JOJ Sciences
ISSN: 2641-8290

Juniper Publishers
key to the Researchers

Research Article
Volume 2 Issue 5 - October 2022
DOI: 10.19080/JOJS.2022.02.555598

JOJ scin

Transmission of Covid 19 From Contaminated Surfaces

Guggenbichler S[1] and Guggenbichler JP[2]*

[1]*Division for Vascular Surgery and Endovascular Surgery of the University Clinic for Cardiac Surgery, Vascular Surgery and Endovascular Surgery, Austria*

[2]*AmiSTec GMbH und Co KG, Kossen, Austria*

Submission: October 06, 2022; **Published:** October 21, 2022

***Corresponding author:** Guggenbichler JP, Em. Univ. Prof. Dr. med. Department or Pediatrics, Univ Erlangen Germany, AmiSTec GMbH und Co KG, Kossen, Austria

Introduction

Corona virus infections and deaths are still prevalent worldwide, the incidence is even worldwide soaring again. Intense efforts for prevention are mandatory. Early studies suggested that SARS-CoV2 is transmitted through respiratory droplets from infected individuals [1]. Human-to-human transmission is the main route of infection, presenting a substantial threat of rapid spread of the virus throughout the community. It has been documented that also persons with mild or clinically unapparent disease can also spread the virus. However, as a greater understanding of the infection has been achieved: the routes of transmission have been widened by the WHO to include possible human to human contact, airborne, fomite, fecal-oral, bloodborne, mother-to-child and animal-to-human transmission [2].

Increasing concern of contact transmission during outbreaks has been cited. Viruses are transmitted by droplets expelled by cough and sneezes, which contaminate surfaces. Ample evidence in the literature indicates that pathogenic human coronavirus contaminates the environment 2 to 6m away from a contaminated person [3], and a single droplet may easily contain an infectious dose. Viral pathogens are surviving on a surface - even more if epithelial cell material is contained in the droplets - for an extended period of time [4]. There are reports of a human lung cell culture model show persistence of infectious viral particles at least 5 days of on a range of common nonbiocidal surface materials, including polytetrafluoroethylene (Teflon; PTFE), polyvinyl chloride (PVC), ceramic tiles, glass, silicone rubber and stainless steel [5,6].

The solution is self-sanitizing surface with fast eradication of corona virus particles on surfaces. A number of technologies have been propagated with no or limited success [7-10]. Antimicrobial surfaces contain e.g, the photocatalyst TiO2, which generates antimicrobial active oxygen-radicals in the presence of water are able to destroy bacteria and also viral pathogens. The antimicrobial activity of reactive free radicals formed upon UV radiation or light by TiO_2 has been investigated as an alternative to antibiotics and disinfectants. Some antimicrobial activity has been observed on surfaces endowed with TiO2 molecules [11]. The activity of a photocatalytic mechanism by the formation of oxygen radicals however vanishes rapidly by evaporation of oxygen radicals into the environment. The time for effective eradication of microorganisms is too short – the ensuing concentration on a surface too low. The antimicrobial activity can therefore only be documented by coating the contaminated surface with a foil (JIS Japanese industrial standard). By this method the antimicrobial activity is determined in the capillary space between the surface and a foil which prevents these free radicals from evaporation into the environment. At the same time free radicals accumulate in the capillary space between the surface and the foil in unrealistic high concentrations. This highly arbitrary method of testing is far away from the requirements of an antimicrobial surfaces suitable for a "real life situation". Investigation by the push plate method (RODAC Plate method) is therefore much more meaningful. The antimicrobial activity of technologies based only on formation of free oxygen radicals cannot be documented by the push plate (RODAC plate Replicate Organism Detection and Counting) method which is relevant for germfree surfaces [12,13].

The most effective mode of antimicrobial activity is however based on "in situ generated biocides" on the basis transition metal oxides. The fast efficacy has been documented by laser scanning microscopy which showed eradication of 10 million CFU - even in a biofilm – within 30 minutes [13]. Intense investigation of the technology in situ generated biocides revealed mechanisms with a potential to eradicate a wide spectrum of bacterial microorganisms, fungi, and viral pathogens without incorporation into the bacterial metabolism. Catalysts using transition metal oxides e.g., molybdenum oxide and Tungsten oxide have been

investigated as in situ generated biocides with eradication of 10 million pathogens within 30 minutes documented by laser scanning microscopy [14].

