THE EFFICACY OF THE 99TECHNOLOGIES (99T) DISINFECTION SYSTEMS AS PART OF EFFECTIVE PREVENTIVE MEASURES AGAINST THE NOVEL CORONAVIRUS

The capability of the 99T environmental disinfection technology to eradicate the Novel Coronavirus from inanimate surfaces is the result of its wide-spectrum virucidal activity verified through the EN 14476 international standard. In light of the impossibility to carry out direct efficacy test on Novel Coronavirus, it is crucial to highlight the ability of the 99T systems to remove from surfaces strains of viruses, used in the EN14476 testing procedure, which are significantly much more resistant to the inactivating effect of disinfectants than the Novel Coronavirus.

The 2019 Novel Coronavirus, also known as SARS-CoV-2, is a virus, which has been identified as the cause of an outbreak of respiratory illness first detected in the city of Wuhan (China) at the end of December 2019. So far, more than 200 000 cases have been confirmed worldwide and more than 8000 people have lost their lives, while many others are hospitalized with severe symptoms. For this reason, on 11th of March 2020, WHO (World Health Organization) has declared COVID-2019 a pandemic. Moreover, the current data suggest that the number of SARS-2-CoV positive individuals is much higher than the detected, considered that most patients experience mild or even no symptoms. [1].

SARS-CoV-2 belongs to the family of coronaviruses, which are enveloped viruses that can infect both humans and animals. Since 2002 two other strictly related coronaviruses infecting animals (SARS-CoV in 2002 and MERS-CoV in 2012) have evolved and caused outbreaks in humans, that have led to a high mortality rate (10% for SARS and 35% for MERS) [2]. Current data show that SARS-CoV-2 has a substantial lower fatality rate for hospitalized cases as compared to SARS-CoV and MERS-CoV (4% VS 28% and 65%). Moreover, although there are still some uncertainties, it seems that 80% of patients experience mild to moderate disease, 13,8% have severe disease while 6,1% are critical. Patients at higher risk are people aged over 60 years old and those with underlying conditions such as hypertension, diabetes, cardiovascular disease and cancer.

Common signs of SARS-CoV-2 infection include respiratory symptoms, fever, cough, fatigue, dyspnea, myalgia and in some cases diarrhea and vomiting. In more severe cases, infection can cause pneumonia, severe acute respiratory syndrome, kidney failure and even death [2, 3].

It is not fully known yet how the virus spreads but nowadays it has been confirmed that sustained person-to-person spread can occur. According to China CDC (Center for Disease Control), the transmissibility of this virus is estimated to be similar to SARS and sufficient for sustained community transmission without unprecedented control measures. The median incubation period is estimated between four and five days, with a range of up to 14 days. A recent modelling study however confirmed that it remains prudent to consider the incubation period of at least 14 days [2].

The most probable transmission routes of human coronaviruses are represented by respiratory droplets coming from sneezes and coughs of infected people, close personal contact (such as touching and shaking hands) and contaminated objects and surfaces [1]. Considering that current available data are limited and that investigations are still ongoing, a complete clinical picture with regard to SARS-CoV-2 is still missing [1].

The persistence of SARS-CoV-2 in the outdoor environment hasn't been fully assessed, however so far some preliminary data have confirmed that extensive environmental contamination from infected patients can occur [4] and that SARS-CoV-2 and SARS-CoV-1 have similar viability in aerosol (at least three hours), a similar half-life (around 2.7 hours) and a similar stability on different type of surfaces. The study underlined that both viruses could remain detectable for up to 4 hours on copper, for up to 24 hours on cardboard, and for up to 3 days on plastic and stainless steel. The estimated half-lives for SARS-CoV-2 were ~13 hours on steel and ~ 16 hours on polypropylene. According to the researchers, these data indicate that both aerosols and contaminated surfaces are plausible transmission pathways [12].

