entered the sewage system via the toilet bowl and sink drains. In block E of the Amoy Gardens residential complex there were some dried odor traps in floor drains. As a result, the SARS-CoV-1-containing air came from the sewage pipe into the indoor air of these apartments (Figure 1) [21].

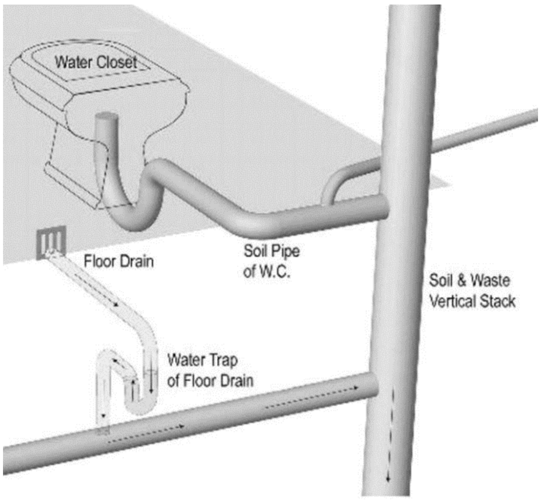

Figure 1: Dried-out floor drains led to the rapid spread of SARS-CoV1 in Hong Kong [21]

In addition to the direct escape of germ-containing aerosols from the sewage system through dried odor traps, as in the case of SARS-CoV-1 in Amaoy Gardens, there is another way by which pathogens of all kinds can get back into the air and from the toilet bowl, sink, shower, bathtub and floor drain to reach people.

The component responsible for this is the odor trap in toilet bowls, wash basins, showers, bathtubs and floor drains.

This transmission path has long been known for bacterial pathogens and is often proven in clinical studies. The starting point is always the odor trap in the drainage systems of sanitary facilities [5 - 20].

Both pneumoenteritic virus SARS-CoV-1 from Amoy Gardens as well as SARS CoV 2 are pathogens that multiply in the respiratory tract as well as in the gastrointestinal tract.
They are carried on in tiny, invisible traces of stool residues or of dried secretions of mucus from the mouth, the nasopharynx and from the bronchi and lungs of the sick by smear infection.

These particles also get into the respective odor traps under the sinks while washing hands or cleaning vegetables and meat for food preparation.

CASANOVA et al. (2009) demonstrated in laboratory experiments with model viruses that they survive in water and pasteurized wastewater for a maximum of 22 days and remain infectious. This is interpreted by the authors as meaning that especially contaminated water is a potential vehicle for human exposure when aerosols are generated [2].

For SARS-CoV-2 there are test results on the stability of the virus in aerosols and on surfaces [4].

Hong Kong 2003 SARS epidemic reports indicate that SARS-CoV-1 survived and remained infectious in the Amoy Gardens sewage system for several days [21].

Only a few days ago, DOREMALEN and co-workers showed in laboratory experiments that both viruses (SARS-CoV1 and SARS-CoV2) have comparable survival rates and infectivity in aerosols. The half-lives are 1.1-1.2 hours [4].

It is also known from a series of clinical studies on the epidemiological effect of the disinfection of odor traps [8, 14, 15, 20] that microorganisms that get into the odor traps of the upper sewage system by washing and rinsing during use the sewage system as aerosol formation when the corresponding sanitary component is used Leave the bio-aerosol cloud again and can in turn be transferred to people and objects (DÖRING et al. 1991, SISSOKO et al. 2005) [5.9].
Both chemical and physical disinfection of odor traps in sanitary areas is therefore an essential measure in clinical infection control [9 -20].

For over fifteen years, these measures to prevent nosocomial infections in clinical risk areas have proven to be extremely effective in several countries in Europe, the United States and Canada [9-20].

Recommendation

The aim of this recommendation is to propose a very simple, inexpensive and fast method for disinfecting the odor traps (siphons) in the sanitary areas of public community facilities, in particular schools and day care centers, but also business premises, which is particularly effective against viruses.
A brief explanation of the hygienic and technical basics is advantageous to understand the importance and necessity of this very simple measure.
Odor traps are the largest reservoirs for microorganisms and pathogens of all kinds in all buildings with common sanitary facilities (schools, clinics, day-care centers, business premises etc.). Up to 10 billion bacteria per milliliter 9 live in the so-called barrier liquids inside the odor traps these barrier liquids are between 200 ml (wash basin) and 1500 ml (toilet bowl).
This means that odor traps in the sanitary area represent the largest germ reservoirs outside the human body [9 - 11].

However, viruses that are pathogenic to humans, such as SARS-CoV-2, also survive in the barrier liquid for several weeks [2].

Publications on the hygienic and epidemiological importance of odor traps are not new. Since 1972, more than 135 publications have considered the connection between the contamination of odor traps and nosocomial infections.
Odor traps have been identified in at least 17 publications as transmission of infections, including the 2003 SARS epidemic in Hong Kong [21].

