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Review article

Contamination of inert surfaces by SARS-CoV-2: Persistence, stability and infectivity. A review

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ABSTRACT

Undoubtedly, there is a tremendous concern regarding the new viral strain "Severe Acute Respiratory Syndrome Coronavirus-2" (SARS-CoV-2) and its related disease known as COVID-19. The World Health Organization has stated that SARS-CoV-2 is mainly transmitted from person-to-person close contact, as well as by small aerosol respiratory droplets. Moreover, the results of some recent studies about the role of air pollution on the spread and lethality of the novel coronavirus suggest that air contaminants could be also a transmission pathway of the virus. On the other hand, indirect transmission of the virus cannot be discarded. Among many sources of indirect transmission, there is the contamination of inert/inanimate surfaces. This manuscript was aimed at reviewing the scientific literature currently available in PubMed and Scopus. The results of the reviewed studies point out that SARS-CoV-2 can last on different surfaces from hours to a few days. However, rapid SARS-CoV-2 inactivation is possible by applying commonly available chemicals and biocides on inanimate surfaces. Consequently, although the presence of SARS-CoV-2 on inanimate surfaces can represent a potential route of transmission, appropriate disinfection measures should reduce the possibilities of coronavirus transmission, and hence, significantly decrease the risks of COVID-19.

1. Introduction

Nowadays, the potential transmission routes of the SARS-CoV-2 and the resulting infections are still not clear. However, the problem is not about the quantity of investigations that have been carried out. In November 21, 2020, the number of studies on COVID-19 available in PubMed (<https://pubmed.ncbi.nlm.nih.gov/>) raised to 76,103, with a continuous daily increase. The vast majority of documents have been published in 2020, with only a few papers belonging to 2019, while an increasing number are already dated in 2021. This scientific production is tremendously high when compared with other respiratory viruses, such as influenza. To date, there are 137,047 articles available at PubMed, which in turn have been published from the 19th century. Without any doubt, in the past no other disease has received so much attention in such a short space of time.

According to the World Health Organization (WHO, 2020a), SARS-CoV-2 is mainly transmitted through person-to-person close contact (<1.5–2.0 m), as well as by aerosol respiratory droplets smaller than 5 µm of diameter. Obviously, taking into account that SARS-CoV-2 is a respiratory virus, airways are key for the infection person-to-person

(Rothan and Byrareddy, 2020). Moreover, several studies on the airborne transmission of this coronavirus have been also recently conducted (Buonanno et al., 2020; Morawska and Cao, 2020; Morawska et al., 2020; Yao et al., 2020a, 2020b). In particular, the transport of droplet aerosols generated by infected individuals is an issue of considerable concern and importance, which should be taken into account to reduce the risk of infections (Kohanski et al., 2020; Lee, 2020; Miller et al., 2020; Nissen et al., 2020; Zhou and Ji, 2021). On the other hand, recent studies on the role of air pollution on the spread and lethality of the coronavirus have also attracted a notable attention (Bontempi, 2020; Coccia, 2020; Copat et al., 2020; Domingo et al., 2020; Domingo and Rovira, 2020). It is hypothesized that certain air pollutants – mainly particulate matter (PM_{2.5} and other small PMs) – can carry SARS-CoV-2 attached, which could be involved in the spread of COVID-19. In this sense, Setti et al. (2020a) raised the question whether 2 m of interpersonal distance would be enough to avoid the person-to-person transmission of the coronavirus. In recent months, a number of studies on this topic have been conducted (Adhikari and Yin, 2020; Comunian et al., 2020; Marquès et al., 2020; Setti et al., 2020b,c,d; Yao et al., 2020a, 2020b; Zoran et al., 2020).