The denotation "in situ generated biocides" means, that the additives show indirect antimicrobial activity by emanation of electrons which produce the following substances with antimicrobial activity on a surface. The mechanism of action of this biocidal technology is based on a synergy of four mechanisms.

i. In-situ generation of H3O+ ions through the reaction with moisture from the air is inspired by the body's own defense mechanism imitating e.g., the acid coating of the skin. The acidified surfaces have a pH of 4.5 and the H3O+ ions are able to diffuse through the cell membranes where they can distort the pH-equilibrium and transport systems of the cell.

ii. formation of free radicals not only oxygen radicals but also hydroxyl radicals has been documented by J Davies, Panum Insitute Kopenhagen.

iii. In addition, a synergistic mode of action has been observed by formation of a positive zeta potential, responsible for the fast eradication of pathogens [15].

iv. The formation of paramagnetic ions contributes to the synergistic antimicrobial activity[16].

v. All these substances are confined to a 0.25 µm distance at the surface according to the Zeeman effect [17].

vi. Various substrates have been investigated with excellent antimicrobial activity.

Molybdenum Compounds

Molybdenum has an excellent antimicrobial activity, there are however some less favorable properties. There is some water solubility of Molybdenum oxide. Besides it is not UV light stabile. Molybdenum oxide is not used in any application except for ECG lead wires. Molybdenum shows a moderate water solubility of 0.003 mol/l at a pH value > 7.55.

Tungsten blue oxide

It has been found that only the 5 % oxygen deficient tungsten blue oxide has an excellent antimicrobial activity in contrast to the oxygen saturated tungsten yellow oxide with limited antimicrobial activity.

Tungsten oxide is entirely water insoluble.

Zinc Molybdate

The incorporation of Molybdenum oxide into the zinc oxide crystal lattice showed a comparable antimicrobial activity to Molybdenum oxide. Voluntary safety information based on the safety data sheet format according to Regulation (EC) No.1907/2006 (REACHSDS Information on hazard classes according to Regulation (EC) No. 1272/2008 Classification according to GHS (1272/2008/EC, CLP).

i. Acute toxicity: Zinc Molybdate is not classified as toxic.

ii. Exposure route Endpoint Value Species Method Source

iii. oral LD50 >2,000 mg/kg rat ECHA

iv. Skin corrosion/irritation:

v. Not to be classified as skin corrosive/irritant.

vi. Serious eye damage/eye irritation Is not classified as severe eye damage or eye irritant.

Respiratory or skin sensitization. is not to be classified as an inhalation or skin allergen. Information regarding the carcinogenicity of calcium and zinc molybdate, tungsten blue oxide and Polyoxometallates was not found. Zinc Molybdate is water and alcohol insoluble. This, the white color and the UV light stability makes the compound suitable for addition to melamine resin for antimicrobial furniture and numerous additional applications e.g., in public transportation [13].

Polyoxometallates

Molybdenum shows a slight water solubility. In order to overcome this flaw molybdenum oxide has been incorporated into the tungsten blue crystal lattice in a 1:1 concentration. An identical ions radius is responsible of the easy incorporation of both compounds. This results in a water and alcohol insoluble compound with increased antimicrobial activity against bacterial pathogens due to a strong Zeta potential. In addition, antimicrobial activity e.g., against moulds (Aspergillus spp), Legionella pneumophila, various viral pathogens e.g., bird flu, swine flu and influenza virus, hepatitis B and C has been documented [18]. Treated articles with Polyoxometallates showed a 99.22% reduction of COVID 19 viral surrogate particles documented by MSL Laboratories. Due to the markets demand to combat the pandemic, manufacturers are being asked to provide proof that their product is effective against SARS-CoV2 or COVID19. Currently the organism related to the pandemic poses a significant threat to people handling it outside of high-level research laboratory, it is therefore not available commercially for use in public laboratories. In this case like this and other outbreaks before it, the position of the industry is to use a suitable surrogate in its place which would represent the target strain and would therefore have representative results of a products performance.

