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Safe use of sanitizers against SARS-CoV-2

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Structure and heat stability of SARS-CoV-2

SARS-CoV-2 entry into host cells is mediated by the transmembrane spike S glycoprotein that forms homotrimers protruding from the viral surface. These structures confer a "corona" (crown) morphology. Transmembrane spike S glycoprotein is called viral antireceptor, and binds the ACE2 (*angiotensin-converting enzyme 2*) localized on the surface of the host cell [1]. The spike S glycoprotein origins from the outer layer of virus called *envelope* or *pericapsid* which is an accessory structure composed by lipids derived from host cells during viral budding.

The biochemical composition explains the stability of virus up to 56 °C. Temperature above 56 °C kills the virus by protein denaturation (around 10.000 units per 15 min, quick reduction) [2].

SARS-CoV-2 is transported in droplets that are coughed or sneezed out. Current evidences indicates that viral transmission occurs by breath or adsorption via the mucosa of mouth and eye conjunctiva. The transmission can be direct or through an infected object.

SARS-CoV-2 inactivation with chemical agents

Human coronaviruses can remain vital outside the body for hours and similar results were obtained with SARS-CoV-2. Surface disinfection with 62-71% ethanol, 0.1% sodium hypochlorite and 0.5% hydrogen peroxide for at least 1 minute, reduces coronavirus infectivity [3]. Hand hygiene is extremely important to prevent the spread of the SARS-CoV-2. Alcohol-based product (alcoholic hydrogel solutions) are efficient for virus inactivation. Similarly , soap works well when used for at least 1 minute. The efficacy is due to the chemical property of soap. Soap contains fat-like substances, known as amphipathic that interact with virus lipids, while water washes them off.

Disinfection and sanitization of domestic environments: how to proceed safely

Misinformation and fake news concerning various aspects of the new coronavirus are spreading undisturbed on the web. Alleged "recipes" have also been circulating to create home-made disinfectants in place of certified products already sold out. Unfortunately, many of these websites report

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recipes incorrectly due to a misinterpretation of the guidelines established by the World Health Organization for the preparation of disinfectants, which are addressed exclusively to authorized local producers. As a result, many of these self-made preparations can be ineffective or even dangerous for human health with risk of intoxication.

Considering the dangerous characteristics of the aforementioned substances, the Italian National Institute of Health (ISS) strongly advises against the preparation of disinfectants at home. However, certified products are not always available in supermarkets or pharmacies close to us, and the use of self-made disinfectants for surface sanitization becomes a concrete path.

Improper use of sanitizers can be dangerous

Disinfectant agents should be used with caution as they may cause skin irritation and injuries. When the skin barrier is damaged, it loses the ability to retain water causing dry skin. Dry skin can be associated to dermatitis and a greater risk of infections.

Moreover, “home-made” preparation of disinfectants may be dangerous. For example, hypochlorite mixed with ammonia or acid (e.g., household cleaning agents) releases chlorine gas that is highly toxic.

In Italy, the Niguarda Hospital Poison Center has launched an alert. Since the beginning of SARS-CoV-2 emergency, the requests for advices on domestic poisoning by disinfectants have increased by 65%, and up to 135% in the pediatric population (<5 years). The causes are the excessive use of disinfectants to sterilize masks leading to inhalation of chemical agents, home-made preparation of chemically incompatible compounds and, finally, improper storage with risk for children.

When should disinfectant solutions be used?

Sars-CoV-2 can survive on surfaces for days, but the infectious load hardly reaches values that require a systematic disinfection of everything. Therefore, it is sufficient to pay major care to:

- External-internal surfaces of the house: floors, keys, storage places and tables, handle of the entrance door, handrail, landing, intercom and light switches.
- Small surfaces and equipment: to disinfect sensitive surfaces such as the computer keyboard, smartphones or headphones the best solution is to rub over a paper cloth soaked in ethanol.

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- In the car: external and internal opening handles and all surfaces frequently in contact with hands (handbrake, steering wheel, radio panel, etc …).
- Purchase of goods: do not introduce the shopping bag in the kitchen, leave it at the entrance and transfer the packages one by one. Sanitize only closed packages with the indicated solutions (prefer ethanol and hydrogen peroxide) before introducing them into the kitchen.

Sterilization by hot temperature

Thermal inactivation of the virus can be useful for cleaning objects which can be damaged by the aforementioned chemicals, or to clean bottles, pacifiers and toys for children and babies. To sterilize clothes which have been in close contact with infected people, it is necessary to use high washing temperatures (60 °C) or classic bleach-based detergents (to be considered according to the garment to be treated).

Safe procedures for the preparation of disinfectant solutions.

1) 0.1% sodium hypochlorite solution (bleach) - for surfaces -

The commercially available bleach packs usually contain sodium hypochlorite at a concentration of 5% (check the label on the pack).

To obtain a final volume of 100 ml of 0.1% solution starting from commercial bleach:

- Use a graduated container and rinse it thoroughly after use
- Add 98 ml of distilled water (commercially available at the supermarket).
- Add 2 ml of commercial 5% bleach.

2) 70% ethanol (or ethyl alcohol) solution - for skin or surfaces -

95-96% ethanol bottles can be purchased at the supermarkets or drug stores.

To obtain a final volume of 100 ml of 70% alcoholic solution proceed as follows:

- Use a graduated container and rinse it thoroughly after use.
- Add 70 ml of Ethanol.
- Add 30 ml distilled water.

3) 0.5% hydrogen peroxide solution - for skin or surfaces -

Hydrogen peroxide is commercially available in drug stores under the form of skin disinfectant solution at 3% (higher concentrations can be toxic and irritating for the skin).

To obtain a final volume of 100 ml of 0.5% hydrogen peroxide solution proceed as follows:

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- Use a graduated container and rinse it thoroughly after use.
- Add 83 ml of distilled water.
- Add 17 ml of 3% hydrogen peroxide solution.

4) Hand sanitizer gel (recipe reported on the WHO website) - for skin use -

For preparation of the hand sanitizer gel the following reagents are needed: 96% ethanol; 3% hydrogen peroxide; 98% glycerol (available in pharmacies or drug stores, necessary to protect the hands from alcohol dehydrating action); distilled water.

To obtin a final volume of 100 ml of product proceed as follows:

- Use a graduated container and rinse it thoroughly after use,
- Add 83 ml of 96% ethanol,
- Add 4.2 ml of 3% hydrogen peroxide solution,
- Add 1.5 ml of 98% glycerol,
- Bring to a volume of 100 ml by adding distilled water.

Once the desired preparations have been obtained, transfer the product into containers that allow immediate use, such as spray dispensers. Do not mix together the preparations.

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