In literature, we can also find many other studies describing the ability of human coronaviruses to survive on surfaces: a study in 2013 reported the ability of MERS-CoV to remain viable on plastic and metal surfaces for 48 hours at 20°C and 40% relative humidity, which represent common environmental conditions in a hospital ward or regular indoor space [5]. Another study in 2015 reported the ability of the human coronavirus 229E (HuCoV-229E) to survive and remain infectious for at least 5 days on many common touch surfaces, including polytetrafluoroethylene (Teflon; PTFE), polyvinyl chloride (PVC), ceramic tiles, glass, silicone rubber, and stainless steel [6]. In addition, a recently published review described a persistence of a series of human coronaviruses (such as SARS-CoV and MERS-CoV) on inanimate surfaces like metal, glass or plastic for up to 9 days, although underlying that they can be easily

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inactivated by surface disinfection procedures with many biocidal agents (such as 0, 5% hydrogen peroxide) [11].
The most effective form of prevention is represented by avoiding being exposed to the virus [1] because there is currently no vaccine available. Moreover, there is no specific treatment against respiratory illness caused by SARS-CoV-2 [2].
For this reason, the relevant health authorities are releasing and regularly updating a series of recommendations and guidelines, which are inclusive of measures intended to assure adequate environmental infection prevention and control during SARS-CoV-2 outbreak:

- WHO (World Health Organization) suggests to ensure that environmental cleaning and disinfection procedures are followed consistently and correctly. Regarding disinfection, commonly used hospital level disinfectant should be used (as it is the case for the 99S disinfectant solution). Moreover, WHO suggests to clean and disinfect carefully all the equipment that needs to be shared among patients, and to routinely clean and disinfect surfaces which the patient is in contact with, in order to minimize the risk of exposure to the virus [7].

- CDC (the US Center for Disease Control and Prevention) released an interim document with the aim to provide instructions for SARS-CoV-2 infection prevention and control. In this document, the CDC suggests an accurate disinfection of all non-dedicated and non-disposable medical equipment used for patient care, and suggests ensuring that environmental cleaning and disinfection procedures are followed consistently and correctly. Patients' rooms should undergo appropriate cleaning and surface disinfection before returning to routine use. Disinfection should be performed using EPA-approved emerging viral pathogens claims for use against SARS-CoV-2 [8].
  More information regarding environmental infection control in healthcare settings can be found in CDC's "Guidelines for Environmental Infection Control in Healthcare Facilities" and "Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings" [8].

- ECDC (European Centre for Disease and Prevention and Control) suggests to regularly clean and disinfect patients' rooms, furniture and frequently touched surfaces with hospital disinfectants active against viruses [2].

The 99S solution, used in the 99T's bio-decontamination procedures, is certified to have virucidal activity according to the international standard EN 14476. The virus strains tested in order to be compliant with the norm are **Poliovirus type 1 LSc-2ab**, **Adenovirus type 5** and **murine Norovirus**, which are non-enveloped viruses considered highly resistant to disinfection [9, 10].

In fact, on the basis of their tolerance to chemical disinfectants, viruses can be divided in three subgroups:

1. Small, Non-Enveloped Viruses (<5 nm), which are the most resistant to inactivation by disinfection because of their very resistant protein capsid. **Poliovirus type 1 LSc-2ab** and **murine norovirus** belong to this subgroup [10].

2. Large, Non-Enveloped Viruses, which are less resistant to disinfection than small non-enveloped viruses because, although having a resistant protein capsid, their large size (50-100 nm) makes them more vulnerable than their smaller viral counterparts. **Adenovirus Type 5** belongs to this subgroup [10].

3. Enveloped Viruses, which are the least resistant to disinfection because their structure includes a lipid envelope, which is easily compromised by most disinfectants. Once the envelope is damaged, the integrity of the virus is compromised, thereby neutralizing its infectivity [9, 10]. **Coronaviruses**, **such as SARS-CoV-2**, belong to this subgroup [10].