Astonishingly very few medical professionals mention the crucial role of free radical damage in COVID-19. The crucial pathogenic role of free radical damage in respiratory virus induced pneumonia suggest an antioxidative therapeutic strategy for COVID-19. The potential anti-SARS activity (severe acute respiratory syndrome) of the POMs [alpha-PTi (2)W(10) O(40)] (7-) isomers was investigated [19-25]. The SARS 3c-like protease, namely SARS 3CL(pro), is the key function of the protease for both viral replication and transcription and can therefore be considered

How to cite this article: Guggenbichler S, Guggenbichler JP. Transmission of Covid 19 From Contaminated Surfaces. JOJ scin. 2022; 2(5): 555598. DOI: 10.19080/JOJS.2022.02.555598

as one of the main targets for the development of anti-SARS drugs. The antiviral efficacy is especially described for polyoxometalates e.g., enveloped viruses such as hepatitis B, hepatitis C, influenza viruses, herpes viruses, Epstein Barr viruses. It was therefore obvious and of particular interest in the present situation to investigate the antiviral effectiveness of Polyoxometallates in plastics or in coatings in surfaces against corona viruses.

Easy cleaning and eradication of microorganisms on surfaces endowed with transition metal oxides has been documented with water and detergents as microorganisms don't adhere on acid surfaces and don't form a biofilm. Microorganisms in a biofilm are hibernating and don't take up anything from the outside. [26] Independently, the technology is also active against microorganisms embedded in a biofilm! Therefore technologies which are based on incorporation of the antimicrobial agent into the bacterial metabolism are therefore ineffective. Technologies based on oxygen radicals only are substantially less active compared to technologies which provide a synergistic activity of the formation of acid water molecules and a positive zeta potential.

The positive Zeta potential, formed on the surface, is responsible for the observed rapid eradication of microorganism on surfaces. In addition, an excellent antimicrobial activity of Polyoxometallates against bacterial pathogens has been documented. (Figure 1)

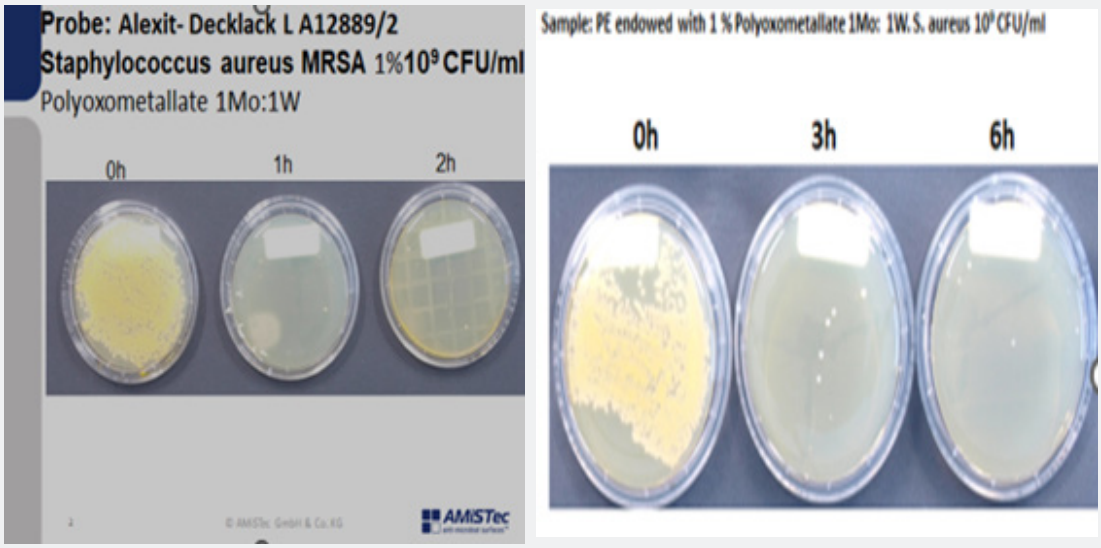

Figure 1.