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In addition to the abovementioned routes of transmission of SARS-CoV-2, there are some other routes of infection which have to be explored. Among them, there might be the transmissibility via contaminated surfaces and hands. This paper was aimed at reviewing the scientific information currently available in PubMed (<https://pubmed.ncbi.nlm.nih.gov/>) and Scopus (<https://www.scopus.com/>) databases until November 21, 2020. The used combination of keywords was as follows: “infected surfaces” and “COVID-19”; “infected surfaces” and “SARS-CoV-2”; “inanimate surfaces” and “COVID-19”; “inanimate surfaces” and “SARS-CoV-2”; “inert surfaces” and “COVID-19”; “inert surfaces” and “SARS-CoV-2”.

2. Viruses on inanimate surfaces

Forty-five years ago, [Mahl and Sadler \(1975\)](#) already published a review on the persistence of various types of viruses on several kinds of surfaces, highlighting the potential role of inanimate surfaces in the transmission of certain viruses. More recently, [Sizun et al. \(2000\)](#) assessed the comparative survival of strains OC43 and 229E of human coronaviruses (HCoV) in suspensions and on various environmental surfaces commonly found in hospitals. The results showed that HCoV could survive for a few hours after drying on three different surfaces (aluminum, cotton gauze sponges, and latex gloves). It was consistent with the possibility of person-to-person virus transmission via hand contamination from surfaces, as also described for other respiratory viruses. Subsequently, [Lai et al. \(2005\)](#) investigated the survival of SARS-CoV strain GUV6109 on various environmental surfaces, including a laboratory request form, an impervious disposable gown, and a cotton non-disposable gown. It was found that, when the coronavirus-containing droplets were dried, it was rapidly inactivated on paper and cotton cloth. Therefore, it was concluded that transmission through droplet-contaminated cotton gowns and paper would be unlikely. In turn, [Kramer et al. \(2006\)](#) reviewed the studies performed in the last decades on the persistence of all types of nosocomial pathogens on surfaces, both in the context of surface disinfection and the control of nosocomial outbreaks. It was pointed out that most viruses from the respiratory tract (i.e.: corona, coxsackie, influenza, SARS or rhino virus) could persist on surfaces for a few days, being a potential source of transmission, if surface disinfection is not preventively performed. On the other hand, the survivability of two avian respiratory viruses (avian metapneumovirus and avian influenza virus) was investigated on 12 different porous and nonporous surfaces. The viruses survived on some of the surfaces for up to 6 days post-contamination, but not after 9 days. Both viruses survived longer on nonporous surfaces than on porous ones. It was suggested that one of the reasons for the poor survival on porous surfaces would be an inefficient elution of virus from these surfaces ([Tiwari et al., 2006](#)). In turn, [Casanova et al. \(2010\)](#) determined the effects of air temperature (AT) and relative humidity (RH) on the survival of the surrogate coronaviruses, gastroenteritis virus (TGEV) and mouse hepatitis virus (MHV), on hard nonporous surfaces. The results showed that when high numbers of TGEV and MHV were deposited, these viruses might survive for days on surfaces at the ambient AT and RH levels typical of health care environments. The survival data for TGEV and MHV suggested that enveloped viruses might remain infectious on surfaces long enough for individuals in contact with, posing a risk for exposure, and consequently, leading to infection and possible disease transmission. [McDevitt et al. \(2010\)](#) evaluated the efficacy of heat and moisture to decontaminate surfaces and control the spread of influenza virus infection. Influenza virus persists in the environment for hours to days, allowing for secondary transmission of influenza via inanimate objects (fomites). Temperatures were maintained well above room temperature (55–65 °C), but without expecting to cause harm to most surfaces, mechanical components, or electrical systems. It was found that moderate heat and adequate moisture provided effective disinfection of surfaces, without harming surfaces, electrical systems, or mechanical components.