CDC claims that registrants who want to determine if their product is eligible for making claims against an envelope emerging viral pathogen, such as SARS-CoV-2, should have an EPA-approved disinfectant that claims virucidal efficacy against at least one large or one small non-enveloped virus [10]. The 99S solution has been tested according to the relevant European standard EN 14476 on **two small non-enveloped viruses and one large non-enveloped virus**. Moreover, it should be noted that one of CDC requirements for being eligible for use against a small non-enveloped emerging viral pathogen, is being effective on at least two small non-enveloped viruses [10].

As a consequence, the elevated bio-decontamination capabilities of 99T can be effectively included among the prevention measures to be adopted for the containment of the Novel Coronavirus.

The 99T systems supersede the traditional and/or manual disinfection process, and thanks to the HyperDRYMist® technology, the disinfectant solution 99S is truly delivered to every spot of the treated environment. Their portability and ease of use allow them to be deployed rapidly. In addition, the 99T systems are fully automated, thus they inherently reduce the time in which cleaning crews are exposed to contaminated environments, consequently lowering the overall risk for operators.

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Disinfection protocols executed with the use of 99T systems can target several areas such as:

1) The critical units where patients suspected of having been infected by the Novel Coronavirus are seen by doctors and/or admitted.
2) The isolation rooms used to house VHF positive patients.
3) Any type of equipment used to treat or transport any suspected or confirmed infected patient.

Thorough cleaning procedures need to be carried out before the implementation of the disinfection process executed with the 99MS system and personnel needs to wear the PPE in accordance to the specific guidelines.

Efficacious and thorough disinfection of surfaces is a cardinal element in the set of preventive measure to be taken on order to contain the spread of the Novel Coronavirus. The 99T system can consequently be effectively enlisted in the preventive measures adopted to contain the spread of the Novel Coronavirus.

REFERENCES:

1. Centers for Disease and Infection Control, update of 4 March 2020. https://www.cdc.gov/coronavirus/2019-ncov/about/index.html
2. European Centre for Disease Prevention and Control (ECDC): Infection prevention and control for the care of patients with 2019-nCoV in healthcare settings, update of 12 March 2020. https://www.ecdc.europa.eu/en/publications-data/infection-prevention-and-control-care-patients-2019-ncov-healthcare-settings
3. World Health Organization, Coronavirus. https://www.who.int/health-topics/coronavirus
4. Ong SWX, Tan YK *et al*. Air, Surface Environmental, and Personal Protective Equipment Contamination by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) From a Symptomatic Patient. Research letter to American Medical Association.
5. Van Doremalen N, Bushmaker T, Munster VJ. "Stability of Middle East respiratory syndrome coronavirus (MERS-CoV) under different environmental conditions", Eurosurveillance. 2013; 18(38):20590.
6. Sarah L. Warnes, Zoë R. Little, and C. William Keevil "Human Coronavirus 229E Remains Infectious on Common Touch Surface Materials" mBio. 2015 Nov 10; 6(6):e01697-15.
7. WHO "Infection prevention and control during health care when novel coronavirus (nCoV) infection is suspected", Interim Guidance, 25 January 2020. https://www.who.int/publications-detail/infection-prevention-and-control-during-health-care-when-novel-coronavirus-(ncov)-infection-is-suspected-20200125
8. Centers for Disease and Infection Control, "Interim Infection Prevention and Control Recommendations for patients with known or patients under investigation for 2019 Novel Coronavirus in a healthcare settings", update of 10 March 2020. https://www.cdc.gov/coronavirus/2019-ncov/hcp/infection-control.html
9. Handbook of Disinfectants and Antiseptics, Joseph M. Ascenzi, 1996.
10. Centers for Disease and Infection Control, Guidance To Registrants: Process For Making Claims Against Emerging Viral Pathogens not on EPA-Registered Disinfectant Labels, 2016.
11. Kampf G, Todt D, Pfaender S and Steinmann E."Persistance of coronaviruses on inanimate surfaces and their inactivation with biocidal agents". Journal of Hospital Infection, 2020 – Article in press.
12. Van Doremalen N, Lloyd-Smith JO, Munster VJ et al. "Aerosol and surface stability of HCoV-19 (SARS-CoV-2) compared to SARS-CoV-1"

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