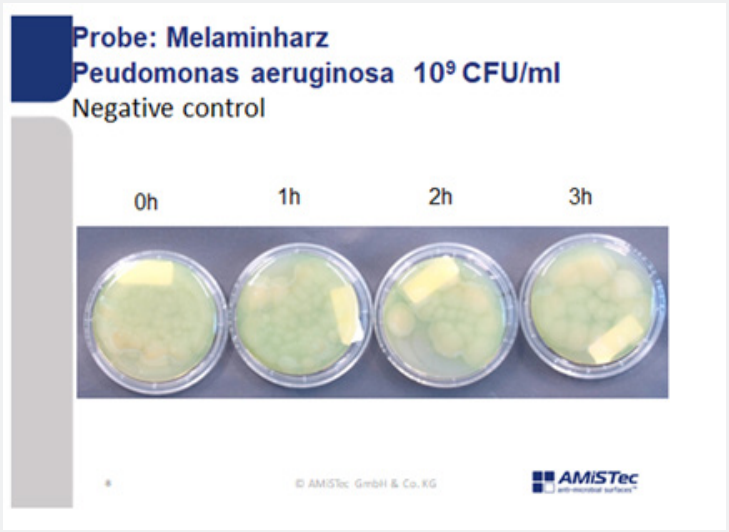

Figure 2.

How to cite this article: Guggenbichler S, Guggenbichler JP. Transmission of Covid 19 From Contaminated Surfaces. JOJ scin. 2022; 2(5): 555598. DOI: 10.19080/JOJS.2022.02.555598

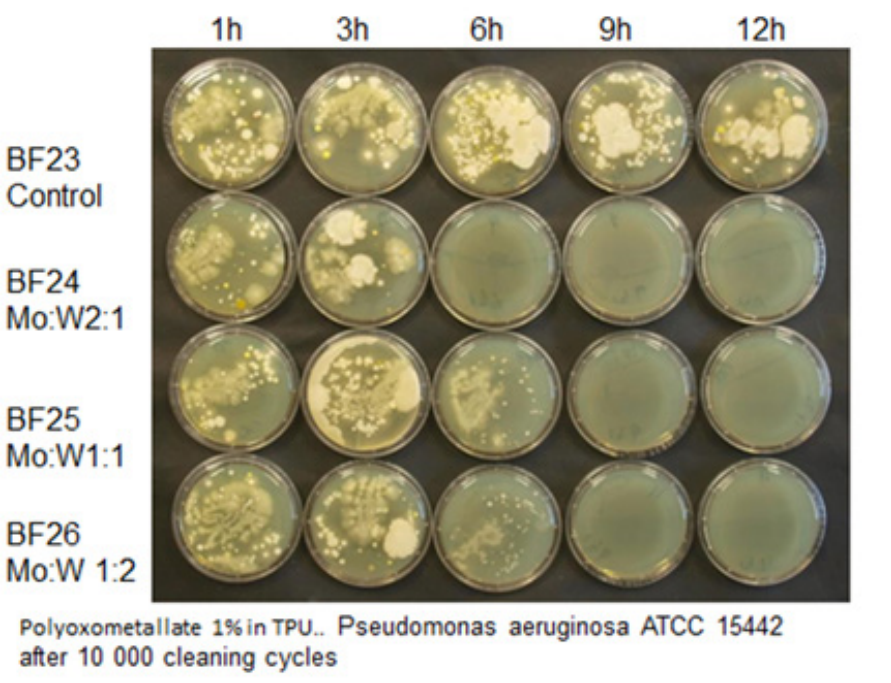

Figure 3.

The technology sustains 10 000 cleaning cycles with water and a tensid without decrease of the antimicrobial activity (Figures 2 & 3).

- The technology is approved by the BPR as in situ generated biocide and is legitimately on the market. In situ generated biocides remain in a polymer or a coating and are not eluted. This is the reason for an activity lasting at least 10 years documented with several samples.