Several clinical case studies between 1991 and 2019 [11-20] on the influence of odor trap disinfection on the frequency of nosocomial patient populations and infections have shown that disinfection of odor traps is of unexpectedly great importance for clinical infection prevention. The rates of nosocomial patient settlements as well as of nosocomial infections are reduced in clinical risk areas by the continuous disinfection of the odor traps under the sink by up to 85% [18,19].

Since the introduction of physical disinfection of odor traps using special disinfection devices (DÖRING et al., 1991) [5], the importance of germ-free odor traps for infection prevention and the prevention of the spread of multidrug-resistant pathogens (MRE) [11-20] has been known in hospital hygiene.
The reason for the great hygienic importance of odor traps is that when the sanitary facility is used, aerosols are formed when the water runs out, which inevitably escape upwards into the room air [9]. The pathogens in the aerosols then land on people and surfaces and are therefore transferable.
The disinfection of clinical odor traps is therefore also a hygienic necessity in the prevention of the transmission of viruses.
The "Find & Kill" method based on sodium hypochlorite and UVC radiation was developed in our laboratory as a high-performance disinfection for sanitary components that conduct wastewater. In August 2002, it was first used in clinical practice in combination with the Continuous physical disinfection of the odor traps [7, 8, 10] tested and then successfully used in the outbreak intervention in several large German university clinics.

"Find & Kill" was developed for bacterial pathogens in odor traps and has been used for almost twenty years in outbreak situations in clinical risk areas, especially against multi-resistant bacterial pathogens (MRE) [14,17,19].

The procedure for chemical disinfection recommended here is adapted to viruses such as SARS-CoV-2 with regard to the concentration of the disinfectant and the exposure time and is simplified so that no previous knowledge or special protective equipment is required for its implementation and it can therefore be carried out by anyone at any time.

Results of clinical studies on the disinfection of odor traps

The following effects were shown in clinical intervention studies (case studies) by eliminating odor traps as sources of germs by disinfection:

(1) DÖRING and co-workers demonstrated for the first time in 1991 the transmission of Pseudomonas aeruginosa from odor traps to the hands of nursing staff in the clinic [5]. This transmission was completely prevented by continuous thermal disinfection of the odor traps.

(2) As the results of the first long-term clinical case study on this problem in an interdisciplinary intensive care unit, SISSOKO et al. [7-10] reported for the first time that the incidence rates of nosocomial patient populations due to Gram-negative pathogens by 50 - 70% and that nosocomial infections were reduced by means of a continuous disinfection of odor traps by at least 50%. As a consequence, a reduction in antibiotic consumption by approx. 30% and a reduction in the mean length of stay of intensive care patients by approx. 15% were reported (SISSOKO and SÜTTERLIN 2004) [10].

(3) In a multicenter study, SISSOKO and co-workers [9] documented the emission of gram-negative bacteria from contaminated odor traps from different clinics and wards for the first time through quantitative measurements.

(4) KRAMER et al. (2005) [11, 12] identified contaminated stench traps under the sink as risk factors for nosocomial patient colonization and infections in a neonatal intensive care unit and implemented the prevention of bacterial emissions from stench traps using self-disinfecting siphons in a hospital water safety plan.

(5) WÜRSTL et al. (2011)[13] report the complete prevention of the spread of a multi-resistant Pseudomonas spp. through chemical and continuous physical disinfection on a hematological-oncological ward.

(6) In 2012 SCHNEIDER et al. report on the prevention of the spread of a Pseudomonas aeruginosa on a pediatric oncology by continuous physical disinfection of odor traps under the sink. [14].

(7) In 2014 WOLF et al. reported on the complete prevention of the spread of ESBL pathogens in a Dutch intensive care unit. [17]. The work was nominated for the Dutch Hygiene Award due to its high epidemiological relevance and, following a lecture by the author at the APIC Congress

2015 in Nashville (USA), led to the first work with devices for the continuous disinfection of odor traps in the USA (Virginia).

(8) Halving the infection rates with Pseudomonas aeruginosa in a neonatological intensive care unit in Hamilton (Canada) after the introduction of continuous physical disinfection of odor traps was reported by FUSCH et al. (2015) [16].

(9) In several cases, chemical-physical Find & Kill disinfection with subsequent replacement of standard odor traps for self-disinfecting odor traps has proven to be an effective means of outbreak intervention with a long-term effect (WÜRSTL et al. (2011) [14] SCHNEIDER et al. (2012)[15] , WOLF et al. (2014) [17] FUSCH et al. (2015) [16], WILLMANN et al. (2015) [18], DE JONGE et al. (2019) [19]).

Conclusion from this data:

The risk of nosocomial patient colonization and subsequent infections by bacterial pathogens was reduced in different clinical risk areas by disinfecting odor traps between 50% [5, 7, 10, 16], 85% [18.19] and 100% [17].