[Warnes et al. \(2015\)](#) investigated the ability of human coronavirus 229E (a surrogate for MERS coronavirus, structurally very similar) to retain infectivity on a range of common surface materials, including polytetrafluoroethylene (Teflon), polyvinyl chloride (PVC), ceramic tiles, glass, silicone rubber, and stainless steel. It was found that coronavirus 229E remained infectious in a human lung cell culture model following at least 5 days of persistence on the studied nonbiocidal surface materials. In contrast, SARS-CoV-1 was rapidly inactivated on a range of copper alloys. In the same line, [Khan et al. \(2016\)](#) investigated whether high-touch surfaces in three rooms of laboratory-confirmed MERS patients could be contaminated with MERS RNA. It was observed that 2 out of 51 surfaces were contaminated with MERS viral genetic material. It showed that within an intensive care unit, the viral material might contaminate fomites, being an hypothetical cause of nosocomial infections. In another study, [Perry et al. \(2016\)](#) examined the persistence and the ability – under several environmental conditions – of two influenza (H1N1) virus strains to remain infectious on stainless steel surfaces. It was observed that influenza A (H1N1) viruses could persist and remain infectious on stainless steel surfaces for 7 days. On the other hand, [Otter et al. \(2016\)](#) suggested that surface survival of SARS-CoV-1/MERS seemed to be greater than that of influenza virus. The authors noticed that the important methodological differences (i.e.: variation in the choice of virus species and strain, the method used to detect virus, deposition mode, volume applied, surface substrate, suspending medium, temperate and relative humidity, and drying time) would difficult the comparison between studies. In a recent review on coronaviruses widespread on nonliving surfaces, [Deyab \(2020\)](#) reported that these pathogens could remain active on surface and materials such as steel, glass, plastic, Teflon, ceramic tiles, silicon rubber and stainless-steel copper alloys, Al surface, sterile sponges, surgical gloves and sterile latex for up to few days. The environmental conditions such as temperature and relative humidity show a great effect on the persistence of coronaviruses on surfaces. Similar results could be extrapolated for SARS-CoV-2 in terms of transmission and deactivation.

3. SARS-CoV-2 and inanimate surfaces

The studies hereby included are analyzed according to the date of publication in the respective journals. It is important to note that most of them are revisions of the scarce data on SARS-CoV-2 and approaches based on data from other human coronaviruses.

In March 2020, [Kampf et al. \(2020a\)](#) reviewed data on the persistence of all coronaviruses, including the emerging SARS-CoV-1 and MERS, as well as veterinary coronaviruses. Based on the analysis of 22 studies, it was concluded that human coronaviruses such as SARS-CoV-1, MERS, and endemic human coronaviruses, could persist on inanimate surfaces such as metals, glass or plastic for up to 9 days, but they might be efficiently inactivated by surface disinfection procedures. Although no specific data were available for SARS-CoV-2, the authors suggested that similar effects against this novel coronavirus might be expected. The first published experimental results on the surface stability of SARS-CoV-2 – compared with SARS-CoV-1 – correspond to [van Doremalen et al. \(2020\)](#), whose data consisted of 10 experiments involving both coronaviruses in five environmental conditions: plastic, stainless steel, copper, and cardboard, plus aerosols, which were also included. SARS-CoV-2 was more stable on plastic and stainless steel (estimated median half-life of this coronavirus was approximately 5.6 h on stainless steel and 6.8 h on plastic) than on copper (1 h) and cardboard (3 h). Viable virus was detected up to 72 h after application to these surfaces. The stability of SARS-CoV-2 was similar to that of SARS-CoV-1 under the experimental conditions tested. The conclusion was that fomite transmission of SARS-CoV-2 is certainly plausible. In turn, [Ren et al. \(2020\)](#) corroborated that the majority of viruses from the respiratory tract, such as coronaviruses, influenza, SARS-CoV-1, or rhinovirus, could persist on inanimate surfaces for a few days. It was noted that absorbent materials like cotton were safer than unabsorbent