- A number of additional properties have been observed. POMs exhibit strong antimicrobial activity against virtually all bacterial microorganisms regardless of their resistance to antibiotics and disinfectants due to a strong Zeta potential. In addition, also fungi, moulds (Aspergillus spp.), enveloped and non-enveloped virus based on a strong Zeta potential [27]. Last not least also a strong antifouling activity has been documented. Polyoxometallateshave a deep blue color. However, if the particle size is reduced to Lambda half (0.25 µm) by thermal fractioring a transparent coating can be achieved [28].

Surfacesendowed with Polyoxometallates

Polymers for Tray tables push buttons etc. in airplanes. Eradication of the test strain S aureus109 CFU/ml within 3 hours

Leather and artificial leather

Paints

Airfilters

Safety

a. Molybdenum is an essential trace element for several enzymes important to animal and plant metabolism: Molybdenum is needed for at least three enzymes.

b. Sulfite oxidase catalyses the oxidation of sulfite to sulfate, necessary for metabolism of sulfur amino acids. Sulfite oxidase deficiency or absence leads to neurological symptoms and early death.

c. Xanthine oxidase catalyses oxidative hydroxylation of purines and pyridines including conversion of hypoxanthine to xanthine and xanthine to uric acid.

d. Aldehyde oxidase oxidises purines, pyrimidines, pteridines and is involved in nicotinic acid metabolism.

e. Low dietary molybdenum leads to low urinary and serum uric acid concentrations and excessive xanthine excretion.

f. Molybdenum functions as an electron carrier in those enzymes that catalyse the reduction of nitrogen and nitrate.

g. **Carcinogenicity** has been reported in the Safety Data Sheet for Molybdenum oxide.

How to cite this article: Guggenbichler S, Guggenbichler JP. Transmission of Covid 19 From Contaminated Surfaces. JOJ scin. 2022; 2(5): 555598. DOI: 10.19080/JOJS.2022.02.555598

This however requires additional information: Data on molybdenum trioxide are available from two chronic inhalation studies of submicron particles conducted in F-344/N rats and B6C3F1 mice (50/sex/group) that were exposed to concentrations of 0, 10, 30, or 100 mg/m3 of molybdenum trioxide for 6 hr/d, 5 d/wk for 103 wk (NTP 1997). Incidences of alveolar/ bronchiolar adenoma or carcinoma (combined) were increased in low-, mid-, and high-dose males (1/50, 1/50, 4/50, respectively, compared to 0/50 in controls). In the larynx, incidences of squamous metaplasia of the epithelium lining the base of the epiglottis in all exposed groups of male and female rats were significantly greater than those in the control groups and rose with increasing exposure concentration (11/50, 16/50, 39/50 males in low-, mid- and high-dose groups, respectively, vs. 0/50 in controls; 18/50, 29/50, 49/50 females in low-, mid-, and high-dose groups, respectively, vs. 0/50 in controls). The incidences of alveolar/bronchiolar carcinoma were significantly greater in all exposed groups of male mice (16/50, 14/49, and 10/50) than in the control group (2/50). In addition, the incidences of alveolar/bronchiolar adenoma or carcinoma (combined), in male mice, exposed at concentrations of 10 or 30 mg/m^3 (27/50 or 21/49), were also significantly greater than the control group (11/50), while the incidence in the 100 mg/m^3 dose group (18/50) was not. In female mice, the incidence of alveolar/Bronchiolar adenoma or carcinoma (combined) was significantly greater in the 100 mg/m3 dose group (15/49) than controls (3/50), but incidences in the 10 and 30 mg/m3 dose groups were not significant (6/50 and 8/49). Incidences of metaplasia of the alveolar epithelium of minimal severity in the centriacinar region of the lung were significantly increased in all exposed groups of mice. The incidences of squamous metaplasia of the epithelium lining the base of the epiglottis were significantly increased in all exposed groups of males and females. In both male and female mice, the incidences of hyperplasia of the laryngeal epithelium at level II of the larynx rose with increasing exposure concentration but were statistically significant only in the highest dose group. Based on these results, NTP reported that there was some evidence of carcinogenicity for male and female mice, but equivocal evidence of carcinogenicity in male rats exposed for 2 yr.