Disinfection of odor traps thus has an unexpectedly strongly reducing influence on the transmission of bacterial pathogens.

It is therefore strongly recommended that sanitary disinfection be carried out as described below before the community facilities are reopened. This concerns the drainage systems (odor traps) and goes beyond the usual practice of surface disinfection. It eliminates the risk of transmission of corona viruses, which can survive in the liquid from odor traps for several weeks.

Information for decommissioned public facilities

Public institutions are primarily understood to mean schools, day-care centers, hotels, restaurants, museums, libraries, etc.
Odor traps (siphons) under sinks, shower trays, in toilet bowls and in floor drains represent the necessary closure of the sewage system against the indoor air of the building.

This prevents, on the one hand, the smell and, above all, pathogens of all kinds (including viruses) that have previously entered the sewage system from getting back into the room air and a danger to the people who are in these rooms and who use these sanitary facilities will ..

Odor traps can only fulfill this important function if there is sufficient barrier liquid (water) in them. If the barrier liquid evaporates when the sanitary component is not used for a long time, the dangerous, germ-containing air from the sewage system enters the room.

This process was an important transmission route for SARS-CoV-1 in the 2003 Hong Kong epidemic. In one part of the building (Block E) of the Amoy Gardens residential complex, some floor drains did not contain enough sealing liquid, so that SARS-CoV-1 could spread extremely quickly in this part of the building [21].

Therefore it is during the period of non-use of the above Public institutions (especially schools or day care centers) need to refill water in all odor traps every week and thus prevent partial or complete dehydration.

If odor traps go unnoticed and dry out, this can usually be recognized by the typical musty smell of rotten eggs. In this case, the odor traps must be filled and the corresponding room must be well ventilated (draft) for several hours.

Carrying out the disinfection

Chemicals

Sodium hypochlorite (chlorine bleaching lye, NaOCl, engl. bleach)
Chlorine bleaching lye is a strongly virucidal disinfectant.
The household and retail concentration of 2.8 % is
(approx. 1.2 €/litre) does not require any special knowledge in handling. The large container variant with 13.5 % active ingredient is cheaper (from approx. 0.5 €/litre), but requires special knowledge in handling in occupational health and safety.

Sanitary components to be treated

All water traps in drains from:

> washbasins
> Sink
> Toilet bowl
> Shower drains
> Floor drains
> Bathtubs

Implementation

Disinfection is carried out at least twice. It is recommended that the initial treatment is carried out as soon as possible after the facility is closed. Secondary treatment shall be carried out, if possible, two days before the re-opening of the facility.

Initial disinfection (first treatment)

The following quantities of chlorine bleaching lye are added to the drains of the respective sanitary component during the first disinfection (initial treatment).

Initial treatment	
	Disinfectant
	NaOCl 2.80%
Washbasin	100 ml
Rinsing Sink	100 ml
Toilet bowl	300 ml
Shower drains	100 ml
Floor drains	150 ml
Bath tubs	100 ml

The required amount of disinfectant is slowly filled into the drain of the respective sanitary component using a measuring cup.

The reaction time : 15 minutes

At the end of the exposure time, rinse with cold or lukewarm tap water for 1 minute at a time with the tap half open.

Floor drains are rinsed using a jug of 5 litres of cold or lukewarm tap water. Per floor drain 5 litres of water are used for rinsing.

Second disinfection (final treatment)

During the second disinfection (final treatment), the following quantities of chlorine bleaching lye are added to the drains of the respective sanitary component.

Final treatment

	Disinfectant NaOCl 2.80%
Washbasin	75 ml
Sink	75 ml
Toilet bowl	200 ml
Shower drains	75 ml
Floor drains	100 ml
Bath tubs	100 ml

As with the initial treatment, the required amount of disinfectant is slowly poured into the drain of the respective sanitary component using a measuring cup.
The reaction time: 15 minutes
At the end of the exposure time, rinse with cold or lukewarm tap water for 2 minutes at a time with the tap half open.
Floor drains are rinsed using a jug of 5 litres of cold or lukewarm tap water. Per floor drain 5 litres of water are used for rinsing.

Health and safety at work

When using sodium hypochlorite solutions in the concentration 2.8%, the safety and occupational safety instructions for the product "Sodium hypochlorite 2.8%" (e.g. "Danklorix") must be observed.

When using sodium hypochlorite solutions with a concentration of 13.5%, they must be diluted 1:5 (4 parts water plus 1 part 13.5% sodium hypochlorite solution) before use.
4 parts of water are added and 1 part of 13,5 % sodium hypochlorite solution is added slowly while stirring continuously.
When diluting, the safety and occupational safety instructions for the product "sodium hypochlorite 13.5%" must be observed.

Detailed information on safety data sheets and industrial safety instructions can be obtained from the author if required.

Illustrated working instructions in English are also available.

Consulting

For further information and advice on the application of the proposed method, the author is always available.

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