materials for protection from virus infection, while the risk of transmission via touching contaminated paper was low. Anyhow, because of the lack of information when that review was published, the authors recommended using preventive strategies such as washing hands and wearing masks for containing COVID-19. The importance of surface-mediated transmission, particularly in light of the current outbreak, was also demonstrated by [Rawlinson et al. \(2020\)](#), who used a DNA oligonucleotide surrogate for contaminated bodily fluid based on the cauliflower mosaic virus (AB863139.1) to determine how SARS-CoV-2 would spread within a clinical surface environment. The results showed that within 10 h, the surrogate moved from the isolation room and transferred to 41% of all surfaces sampled. That study highlighted the role of surfaces as a reservoir of pathogens and the need to address requirements for surface cleaning. In relation to this, since SARS-CoV-2 is an enveloped virus, according to the authors, it should be very susceptible to most cleaning agents. In another review on the persistence of infectious SARS-CoV-2 on inert surfaces, [Gerlier and Martin-Latil \(2020\)](#) corroborated the persistence of SARS-CoV-2 based on the results of the two studies that were available at that time: [van Doremalen et al. \(2020\)](#), which has already been discussed above, and [Chin et al. \(2020\)](#). The later measured the stability of SARS-CoV-2 at different temperatures and on different surfaces. No infectious virus was recovered from printing and tissue papers after a 3-h incubation. Also, no infectious virus was detected from treated wood and cloth on day 2. SARS-CoV-2 was more stable on smooth surfaces, but no infectious virus was found from treated smooth surfaces on day 4 (glass and banknotes), or on day 7 (stainless steel and plastic). Once again, SARS-CoV-2 was susceptible to regular disinfection methods. [Carraturo et al. \(2020\)](#), who stated that besides the high infectiousness of SARS-CoV-2, its transmission might be contained applying appropriate preventive measures such as personal protection equipment, and disinfecting agents, drew similar conclusions.

Using data from the scientific literature, [Aboubakr et al. \(2020\)](#) concluded that the persistence of SARS-CoV-1 and SARS-CoV-2 was significantly low on copper, latex and less porous fabrics in comparison to surfaces like metals (stainless steel and zinc), glass, and more porous fabrics. Interestingly, these authors suggested that using copper-made common touch surfaces in hospitals might help to reduce the persistence of SARS-CoV-2. On the other hand, this coronavirus could have different survivability on a single surface according to changes in temperature and relative humidity. Regarding this, [Biryukov et al. \(2020\)](#) investigated the effects of temperature, relative humidity, as well as droplet size on the stability of SARS-CoV-2 in a simulated clinically relevant matrix dried on non-porous surfaces. It was observed that SARS-CoV-2 decayed more rapidly when either humidity or temperature increased, but the droplet volume (1–50 μ l) and surface type (stainless steel, plastic or nitrile glove) did not significantly impact on the decay rate. Therefore, a potential fomite transmission could persist for hours to days in indoor environments, having important implications to assess the risks of surface contamination. Recently, [Morris et al. \(2020\)](#) examined the effect of temperature and relative humidity on the stability of SARS-CoV-2 and other enveloped viruses. It was found that SARS-CoV-2 survived better at low temperatures and extreme relative humidity. The estimated median virus half-life was more than 24 h at 10 °C and 40% relative humidity, being approximately 1.5 h at 27 °C and 65% relative humidity.

In turn, [Suman et al. \(2020\)](#) reviewed the sustainability of coronaviruses on different surfaces, which were similar for SARS-CoV-1 and SARS-CoV-2. The infection decay chart for SARS-CoV-2 showed a linear decrease in its infection capability over time, and depending on the surface: plastic (72 h), stainless steel (48 h), copper (4 h) and cardboard (24 h). The alcohol-based disinfectants can reduce significantly the survival and decay time of SARS-CoV-2. On the other hand, [Colaneri et al. \(2020\)](#) investigated the presence of SARS-CoV-2 in samples of swabs collected from inanimate surfaces in an infectious disease emergency unit and in a sub-intensive care ward. Only two samples were

positive for low-levels of SARS-CoV-2. All transport media were inoculated onto susceptible cells, but none induced a cytopathic effect on day 7 of culture. According to their results, daily contact with inanimate surfaces and patient fomites in contaminated areas could mean a medium of infection, but less extensive than it is currently considered.