No carcinogenicity has been reported for Tungsten oxides, Zinc Molybdate and Polyoxometallates. [18]

This information however has less impact on the clinical application of these compounds: Carcinogenicity has been reported by inhalation of submicron particles of molybdenum oxide: As an in situ generated biocide Molybdenum oxide is not eluted from a polymer of a coating. For the production of Molybdenum oxide masterbatch efficient protective technologies are available (Figure 3). Besides Molybdenum oxide is not used in any application except for ECG lead wires. No carcinogenicity has been reported for Tungsten oxides, Zinc Molybdate and Polyoxometallates [18].

Skin tolerance test

No side effects after application of 5 x 5 cm surfaces endowed with Zinc molybdate 2% in a gloss paint on a forearm in a wet chamber for 120 hours has been observed. No allergenicity has been seen, the additives are essential trace elements in the body! No induction of resistant microorganisms has been observed.

Application of the technology

An important endowment of surfaces with corona virus activity is mandatory in public transportation e.g., in airplanes and airports, trains and buses in addition to the eradication of bacterial microorganisms and fungi. The technology would also be suitable for hospital surfaces in wards with admission of COVID 19 patients. Also, air filters e.g., in classrooms would substantially benefit from anti coronavirus activity. There are certainly numerous additional surfaces requiring anti COVID 19 applications e.g., in public transportation but also airports and bus stations where the siderails of escalators are heavily contaminated with resistant bacterial microorganisms, fungi and possibly viral pathogens.

References

1. Coleman CM, Frieman MB (2014) Coronaviruses: important emerging human pathogens. J Virol 88(10): 5209-5212.
2. Wang C Horby PW, Hayden PW, Frederick GH, Gao GF (2010) A novel coronavirus outbreak of global health concern. Lancet 395(10223): 470- 473.
3. Enjuanes L, Zuniga S, Castaño Rodriguez C, Gutierrez Alvarez J, Canton J, et al. (2016) Molecular Basis of Coronavirus Virulence and Vaccine Development. Adv Virus Res 96: 245-286.
4. Almaghaslah D, Kandasamy G, Almanasef M, Vasudevan R, Chandramohan S (2020) Review on the coronavirus disease (COVID-19) pandemic: Its outbreak and current status. Int J Clin Pract 74(11): e13637.
5. Warnes SL, Little ZR, Keevil CW (2015) Human Coronavirus 229E Remains Infectious on Common Touch Surface Materials. Journal of Clinical Microbiology 6(6): e01697-15.
6. Liu J, Liao X, Qian S, Yuan J, Wang F, et al. (2020) Community Transmission of Severe Acute Respiratory Syndrome Coronavirus 2, Shenzhen, China, 2020. Emerg Infect Dis 26(6): 1320-1323.
7. Kramer A, Galabov AS, Sattar SA, Döhner L, Pivert A et.al. (2006) Virucidal activity of a new hand disinfectant with reduced ethanol content: comparison with other alcohol-based formulations J Hosp Infect 62(1): 98-106.
8. Fathizadeh H, Maroufi P, Momen, Heravi MS, Kose S, et al. (2020) Protection and disinfection policies against SARS-CoV-2 (COVID-19) Infez Med 28(2): 185-191.
9. Rai NK, Ashok A, Akondi BR (2020) Consequences of chemical impact of disinfectants: safe preventive measures against COVID-19. Crit Rev Toxicol 50(6): 513-520.
10. Sagripanti JL, Routson LB, Lytle CD,(1993) Virus inactivation by copper or iron ions alone and in the presence of peroxide. Appl Environ Microbiol 59(12): 4374-4376.

How to cite this article: Guggenbichler S, Guggenbichler JP. Transmission of Covid 19 From Contaminated Surfaces. JOJ scin. 2022; 2(5): 555598. DOI: 10.19080/JOJS.2022.02.555598

11. Jongprateep O, Mani-Lata C, Sakunrak Y, Audcharuk K, Narapong T, et al. (2021) Titanium dioxide and fluoropolymer-based coating for smart fabrics with antimicrobial and water-repellent properties. RSC Adv 12(1): 588-594.

12. Guggenbichler S, Hell M, Guggenbichler JP(2020) Hospital Acquired Infections with Multiresistant Microorganisms: Can We Escape the postantibiotic Era? Journal Biomedical Research.