Recently, [Kampf et al. \(2020b\)](#) extensively reviewed the potential sources and pathways of SARS-CoV-2 transmission. Regarding inanimate surfaces, data from hospitals were collected in order to describe the frequency of detection of SARS-CoV-2 on inanimate surfaces in the immediate patient surroundings. The detection rate was variable on surfaces (0–75%) of intensive care units (ICUs), in isolation rooms (1.4–100%), and on general wards (0–61%). The mean coronavirus concentrations per swab were 4.4–5.2 \log_{10} on ICUs and 2.8–4.0 \log_{10} on general wards. On cleaned and disinfected surfaces, viral RNA was rarely detected, while the presence of viral RNA on the floor could be indicative for sedimentation of contaminated droplets. For their part, [Gerlach et al. \(2020\)](#) assessed – on several surfaces – the efficacy of single components of disinfectants and household cleaning agents against SARS-CoV-2. The materials tested were the following: stainless steel, plastic, glass, polyvinyl chloride, cardboard and cotton fabric. SARS-CoV-2 remained viable on all surfaces throughout a dehydration period of 1 h, being the surface stability of the coronavirus in alignment with the previous results of [van Doremalen et al. \(2020\)](#). No significant loss of infectivity on cotton fabric was noted, indicating SARS-CoV-2 persistence. Although SARS-CoV-2 is more stable on plastic and stainless steel, it was highly susceptible to 70% ethanol or isopropanol, for example, or also to 0.1% H_2O_2 , within 60 s of exposure, independently of the contaminated surface. Recently, [Xue et al. \(2020\)](#) reviewed the stability of SARS-CoV-2 and similar viruses on surfaces, as well as those materials that might actively reduce SARS-CoV-2 surface contamination and its associated transmission. The authors concluded that although previous studies have shown that certain viruses survive longer on some surfaces compared with others ([Vasickova et al., 2010](#)), it is unclear the role of surface chemistry on viral survival, infectivity, and denaturation. In turn, the role of the local environment would be still unclear.

4. SARS-CoV-2 in banknotes and coins

In the past decade, [Thomas et al. \(2008\)](#) assessed the survival of human influenza viruses on banknotes, which had been experimentally contaminated with various influenza virus subtypes at several concentrations, being survival tested after different periods. It was found that infectious virus might survive for several days on banknotes. These results provided potential evidence that cash could mean a viral vector. However, it would require a relatively large inoculum and the presence of a protective matrix, such as respiratory mucus. Although another potential vector of transmission of SARS-CoV-2 could be paper money and coins, information is certainly limited. Recently, [Ren and Tang \(2020\)](#) hypothesized that during the COVID-19 pandemic, when people are infected by the virus, they could transmit it onto paper or coin money through touch and droplets, potentially making any physical currency a possible carrier of the coronavirus. Consequently, during cash circulation, SARS-CoV-2 might be spread among individuals, which would increase the chance of people to become infected by the coronavirus. Notwithstanding, these authors highlighted that – right now – there are no experimental studies corroborating that individuals could be infected with SARS-CoV-2 by cash circulation. Their hypothesis was mainly based on the results of [van Doremalen et al. \(2020\)](#) on the stability of the coronavirus in metals and paper. Similarly, [Pal and Bhadada \(2020\)](#) have summarized the possibilities of transmission of COVID-19 via currency. Two questions were discussed: i) does viral transmission occur through cash and coins?; and ii) which are the precautions and practices that can be followed when handling cash and coins? It was concluded that banknotes and coins should be considered as potential sources of transmission of SARS-CoV-2. However, these same authors also indicated the need of laboratory stimulation data that may help to

resolve the pending issues. Meanwhile, handling of cash and coins should be done with precautions. Cashless and contactless transactions using online banking would be recommended, if possible.

5. Miscellaneous on COVID-19 and surfaces: mitigation of the coronavirus

The studies reviewed above suggest that, in general terms, SARS-CoV-2 – like other human coronaviruses – can remain infectious on dry inanimate/inert surfaces for periods between hours and a few days, at room temperature. To avoid the potential transmission of SARS-CoV-2 from surfaces, the WHO (WHO, 2020b) recommends cleaning surfaces with water, detergents and disinfectants usually effective to clean the environment. In relation to this, Akram (2020) has reported that disinfection of frequent touch surfaces with 62–71% ethanol, 0.1% sodium hypochlorite, and 0.5% hydrogen peroxide is effective against SARS-CoV-2, but ineffective with 1-min exposure time. Other biocidal agents such as 0.05–0.2% benzalkonium chloride, or 0.02% chlorhexidine digluconate, are less effective (Kampf et al., 2020a). Dev Kumar et al. (2020) have reviewed the effects of a number of biocides and antimicrobial agents for the mitigation of the coronavirus. It was noticed that ethanol at concentrations >70%, povidone iodine, hypochlorite, and quaternary ammonium compounds combined with alcohol, are effective against SARS-CoV-2 for surface disinfection. In turn, hydrogen peroxide vapor, chlorine dioxide, ozone, and UV light could be applied to reduce viral load present in aerosols. In this sense, Fathizadeh et al. (2020) also suggested the same disinfection practices against SARS-CoV-2 on inanimate surfaces.

Special attention should be paid at medical and dental settings where disinfecting surfaces is one of the aspects of great importance. In clinical areas, the surfaces must be cleaned and the air exchanged at the end of each session. The same procedures should be adopted in the waiting room and in other areas where the patient might pass or touch objects (Fiorillo et al., 2020). With respect to preventive hospital measures, Chia et al. (2020) have indicated that the concentrations of SARS-CoV-2 in the air and high-touch surfaces in rooms of infected patients could be highest during the first week of COVID-19 illness. In turn, D'accolti et al. (2020) investigated the coronavirus contamination on surfaces of the acute COVID-19 ward of an Italian hospital. Ward surfaces, including 4 points inside and 6 points outside the patients' rooms, were sampled by swabs, 7 h after routine sanitation. SARS-CoV-2 contamination was only detected in 3 samples, suggesting that the occurrence of the coronavirus on hospital surfaces might be limited. Contrary, this virus persists for a longer duration on surfaces under controlled laboratory conditions. Anyway, effective transmission of SARS-CoV-2 by surfaces/fomites within the hospital ward might be rather a rare event. Recently, Kana-mori et al. (2020) have reviewed survival and contamination of SARS-CoV-2 in the healthcare environment, as well as healthcare-associated transmission and infections of SARS-CoV-2 through environmental surfaces and shared medical devices. It has been concluded that direct exposure to respiratory droplets is a main transmission route of SARS-CoV-2. However, it is essential to improve thoroughness of cleaning/disinfection practice in healthcare facilities in order to reduce the risk of healthcare-associated transmission of this coronavirus via the healthcare environment as a fomite.

In Korean hospitals, Lee et al. (2020) investigated the presence of SARS-CoV-2 on the surface of environmental materials contaminated by COVID-19 patients. In order to assess the spread of COVID-19, as well as the infection risk, the study was mainly focused on surfaces frequently touched by subjects testing positive for COVID-19, within the facilities where the outbreak occurred. The results of that investigation showed that a prompt disinfection and cleaning of potentially contaminated surfaces would be an effective infection control measure to reduce the infectivity of the coronavirus, blocking also the potential transmission in the congregate healthcare setting. With similar objectives, Razzini et al. (2020) evaluated the contamination of the air and surfaces by

SARS-CoV-2 in the COVID-19 ward of an Italian hospital. The correlation between the coronavirus concentration and the distance from patients was also assessed. The results also showed that both air and surfaces within areas assigned to patients were contaminated by SARS-CoV-2. It suggests that strict structural and personal protection measures, as well as systematic disinfections should be implemented in order to reduce the infection risk for healthcare professionals in these areas.