13. Guggenbichler S1, Hell M, Guggenbichler JP(2021) Investigation of the antimicrobial activity of hospital furniture coated with melamine resin endowed with catalysts as in situ generated biocides Journal Biomedical Research.

14. Grill A, Mairhofer A, Kreuzinger M, Schilcher K, (2018) Krankenhausinfektionen Verminderung durch antimikrobielle Oberflächen. Laser scammimh Mikroskopie. Poster Jahrestagungösterreichische Gesellschaft für Mikrobiologie.

15. Ferreyra Maillard APV, Espeche JC, Maturana P, Cutro AC, Hollmann A (2021) Zeta potential beyond materials science: Applications to bacterial systems and to the development of novel antimicrobials. Biochim Biophys Acta Biomembr. 1863(6): 183597.

16. Kovacova M, Kleinova A, Vajdak J, Humpolicek P, Kubat P, Bodik M, Markovic Z, Spitalsky Z (2020) Photodynamic-active smart biocompatible material for an antibacterial surface coating. J Photochem Photobiol B 211: 112012.

17. Reese HM (1900)The Zeeman effect Science. 12(295): 293-297.

18. Colovic MB, Lackovic M, Lalatovic J, Mougharbel AS, Kortz U, et al. (2020) Polyoxometalates in Biomedicine: Update and Overview. Curr Med Chem 27(3): 362-379

19. Gupta P, Goyal K, Kanta P, Ghosh A, Singh MP (2019) Novel 2019-coronavirus on New Year's Eve. Indian J Med Microbiol 37(4): 459- 477.

20. Bazaid AS , Aldarhami A, Binsaleh N, Sherwami S, Althomali OW (2020) Knowledge and practice of personal protective measures during the COVID-19 pandemic: A cross-sectional study in Saudi Arabia. 15(12).

21. Al Motawa MS, Abbas H, Wijten P, de la Fuente A, Xue M, et al. (2020) Vulnerabilities of the SARS-CoV-2 Virus to Proteotoxicity-Opportunity for Repurposed Chemotherapy of COVID-19 Infection. Front Pharmacol 11: 585408

22. Lisi L, Lacal MP, Barbaccia ML, Graziani G (2020) Approaching coronavirus disease 2019: Mechanisms of action of repurposed drugs with potential activity against SARS-CoV-2. Biochemical Pharmacol 180: 114169.

23. Wu J (2020) Tackle the free radicals damage in COVID-19. Nitric Oxide 102: 39-40.

24. Lisi L, Lacal MP, Barbaccia ML, Graziani G (2020) Approaching coronavirus disease 2019: Mechanisms of action of repurposed drugs with potential activity against SARS-CoV-2. Biochemical Pharmacology 180: 114169.

25. Hu D, Shao Ch, W Guan W, Su Z, Sun J (2007) Studies on the interactions of Ti-containing polyoxometalates (POMs) with SARS-CoV 3CLpro by molecular modeling. J Inorg Biochem 101(1): 89-94.

26. Penesyan A, Paulsen IT, Gillings MR, Kjelleberg S, Manefield MJ (20202) Secondary Effects of Antibiotics on Microbial Biofilms. . Front Microbiol.

27. Rajkowska K, Koziróg A, Otlewska A, Piotrowska M, Atrián-Blasco E, et al. (2020) Antifungal Activity of Polyoxometalate-Ionic Liquids on Historical Brick. Molecules 25(23): 5663.

28. Shafaei S, Van Opdenbosch D, Fey T, Koch M, Guggenbichler JP et al. (2016) Enhancement of the antimicrobial properties of orthorhombic molybdenum trioxide by thermal induced fracturing of the hydrates. Mater Sci Eng C Mater Biol Appl 58: 1064-1070.

DOI: 10.19080/JOJS.2022.02.555598

How to cite this article: Guggenbichler S, Guggenbichler JP. Transmission of Covid 19 From Contaminated Surfaces. JOJ scin. 2022; 2(5): 555598. DOI: 10.19080/JOJS.2022.02.555598