On the other hand, Jamal et al. (2020) discussed the recommended equipment and settings for dental clinics that can attend confirmed COVID-19 patients. However, the use of household cleaning and disinfection for COVID-19 prevention has also raised some concerns. Thus, Gharpure et al. (2020) reported that the calls to poison centers regarding human exposure to cleaners and disinfectants increased since the onset of the COVID-19 pandemic. It includes applying household cleaning and disinfectant products to skin, and inhaling or ingesting cleaners and disinfectants.

Ratnesar-Shumate et al. (2020) found evidence that simulated sunlight might rapidly inactivate SARS-CoV-2 on surfaces, suggesting that surface persistence, and subsequently exposure risk, could significantly vary between indoor and outdoor environments. This is accordance with the results of Schuit et al. (2020). However, Ratnesar-Shumate et al. (2020) also remarked that in order to appropriately assess the risk of exposure in outdoor environments, information on the viral load present on surfaces, the transfer efficiency of virus from those surfaces upon contact, as well as the amount of virus needed to cause infection, are still needed. As above commented, increasing temperature and relative humidity also accelerates inactivation of SARS-CoV-2 on surfaces (Biryukov et al., 2020).

Very recently, Wilson et al. (2020) published the results of a quantitative microbial risk assessment to estimate and compare COVID-19 infection risks, after single hand-to-fomite-to-mucosal membrane contacts for high and low levels of viral bioburden, and variable disinfection efficacy. It was found that under low viral bioburden conditions, minimal log₁₀ reductions might be needed to achieve risks less than 1:1,000,000. In turn, for higher viral bioburden conditions, log₁₀ reductions of more than two might be needed to achieve median risks of less than 1:1,000,000 (especially assuming that 10% of gc/cm² represents infective virus). Data are still needed for: i) SARS-CoV-2 bioburden on different environment-specific (home or healthcare) fomites; and ii) fomite-specific touch frequencies. This information should allow improving the surface hygiene measures. Finally, regarding a frequent hand washing for the prevention of COVID-19, it has been reported that this routine implies a prolonged exposure to water and other chemical or physical agents, which can induce a number of adverse dermatologic effects. However, the hand washing should never be diminished by the eczematous changes that may occur in the hands (Beieu et al., 2020), which are perfectly manageable (Chang et al., 2020; Rundle et al., 2020).

6. Conclusions

Several investigations have shown that human coronaviruses such as endemic HCoV, MERS and SARS-CoV-1 may persist on inert/inanimate surfaces from some hours to a few days (Kampf et al., 2020a). Therefore, it might be expected that SARS-CoV-2 could show a similar behavior than SARS-CoV-1, the most closely related human coronavirus. In the early months of the current pandemic, the surface stability of the new coronavirus was already assessed. Thus, van Dorelamen et al. (2020) reported that fomite transmission of SARS-CoV-2 was plausible, with the virus being able to remain infectious on surfaces up to days, a time that would depend on the inoculum shed. In recent months, various studies on the stability and infectivity of SARS-CoV-2 on inert surfaces have been conducted (Biryukov et al., 2020; Carraturo et al., 2020; Chin et al., 2020; Colaneri et al., 2020; Morris et al., 2020). All of them agree with the fact that SARS-CoV-2 can last on different surfaces for times ranging

from hours to a few days. The maximum time would correspond to materials such as stainless steel, plastic and cardboard (van Dorelamen et al., 2020). In contrast, on copper surfaces the coronavirus can only sustain approximately 4 h (Suman et al., 2020). Interestingly, a rapid SARS-CoV-2 inactivation is possible by using commonly available chemicals and biocides on inanimate surfaces (Akram, 2020; Dev Kumar et al., 2020; Gerlach et al., 2020). In summary, although the presence of SARS-CoV-2 on inanimate surfaces is possible, washing hands and regular disinfection practices should reduce the possibilities of transmission of the coronavirus by this potential route of infection.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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